20-1025 (Lead); 20-1138 (Consolidated)

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

ENVIRONMENTAL HEALTH TRUST; CONSUMERS FOR SAFE CELL PHONES; ELIZABETH BARRIS; THEODORA SCARATO

CHILDREN'S HEALTH DEFENSE; MICHELE HERTZ; PETRA BROKKEN; DR. DAVID O. CARPENTER; DR. PAUL DART; DR. TORIL H. JELTER; DR. ANN LEE; VIRGINIA FARVER, JENNIFER BARAN; PAUL STANLEY, M.Ed.
Petitioners

v.

FEDERAL COMMUNICATIONS COMMISSION;
UNITED STATES OF AMERICA
Respondents

Petition for Review of Order Issued by the
Federal Communications Commission

DEFERRED JOINT APPENDIX

VOLUME 15

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INDEX TO DEFERRED APPENDIX

Tab No.	JA Page Nos.	Date	Filer/Author	Filing/Attachment Description
VOLUME 1 – Tabs 1-2				
COMMISSION ORDER AND NOTICE OF INQUIRY				
1	1-160	Dec. 4, 2019	FCC	*Resolution of Notice of Inquiry Order*
2	161-363	Mar. 29, 2013	FCC	*Notice of Inquiry*
VOLUME 2 – Tabs 3 – 7 Part 1				
COMMENTS AND OTHER FILINGS				
3	364-428	Sep. 3, 2013	CTIA-The Wireless Association	FCC; Comments of the CTIA - The Wireless Association, ET Docket No. 13-84
4	429-467	Nov 18, 2013	CTIA-The Wireless Association	FCC; Reply Comments of the CTIA - The Wireless Association, ET Docket No. 13-84
5	468-572	Sep. 3, 2013	Mobile Manufacturers Forum	FCC; Mobile Manufacturers Forum Comments, ET Docket No. 13-84
6	573-588	Nov. 18, 2013	Mobile Manufacturers Forum	FCC; Mobile Manufacturers Forum Reply Comments, ET Docket No. 13-84

INDEX TO DEFERRED APPENDIX

Tab No.	JA Page Nos.	Date	Filer/Author	Filing/Attachment Description
7 Part 1	589-764	Sep. 16, 2019	Joel M. Moskowitz PhD	Research Compilation; Abstracts of over 2,100 studies published between 1990 - 2017; Prof. Henry Lai. (Tab 7 Part 1)
VOLUME 3 – Tab 7 Part 2				
7 Part 2	765-1164	Sep. 16, 2019	Joel M. Moskowitz PhD	Research Compilation; Abstracts of over 2,100 studies published between 1990 - 2017; Prof. Henry Lai.(Tab 7 Part 2)
VOLUME 4 – Tab 7 Part 3				
7 Part 3	1165-1564	Sep. 16, 2019	Joel M. Moskowitz PhD	Research Compilation; Abstracts of over 2,100 studies published between 1990 - 2017; Prof. Henry Lai.(Tab 7 Part 3)
VOLUME 5 – Tabs 7 Part 4 – 8 Part 1				
7 Part 4	1565-1602	Sep. 16, 2019	Joel M. Moskowitz PhD	Research Compilation; Abstracts of over 2,100 studies published between 1990 - 2017; Prof. Henry Lai.(Tab 7 Part 4)
8 Part 1	1603-1964	Sep. 13, 2019	Joel M. Moskowitz PhD	Research Compilation; Abstracts of Over 600 Studies Published Between August 2016- August 2019, Dr. Joel Moskowitz; 2019 (Tab 8 Part 1)

INDEX TO DEFERRED APPENDIX

VOLUME 6 – Tabs 8 Part 2 - 10				
8 Part 2	1965-2130	Sep. 13, 2019	Joel M. Moskowitz PhD	Research Compilation; Abstracts of Over 600 Studies Published Between August 2016- August 2019, Dr. Joel Moskowitz; 2019 (Tab 8 Part 2)
9	2131-2142	Sep. 28, 2016	Gary C. Vesperman	Research Compilation; Abstracts of 15 New Studies, Dr. Joel Moskowitz PhD, 2016
10	2143-2378	Jul. 7, 2016	Environmental Health Trust	Research Compilation; Studies and Documents; City of Pinole, CA
VOLUME 7 – Tabs 11 – 13 Part 1				
11	2379-2389	Jul. 7, 2016	Environmental Health Trust	US Exposures Limits - A History of Their Creation, Comments and Explanations; Eng. Lloyd Morgan
12	2390-2439	Aug. 26, 2016	Heidi M. Lumpkin	Biosystem & Ecosystem; Birds, Bees and Mankind: Destroying Nature by 'Electrosmog': Effects of Mobile Radio and Wireless Communication. Dr. Ulrich Warnke, Ph.D., 2007
13 Part 1	2440-2778	Jul. 13, 2016	Parents for Safe Technology	Cancer; IARC Monograph: Non-Ionizing Radiation Part 2: RF EMFs, 2013 (Tab 13 Part 1)
VOLUME 8 – Tabs 13 Part 2 - 23				
13 Part 2	2779-2920	Jul. 13, 2016	Parents for Safe Technology	Cancer; IARC Monograph: Non-Ionizing Radiation Part 2: RF EMFs, 2013 (Tab 13 Part 2)

INDEX TO DEFERRED APPENDIX

14	2921-2927	Nov. 18, 2013	Kevin Mottus	Cancer; IARC Press Release: IARC Classifies RF EMFs As Possibly Carcinogenic to Humans, 2011
15	2928-3002	Jul. 11, 2016	Environmental Health Trust	NTP; Report of Partial Findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposures); Draft 5-19-2016
16	3003-3009	Oct. 1, 2018	Environmental Health Trust	NTP; Commentary on the utility of the National Toxicology Program study on cell phone radiofrequency radiation data for assessing human health risks despite unfounded criticisms aimed at minimizing the findings of adverse health effects. Environmental Research. Dr. Ron Melnick; 2019
17	3010-3036	Apr. 16, 2018	Theodora Scarato	NTP; Dr. Hardell and Dr. Carlsberg letter to the NTP, NIH, DHHS, NTP Technical Report On The Toxicology And Carcinogenesis Studies; Mar. 12, 2018
18	3037-3048	Oct. 1, 2018	Environmental Health Trust	Cancer-NTP; Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields; (Miller et al); 2018
19	3049-3055	Oct. 18, 2018	Joel M. Moskowitz, Ph.D.	Cancer-NTP; The Significance of Primary Tumors in the NTP Study of Chronic Rat Exposure to Cell Phone Radiation. IEEE Microwave Magazine. Prof. James C. Lin; 2019

INDEX TO DEFERRED APPENDIX

20	3056-3065	Aug. 27, 2013	Cindy Sage and David O. Carpenter	BioInitiative Comments
21	3066-3080	Nov. 18, 2013	Kevin Mottus	BioInitiative; 2012 Conclusions
22	3081-3126	Nov. 18, 2013	Kevin Mottus	BioInitiative; Section 24: Key Scientific Evidence and Public Health Policy Recommendations; 2012
23	3127-3146	Jul. 11, 2016	Cecelia Doucette	BioInitiative; Section 1: Summary for the Public (2014 Supplement)
VOLUME 9 – Tabs 24-27				
24	3147-3218	Sep. 30, 2016	Catherine Kleiber	BioInitiative-Modulation; Section 15: Evidence for Disruption by Modulation Role of Physical and Biological Variables in Bioeffects of Non-Thermal Microwaves for Reproducibility, Cancer Risk and Safety Standards, (2012 Supplement)
25	3219-3319	Sep. 3, 2013	Kevin Mottus	BioInitiative; Section 20, Findings in Autism, Consistent with Electromagnetic Fields (EMF) and Radiofrequency Radiation (RFR); 2012
26	3320-3321	Sep. 16, 2019	Joel Moskowitz PhD.	BioInitiative-Neurological; Percent Comparison, Effect vs No Effect in Neurological Effect Studies; 2019
27	3322-3559	Sep. 16, 2019	Joel Moskowitz PhD.	BioInitiative-Neurological; Research Summaries, RFR Neurological Effects (Section 8), 2007-2017; 2017

INDEX TO DEFERRED APPENDIX

VOLUME 10 – Tabs 28-41				
28	3560-3561	Sep. 16, 2019	Joel M. Moskowitz PhD.	BioInitiative-Mechanisms of Harm; Percent Comparison Showing Effect vs No Effect, DNA (Comet Assay), 2017 and Free Radical (Oxidative Stress), 2019
29	3562-3602	Sep. 16, 2019	Joel M. Moskowitz PhD.	BioInitiative-Mechanisms of Harm; Research Summaries, DNA (Comet Assay) Studies; 76 Studies, 2017
30	3603-3721	Sep. 16, 2019	Joel M. Moskowitz PhD.	BioInitiative-Mechanisms of Harm; Research Summaries, Free Radicals (Oxidative Stress Effects), 225 studies, 2019
31	3722-3749	Apr. 11, 2014	Cindy Sage, MA	BioInitiative Working Group; Preliminary Opinion on Potential Health Effects of Exposure to Electromagnetic Fields (EMF); 2014
32	3750-3755	Sep. 16, 2019	Bioinitiative Working Group	BioInitiative Working Group; Consistent Failure to Identify the Potential for Health Effects (Exhibit A); 2014
33	3756-3766	Sep. 14, 2019	Biointiative Working Group	BioInitiative Working Group; Reference List for Important Fertility and Reproduction Papers (Exhibit C); 2014
34	3767-3771	Apr. 14, 2019	Cindy Sage	BioInitiative Working Group; Mitochondrial Dysfunction and Disruption of Electrophysiology (Exhibit G); 2014

INDEX TO DEFERRED APPENDIX

35	3772-3779	Apr. 14, 2019	Cindy Sage, MA	BioInitiative Working Group; Epidemiological Studies, RF fields epidemiology, Comments by Drs. Lennart Hardell, Fredrik Soderqvist PhD. and Michael Carlberg, MSc. Section 3.5.1.1 Epidemiological Studies (Exhibit B); 2014
36	3780-3874	Apr 11, 2014	Cindy Sage, MA	BioInitiative Working Group; An Update on the Genetic Effects of Nonionizing Electromagnetic Fields by Prof. Henry Lai PhD; (Exhibit E); 2014
37	3875-3896	Apr. 11, 2014	Cindy Sage, MA	BioInitiative Working Group; An Update on Physical and Biological Variables, Cancer and Safety Standards by Prof. Igor Belyaev Dr. Sc., (Exhibit F); 2014
38	3897-3904	Sep. 30, 2016	Maria Powell	BioInitiative Co-Editor; Human Health Effects of EMFs: The Cost of Doing Nothing. IOPScience. (Prof. David Carpenter MD.); 2010
39	3905-3919	Sep. 28, 2016	Kevin Mottus	BioInitiative Author; Statement of Prof. Martin Blank PhD., PhD.; 2016
40	3920-3945	Aug 27, 2013	Sage Hardell Herbert	BioInitiative Authors; Prof. Lennart Hardell MD. PhD., Prof. Martha Herbert MD. PhD. and Cindy Sage Comments
41	3946-3984	Aug. 26, 2013	B. Blake Levitt & Henry Lai	BioInitiatiive Author; Prof. Henry Lai PhD, and Blake Levitt Comments

INDEX TO DEFERRED APPENDIX

VOLUME 11 – Tabs 42-59				
42	3985-4072	Sep. 3, 2013	Paul Dart MD	Dr. Paul Dart MD. (Petitioner) Comments
43	4073-4102	Feb. 4, 2013	Dr. Andrew Goldsworthy	The Biological Effects of Weak Electromagnetic Fields, Problems and Solutions, Prof. Andrew Goldsworthy; 2012
44	4103-4106	Sep. 4, 2013	Richard Meltzer	Dr. Richard Meltzer Comments, Radio Frequency (RF) Exposure: A Cautionary Tale
45	4107-4112	Feb. 6, 2013	Donald R. Maisch	Dr. Donald R. Maisch PhD. Comments
46	4113-4129	Nov. 18, 2013	Catherine Kleiber	Biological Effects from RF Radiation at Low-Intensity Exposure, based on the BioInitiative 2012 Report, and the Implications for Smart Meters and Smart Appliances; Dr. Ron M. Powell, PhD.; 2013
47	4130-4137	Aug. 20, 2013	Lawrence James Gust	Eng. Lawrence James Gust Comments
48	4138-4146	Feb. 25, 2013	Michael Schwaebe	Eng. Michael Schwaebe Comments
49	4147-4178	Mar. 18, 2015	Environmental Working Group	Organizations; Environmental Working Group Reply Comments
50	4179-4195	Nov. 18, 2013	Nina Beety	Nina Beety Comments

INDEX TO DEFERRED APPENDIX

51	4196-4206	Sep. 16, 2019	Joel Moskowitz PhD.	Organizations; EMF Scientist Appeal, International Scientists' Appeal to the United Nations; 2015
52	4207-4217	Apr. 5, 2018	NancyD	Organizations; 5G Appeal, Scientist Appeal to the EU, Scientists Warn of Potential Serious Health Effects of 5G; 2017
53	4218-4240	Jun. 7, 2017	Environmental Health Trust	Organizations; Medical Doctors and Public Health Organizations: Consensus Statements and Doctors' Recommendations on Cell Phones/Wireless; 2017
54	4241-4244	Sep. 27, 2016	Kevin Mottus	Organizations; Council of Europe, Résolution 1815, The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment; 2011
55	4245-4257	Feb. 5, 2013	Gilda Oman	Organizations; Council of Europe, Parliamentary Assembly Report: The potential dangers of electromagnetic fields and their effect on the environment; 2011
56	4258-4293	Jul. 11, 2016	Environmental Health Trust	Organizations - Radiation Sickness; European Academy for Environmental Medicine, EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses; 2015

INDEX TO DEFERRED APPENDIX

57	4294-4305	Feb. 5, 2013	David Mark Morrison	Organizations; Scientific Panel on Electromagnetic Field Health Risks: Consensus Points, Recommendations, and Rationales, Scientific Meeting: Seletun, Norway. Reviews on Environmental Health; (Fragopoulou, Grigoriev et al); 2010
58	4306-4361	Aug. 30, 2013	EMF Safety Network	Organizations; EMF Safety Network Comments
59	4362-4374	Jul 7. 2016	Environmental Health Trust	Organizations - Russian Government; Electromagnetic Fields From Mobile Phones: Health Effect On Children And Teenagers | Resolution Of Russian National Committee On Nonionizing Radiation Protection | April 2011, Moscow
VOLUME 12 – Tabs 60 – 68 Part 1				
60	4375-4482	Jul 7, 2016	Environmental Health Trust	Organizations - Cyprus Government; Neurological and behavior effects of Non-Ionizing Radiation emitted from mobile devices on children: Steps to be taken ASAP for the protection of children and future generations. Presentation Slides; 2016
61	4483-4531	Nov. 18, 2013	Kevin Mottus	Organizations; Austrian Medical Association, Environmental Medicine Evaluation of Electromagnetic Fields; Dr. Jerd Oberfeld MD.; 2007
62	4532-4534	Jul. 11, 2016	Environmental Health Trust	Organizations; The American Academy of Pediatrics, Letter to the FCC; 2013

INDEX TO DEFERRED APPENDIX

63	4535-4540	Sep. 29, 2016	Kevin Mottus	Organizations; California Medical Association, House of Delegates Resolution Wireless Standards (Resolution 107 - 14); 2014
64	4541-4543	Sep. 3, 2013	Grassroots Environmental Education, Inc. o/b/o American Academy of Environmental	Organizations; American Academy of Environmental Medicine, Letter to the Federal Communications Commission; 2013
65	4544-4561	Sep. 29, 2016	Kevin Mottus	Organizations - Radiation Sickness; Austrian Medical Association, Guidelines for the Diagnosis and Treatment of EMF Related Health Problems and Illnesses (EMF Syndrome); 2011
66	4562-4590	Sep. 28, 2016	Kevin Mottus	Organizations; International Association of Fire Fighters, Position on the Health Effects from Radio Frequency/Microwave Radiation in Fire Department Facilities from Base Stations for Antennas and Towers; 2004
67	4591-4599	Sep. 28, 2016	Kevin Mottus	Organizations; Cities of Boston and Philadelphia Reply Comments
68 Part 1	4600-4800	Sep. 3, 2013	Environmental Working Group	Organizations; Appeal to the FCC Signed by 26,000 People and Organized by the Environmental Working Group, 2013 (Tab 68 Part 1)

INDEX TO DEFERRED APPENDIX

VOLUME 13 – Tabs 68 Part 2 - 76				
68 Part 2	4801-5171	Sep. 3, 2013	Environmental Working Group	Organizations; Appeal to the FCC Signed by 26,000 People and Organized by the Environmental Working Group, 2013 (Tab 68 Part 2)
69	5172-5186	Aug. 25, 2016	Kevin Mottus	Organizations; Freiburger Appeal - Doctors Appeal; 2002
70	5187-5191	Sep. 3, 2013	Grassroots Environmental Education, Inc.	Organizations; Benevento Resolution, The International Commission for Electromagnetic Safety (ICEMS), 2006
71	5192-5197	Jul. 18, 2016	Environmental Health Trust	Organizations; The Porto Alegre Resolution; 2009
72	5198-5204	Feb. 6, 2013	Kevin Mottus	Organizations; Kaiser Permanente, Letter from Dr. De-Kun Li, Division of Research
73	5205-5210	Sep. 3, 2013	American Association For Justice	Organizations; American Association for Justice, Comments
74	5211-5219	Feb. 6, 2013	Jonathan Libber	Organizations; Maryland Smart Meter Awareness, Comments (filed by Jonathan Libber)
75	5220-5228	Feb. 6, 2013	Electromagnetic Safety Alliance	Organizations; Electromagnetic Safety Alliance, Comments

INDEX TO DEFERRED APPENDIX

76	5229-5241	Sep. 29, 2016	Ed Friedman	Organizations; Wildlife and Habitat Conservation Solutions; What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife. Dr. Albert M. Manville, PhD.; 2016
VOLUME 14 – Tabs 77-96				
77	5242-5258	Sep. 30, 2016	Catherine Kleiber	Mechanisms of Harm; Meta-Analysis, Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. Electromagn Biol Med (Yakymenko et al).; 2016
78	5259-5269	Sep 3, 2013	Monnie Ramsell	Mechanisms of Harm; Blood Brain Barrier; Increased Blood–Brain Barrier Permeability in Mammalian Brain 7 Days after Exposure to the Radiation from a GSM-900 Mobile Phone. Pathophysiology (Nittby, Salford et al); 2009
79	5270-5286	Sep. 3, 2013	Paul Dart MD.	Mechanisms of Harm; DNA Damage; Microwave RF Interacts with Molecular Structures; Dr. Paul Dart MD.; 2013
80	5287-5303	Sep. 3, 2013	The EMR Policy Institute	Medical Treatments & Modulation; Treatment of advanced hepatocellular carcinoma with very low levels of amplitude-modulated electromagnetic fields. British Journal of Cancer. (Costa et al); 2011

INDEX TO DEFERRED APPENDIX

81	5304-5306	Sep. 3, 2013	The EMR Policy Institute	Medical Treatments & Modulation; Treating cancer with amplitude-modulated electromagnetic fields: a potential paradigm shift, again? British Journal of Cancer. (Dr. Carl Blackman); 2012
82	5307-5309	Feb. 8, 2013	Alan Frey	Modulation; Dr. Alan Frey PhD., Comments, Feb. 7, 2013
83	5310-5319	Jul. 11, 2016	Environmental Health Trust	Modulation; Real Versus Simulated Mobile Phone Exposures in Experimental Studies. Biomed Res Int. (Prof. Panagopoulos et al); 2015
84	5320-5368	Sep. 16, 2019	Joel M. Moskowitz, PhD	Neurological; Book Chapter, A Summary of Recent Literature (2007-2017) on Neurological Effects of Radiofrequency Radiation, Prof. Lai; 2018 Referenced 122 Studies.
85	5369-5412	Sep. 28, 2016	Kevin Mottus	Neurological - Report; Evidence of Neurological effects of Electromagnetic Radiation: Implications for degenerative disease and brain tumour from residential, occupational, cell site and cell phone exposures. Prof. Neil Cherry; 225 scientific references. 2002
86	5413-5415	Sep 3, 2013	Kevin Mottus	Neurological; The effects of mobile-phone electromagnetic fields on brain electrical activity: a critical analysis of the literature. Electromagn Biol Med. (Marino et al) (Abstract); 2009

INDEX TO DEFERRED APPENDIX

87	5416-5435	Nov. 18, 2013	Kevin Mottus	Autism and EMF? Plausibility of a pathophysiological link. Pathophysiology, Part I. (Herbert et al); 2013
88	5436-5460	Nov. 18, 2013	Kevin Mottus	Autism and EMF? Plausibility of a pathophysiological link. Pathophysiology, Part II. (Herbert et al); 2013
89	5461-5486	Sep. 3, 2013	Kevin Mottus	Fertility; Research Abstracts, List of References Reporting Fertility and/or Reproduction Effects from Electromagnetic Fields and/or Radiofrequency Radiation (66 references)
90	5487-5499	Sep. 3, 2013	Paul Dart MD	Fertility; Effects of Microwave RF Exposure on Fertility, Dr. Paul Dart MD. (Petitioner); 2013
91	5500-5506	Sep. 3, 2013	Paul Dart MD	Hormonal; RF and Hormones, Alterations in Hormone Physiology; Dr. Paul Dart MD. (Petitioner); 2013
92	5507-5514	Feb. 7, 2013	Toni Stein	Prenatal & Children; Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice. Scientific Reports. (Aldad, Taylor et al); 2012
93	5515-5518	Jul. 7, 2016	Environmental Health Trust	Prenatal & Children; Fetal Exposures and Cell Phones. Studies List. Prof. Hugh Taylor MD.; 2015

INDEX TO DEFERRED APPENDIX

94	5519-5553	Jul. 13, 2016	Parents for Safe Technology	Prenatal and Children; Fetal Cell Phone Exposure: How Experimental Studies Guide Clinical Practice, Hugh S. Taylor MD. PhD., Chair of Obstetrics, Gynecology and Reproductive Sciences, Yale School of Medicine
95	5554-5559	Sep. 3, 2013	Dr. Suleyman Kaplan	Prenatal & Children; Dr. Suleyman Kaplan Comments
96	5560-5614	Nov. 18, 2013	Kevin Mottus	Prenatal & Children; Amended Declaration of Dr. David O. Carpenter MD. (Dec. 20, 2011); *Morrison et al v. Portland Schools*, No. 3:11-cv-00739-MO (U.S.D.C. Oregon, Portland Div.)
VOLUME 15 – Tabs 97-101				
97	5615-5712	Sep. 28, 2016	Kevin Mottus	Prenatal & Children; Doctors and Scientists Letters on Wi-Fi in Schools
98	5713-5895	Jul. 11, 2017	Environmental Health Trust	Dr. Devra Davis PhD., President of Environmental Health Trust (Petitioner) Comments
99	5896-5993	Jun. 7, 2017	Environmental Health Trust	Children; Letter to Montgomery County Schools, Prof. Martha Herbert MD., PhD.; 2015
100	5994-6007	Apr. 29, 2019	Environmental Health Trust	Neurological - Children; A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication. Environ Health Perspect. (Foerster et al); 2018

INDEX TO DEFERRED APPENDIX

101	6008-6014	Sep. 28, 2016	Kevin Mottus	Prenatal & Children; Cell phone use and behavioral problems in young children. J Epidemiol Community Health. (Divan et al); 2012
VOLUME 16 - Tabs 102-126				
102	6015-6026	Jul. 7, 2016	Environmental Health Trust	Prenatal & Children; "Cell Phones & WiFi – Are Children, Fetuses and Fertility at Risk?"; 2013
103	6027-6060	Jul. 7, 2016	Environmental Health Trust	Prenatal & Children; Safe Schools 2012, Medical and Scientific Experts Call for Safe Technologies in Schools
104	6061-6067	Sep. 3, 2013	Kevin Mottus	Prenatal & Children - Stem Cells; Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk. Environmental Health Perspectives (Markova, Belyaev et al); 2010
105	6068-6069	Sep. 26, 2016	Angela Tsaing	Radiation Sickness - Children; Angela Tsiang Comments
106	6070-6071	Mar. 5, 2013	Abigail DeSesa	Radiation Sickness - Children; Abigail DeSesa Comments
107	6072-6111	Sep. 28, 2016	Kevin Mottus	Cell Towers - Research Abstract Compilation; 78 Studies Showing Health Effects from Cell Tower Radio Frequency Radiation; 2016
108	6112-6122	Sep. 3, 2013	Paul Dart MD	Cell Towers; Consequences of Chronic Microwave RF Exposure, Dr. Paul Dart MD. (Petitioner)

INDEX TO DEFERRED APPENDIX

109	6123-6132	Jul. 11, 2016	Environmental Health Trust	Cell Towers - Cancer; Meta-Analysis, Long-Term Exposure To Microwave Radiation Provokes Cancer Growth: Evidences From Radars And Mobile Communication Systems. (Yakymenko et al); 2011
110	6133-6148	Sep. 3, 2013	Monnie Ramsell	Cell Towers - Neurological; Changes of Clinically Important Neurotransmitters under the Influence of Modulated RF Fields, A Long-term Study under Real-life Conditions; Umwelt-Medizin-Gesellschaft; (Buchner & Eger); 2011
111	6148-6160	Dec. 10, 2018	Environmental Health Trust	Cell Towers - DNA; Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. Electromagnetic Biology and Medicine. (Zothansiama et al); 2017
112	6161-6169	Dec. 10, 2018	Environmental Health Trust	Cell Towers - Cancer; Environmental radiofrequency radiation at the Järntorget Square in Stockholm Old Town, Sweden in May, 2018 compared with results on brain and heart tumour risks in rats exposed to 1.8 GHz base station environmental emissions, World Academy of Sciences Journal. (Hardell et al); 2018

INDEX TO DEFERRED APPENDIX

113	6170-6258	Sep. 30, 2016	Catherine Kleiber	Cell Towers; Indian Government, Ministry of Environment and Forest, Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees. 919 studies reviewed; 2011
114	6259-6260	Sep. 3, 2013	Kevin Mottus	Cell Towers; Epidemiological evidence for a health risk from mobile phone base stations, Int J Occup Environ Health. (Hardell et al); 2010
115	6261-6289	Sep. 16, 2019	Joel Moskowitz, PhD	Cell Towers; Biological Effects From Exposure to Electromagnetic Radiation Emitted By Cell Tower Base Stations and Other Antenna Arrays. Environ. Rev. (Lai & Levitt); 2010
116	6290-6301	Jul. 11, 2016	Environmental Health Trust	Cell Towers; Research Summaries of Cell Tower Radiation Studies
117	6302-6311	Sep. 30, 2016	Catherine Kleiber	Cell Towers-Wildlife; Electromagnetic Pollution From Phone Masts. Effects on Wildlife; Pathophysiology. (Dr. Alfonso Balmori); 2009
118	6312-6324	Jul. 18, 2106	Environmental Health Trust	Cell Towers - Wildlife; Testimony of Dr. Albert M. Manville, II, PhD., C.W.B, Before the City of Eugene City Planning Department in Opposition to AT&T/Crossfire's Application for a "Stealth" Cellular Communications Tower; May 6, 2015

INDEX TO DEFERRED APPENDIX

119	6325-6341	Sep. 30, 2016	Catherine Kleiber	Cell Towers - Plants; Radiofrequency Radiation Injures Trees Around Mobile Phone Base Stations. Science of the Total Environment. (Waldmann-Selsam et al); 2016
120	6342-6349	Apr. 8, 2014	M.K. Hickcox	Biosystem & Ecosystem; The Dangers of Electromagnetic Smog, Prof. Andrew Goldsworthy, PhD.; 2007
121	6350-6366	Sep. 3, 2013	The EMR Policy Institute	Biosystem and Ecosystem; Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem – a review. Biology and Medicine (Sivani et al.); 2012
122	6367-6379	Oct. 1, 2018	Environmental Health Trust	5G; 5G wireless telecommunications expansion: Public health and environmental implications, Environmental Research. (Dr. Cindy Russell MD.); 2018
123	6380-6383	Oct. 18, 2019	Joel M. Moskowitz PhD	5G; We Have No Reason to Believe 5G is Safe, Dr. Joel Moskowitz PhD., Scientific American; 2019
124	6384-6392	Jul. 11, 2017	Environmental Health Trust	5G - Millimeter Waves; Nonthermal Effects of Extremely High-Frequency Microwaves on Chromatin Conformation in Cells in vitro—Dependence on Physical, Physiological, and Genetic Factors. IEEExPlore. (Belyaev et al); 2000

INDEX TO DEFERRED APPENDIX

125	6393-6408	Oct. 1, 2018	Environmental Health Trust	5G; What You Need To Know About 5G Wireless And "Small" Cells Top 20 Facts About 5G; Environmental Health Trust
126	6409-6429	Jan. 13, 2015	NYU Wireless	5G; Millimeter-Wave Cellular Wireless Networks: Potentials and Challenges, IEEE; (2014)
VOLUME 17 – Tabs 127 – 142 Part 1				
127	6430-6436	Jul. 13, 2016	Priscilla King	5G; FCC Chairman Tom Wheeler 'The Future of Wireless: A Vision for U.S. Leadership in a 5G World'; 2016
128	6437-6447	Jul. 14, 2016	Angela Tsaing	5G; Letter to House Subcommittee on Communications and Technology; Angela Tsiang; 2016
129	6448-6453	Jan. 8, 2019	LeRoy Swicegood	5G; Ask Congress to Vote No, We Are The Evidence Fact Sheet; 2016
130	6454-6510	Jul. 13, 2016	Parents For Safe Technology	5G; 5G Spectrum Frontiers -The Next Great Unknown Experiment On Our Children, Compilation of Letters to Congress; 2016
131	6511-6513	Apr. 16, 2018	Theodora Scarato	5G;What You Need To Know About 5G Wireless and "Small" Cells
132	6514-6587	Sep. 28, 2016	Kevin Mottus	Wi-Fi; 136 Studies Showing Health Effects from Wi-Fi Radio Frequency Radiation

INDEX TO DEFERRED APPENDIX

133	6588-6603	Jul. 13, 2016	Parents For Safe Technology	Wi-Fi; 2.45-GHz Microwave Irradiation Adversely Affects Reproductive Function in Male Mouse, Mus Musculus by Inducing Oxidative and Nitrosative Stress. Free Radical Research (Shahin et al); 2014
134	6604-6611	Jul. 7, 2016	Environmental Health Trust	Wi-Fi - Fertility; Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. Journal of Pediatric Neurology. (Atasoy et al); 2013
135	6612-6620	Apr. 8, 2014	MK Hickox	Smart Meters: Correcting the Gross Misinformation, Letter by 54 Scientists and MDs; 2012
136	6621-6622	Nov. 18, 2013	Catherine Kleiber	Smart Meters - Radiation Sickness; American Academy of Environmental Medicine, Smart Meter Case Series; 2013
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INDEX TO DEFERRED APPENDIX

139	6700-6705	Jul. 7, 2016	Environmental Health Trust	Smart Meters - Radiation Sickness; Symptoms after Exposure to Smart Meter Radiation. Dr. Ron Powell PhD.; 2015
140	6706-6735	Sep. 3, 2013	Kit Weaver	Kit Weaver, Comments
141	6736-6740	Feb. 6, 2013	Joshua Hart	Organizations - Radiation Sickness; StopSmartMeters, Comments
142 Part 1	6741-6850	Sep. 28, 2016	Kevin Mottus	Cell Phones; Research Abstracts of Over 700 Studies Showing Health Effects from Cell Phone Radio Frequency Radiation; Prof. Henri Lai (Tab 142 Part 1)
VOLUME 18 – Tabs 142 Part 2 - 153				
142 Part 2	6851-7088	Sep. 28, 2016	Kevin Mottus	Cell Phones; Research Abstracts of Over 700 Studies Showing Health Effects from Cell Phone Radio Frequency Radiation; Prof. Henri Lai (Tab 142 Part 2)
143	7089-7099	Sep. 28, 2016	Kevin Mottus	Cancer - Brain Tumors; Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with the use of mobile and cordless phones. Rev Environ Health. (Hardell and Caarlsberg); 2013

INDEX TO DEFERRED APPENDIX

144	7100-7121	Nov. 18, 2013	Kevin Mottus	Cancer-Brain Tumors; Mobile phone use and brain tumour risk: early warnings, early actions? (Gee, Hardell Carlsberg) (Chapter 21 of Report: "Late lessons from early warnings: science, precaution"); 2013
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INDEX TO DEFERRED APPENDIX

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153	7252-7255	Jan 31, 2019	Julian Gehman	Jullian Gehman Esq. Comments
VOLUME 19 – Tabs 154-168				
154	7256-7371	Nov. 5, 2013	Joel M. Moskowitz Ph.D.	Dr. Joel Moskowitz PhD. Reply Comments, Why the FCC Must Strengthen Radiofrequency Radiation Limits in the U.S.

INDEX TO DEFERRED APPENDIX

155	7372-7414	Jun. 17, 2014	Environmental Working Group	Cancer - Children; Cell Phone Radiation: Science Review on Cancer Risks and Children's Health; Environmental Working Group; 2009
156	7415-7417	Sep. 30, 2016	Kevin Mottus	Cell Phones - Plants; Review: Weak Radiofrequency Radiation Exposure From Mobile Phone Radiation on Plants. Electromagnetic Biology and Medicine (Malka N. Halgamuge); 2016
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INDEX TO DEFERRED APPENDIX

161	7442-7445	Apr. 29, 2019	Environmental Health Trust	Testing – Children; Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children. Electromagnetic Biology and Medicine (Gandhi et al); 2011
162	7446-7504	Nov. 17, 2013	Pong Research Corporation	Testing; Pong Research Corporation Reply Comments
163	7505-7514	Aug. 19, 2012	Pong Research Corporation	Testing; Pong Research Corporation, Letter to the FCC
164	7515-7602	Nov. 17, 2013	L. Lloyd Morgan	Environmental Health Trust, Reply Comments (Erroneous Comments Submitted to the FCC on Proposed Cellphone Radiation Standards and Testing by CTIA – September 3, 2013)
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167	7629-7640	Nov. 17, 2013	Consumers for Safe Cell Phones	Consumers for Safe Cell Phone Comments (Reply to CTIA Comments from Sep. 13, 2013)
168	7641-7672	Nov. 17, 2013	Environmental Working Group	Organizations; Environmental Working Group, Reply Comments

INDEX TO DEFERRED APPENDIX

VOLUME 20 - Tabs 169 – 172 Part 1				
169	7673-7682	Dec. 10, 2018	Environmental Health Trust	Industry Influence; World Health Organization, Radiofrequency Radiation and Health - a Hard Nut to Crack (Review). International Journal of Oncology. Prof. Lennart Hardell MD. PhD.; 2017
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171	7717-7719	Sep. 3, 2013	The EMR Policy Institute	Industry Influence; Prof. Martha Herbert MD PhD., Harvard Pediatric Neurologist Letter to Los Angeles Unified School District; 2013
172 Part 1	7720-8073	Feb. 6, 2013	Dr. Donald R. Maisch PhD	Industry Influence; The Procrustean Approach: Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, Dr. Donald Maisch PhD.; 2009 (Tab 172 Part 1)
VOLUME 21 – Tabs 172 Part 2 - 185				
172 Part 2	8074-8158	Feb. 6, 2013	Dr. Donald R. Maisch PhD	Industry Influence; The Procrustean Approach: Setting Exposure Standards for Telecommunications Frequency Electromagnetic Radiation, Dr. Donald Maisch PhD.; 2009 (Tab 172 Part 2)
173	8159-8167	Sep. 29, 2016	Kevin Mottus	Industry Influence; Illusion and Escape: The Cell Phone Disease Quagmire. Dr. George L. Carlo PhD., JD.; 2008

INDEX TO DEFERRED APPENDIX

174	8168-8169	Nov. 18, 2013	Kevin Mottus	Industry Influence; Quote of Prof. Henry Lai PhD from NY Times Article about Percent of Negative Studies Funded By Industry; 2013
175	8170-8177	Nov 18, 2013	Kevin Mottus	Industry Influence; Warning: Your Cell Phone May Be Hazardous to Your Health. Christopher Ketcham, GQ; 2010
176	8178-8182	Sep. 3, 2013	Monnie Ramsell	Industry Influence; Radiation Protection in Conflict With Science; Dr. Franz Adlkofer PhD.; 2011
177	8183-8184	Mar. 21, 2019	Office of Engineering and Technology	US Agencies; Letter from the FCC's OET Dept. to Dr. Shuren of the FDA
178	8185-8188	Apr. 30, 2019	Center for Devices and Radiological Health	US Agencies; Letter from Dr. Shuren of the FDA to the FCC's OET Dept.
179	8189-8279	Sep. 24, 2013	Grassroots Environmental Education, Inc.	US Agencies - Radiation Sickness; US Access Board Acknowledgement of Radiation Sickness (Electromagnetic Sensitivities); 2002
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INDEX TO DEFERRED APPENDIX

181	8378-8386	Sep. 29, 2016	Kevin Mottus	US Agencies; US Department of Interior, Letter of the Director of Office of Environmental Policy and Compliance; 2014
182	8387-8407	Mar. 4, 2013	Susan Brinchman, CEP	US Agencies; Department of the Army, Confidential Legal Correspondence, Dec. 13, 2006
183	8408-8411	Sep. 2, 2013	Kevin Mottus	US Agencies; US Environmental Protection Agency (EPA) Letter to EMR Network; Jul. 6, 2002
184	8412-8424	Jul. 7, 2016	Environmental Health Trust	US Agencies; EPA Letter to the FCC, Comments on FCC 93-142 Environmental Effects of RF; 1993
185 Part 1	8425-8505	Jul. 7, 2016	Environmental Health Trust	US Agencies; US Naval Medical Research Institute. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-frequency Radiation; 1971 (Tab 185 Part 1)
VOLUME 22 – Tabs 185 Part 2 - 238				
185 Part 2	8506-8531	Jul. 7, 2016	Environmental Health Trust	US Agencies; US Naval Medical Research Institute. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations Attributed to Microwave and Radio-frequency Radiation; 1971 (Tab 185 Part 2)
186	8532-8636	Jul. 12, 2015	U.S. Department of Labor	US Agencies; US Department of Labor Comment

INDEX TO DEFERRED APPENDIX

187	8537-8539	Sep. 29, 2016	Kevin Mottus	Radiation Sickness; Exemption for Fire stations, California Assembly Bill No. 57 (2015), codified at Cal. Gov. Code 65964.1
188	8540-8546	Sep. 3, 2013	Susan D. Foster, MSW	Radiation Sickness - Firefighters; Susan Foster Comments
189	8547-8626	Jul. 7, 2016	Environmental Health Trust	Radiation Sickness; Electromagnetic Hypersensitivity, Dr. Erica Mallery-Blythe; 2014
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192	8638-8641	Nov. 18, 2013	Toril H. Jelter MD	Radiation Sickness - Children; Dr. Torill Jelter MD. (Petitioner) Comments
193	8642-8659	Jul. 13, 2016	Deborah Kopald	Radiation Sickness, Deborah Kopald Comments
194	8660-8662	Sep. 30, 2016	Ann Lee MD	Radiation Sickness - Children; Dr. Ann Lee MD. (Petitioner) Comments

INDEX TO DEFERRED APPENDIX

195	8663-8681	Sep. 3. 2013	Paul Dart MD.	Radiation Sickness; Health Effects of Microwave Radio Exposures. Dr. Paul Dart MD.(Petitioner) Comments
196	8682-8683	Sep. 4, 2013	Erica M. Elliott	Radiation Sickness; Dr. Erica Elliott MD. Comments
197	8684-8734	Sep. 16, 2019	Dr. Joel M. Moskowitz PhD.	Radiation Sickness; Electrohypersensitivity Abstracts; 2017
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200	8774-8778	Aug. 26, 2013	Sarah Jane Berd	Radiation Sickness; Sarah Jane Berd Comments
201	8779-8782	Feb. 4, 2013	Cynthia S Larson	Radiation Sickness; Cynthia S. Larson Comments
202	8783-8784	Oct. 3, 2016	Josh Fisher	Radiation Sickness; Josh Fisher Comments
203	8785-8787	Oct. 3, 2016	Paul Stanley	Radiation Sickness; Paul Stanley (Petitioner) Comments

INDEX TO DEFERRED APPENDIX

204	8788-8789	Nov. 25, 2013	Lynnell Rosser	Radiation Sickness; Lynnell Rosser Letter
205	8790-8796	Sep.12, 2013	Charyl Zehfus	Radiation Sickness; Charyl Zehfus Reply Comments
206	8797-8800	Sep. 4, 2013	Annie Starr	Radiation Sickness; Annie Starr Comments
207	8801-8802	Sep. 3, 2013	Rob Bland	Radiation Sickness; Rob Bland Comments
208	8803-8805	Sep. 3, 2013	Nancy Rose Gerler	Radiation Sickness; Nancy Rose Gerler Comments
209	8806-8811	Feb. 5, 2013	Monnie Ramsell	Radiation Sickness; Monnie Ramsell Comments
210	8812-8815	Sep. 3 2013	Miriam D. Weber	Radiation Sickness; Miriam D. Weber Comments
211	8816-8818	Sep. 3 2013	Junghie Elky	Radiation Sickness; Junghie Elky Comments
212	8819-8832	Aug. 30, 2013	Catherine Kleiber	Radiation Sickness; ADA/FHA Catherine Kleiber Comments
213	8833-8837	Sep. 3, 2013	Amanda & Ryan Rose	Radiation Sickness; Amanda & Ryan Rose Comments
214	8838-8842	Sep. 3, 2013	Cindy Bowman	Radiation Sickness; Cindy Bowman Comments
215	8843-8844	Sep. 3, 2013	Sue Martin	Radiation Sickness; Sue Martin Comments
216	8845-8846	Sep. 3, 2013	Richard Gaul	Radiation Sickness; Richard Gaul Comments

INDEX TO DEFERRED APPENDIX

217	8847-8848	Sep. 4 2013	Karen Strode	Radiation Sickness; Karen Strode Comments
218	8849-8850	Sep. 3, 2013	Jaime Schunkewitz	Radiation Sickness; Jaime Schunkewitz Comments
219	8851-8854	Aug. 13, 2013	Linda Bruce	Radiation Sickness; Linda Bruce Comments
220	8855-8858	Feb. 19, 2013	Louise Kiehl Stanphill	Radiation Sickness; Louise Kiehl Stanphill Reply Comments
221	8859-8862	Feb. 7, 2013	Diana LeRoss	Radiation Sickness; Diana LeRoss Comments, Feb. 7, 2013
222	8863-8866	Jun. 17, 2013	Marc Sanzotta	Radiation Sickness; Marc Sanzotta Comments
223	8867-8868	Aug.11, 2016	Barbara A. Savoie	Radiation Sickness; Barbara A. Savoie Comments
224	8869-8885	Jul. 13, 2016	R. Kay Clark	Radiation Sickness; R. Kay Clark Comments
225	8886-8887	Sep. 3, 2013	Steve & Juleen Ross	Radiation Sickness; Steve & Juleen Ross Comments
226	8888-8892	Sep. 3, 2013	Kathy Ging	Radiation Sickness; Kathy Ging Comments
227	8893-8895	Sep. 3, 2013	Jeraldine Peterson-Mark	Radiation Sickness; Jeraldine Peterson-Mark Comments
228	8896-8900	Sep. 3, 2013	Edward G.	Radiation Sickness; Edward G. Comments
229	8901-8903	Sep. 4, 2013	D. Yourovski	Radiation Sickness; D. Yourovski Comments

INDEX TO DEFERRED APPENDIX

230	8904-8907	Sep. 3, 2013	Ellen K. Marks	Radiation Sickness; Ellen K. Marks Comments
231	8908-8911	Sep. 3, 2013	Melo11dy Graves	Radiation Sickness; Melody Graves Comments
232	8912-8913	Sep. 3, 2013	Bernadette Johnston	Radiation Sickness; Bernadette Johnston Comments
233	8914-8916	Sep. 3, 2013	Shane Gregory	Radiation Sickness; Shane Gregory Comments
234	8917-8918	Sep. 3, 2013	Layna Berman	Radiation Sickness; Layna Berman Comments
235	8919-8922	Sep. 3, 2013	Linda Giannoni	Radiation Sickness; Linda Giannoni Comments
236	8923-8925	Sep. 3, 2013	Jennifer Page	Radiation Sickness; Jennifer Page Comments
237	8926-8928	Sep. 3, 2013	Jackie Seward	Radiation Sickness; Jackie Seward Comments
238	8929-8931	Sep. 3, 2013	Elizabeth Feudale	Radiation Sickness; Elizabeth Feudale Comments
VOLUME 23 – Tabs 239-315				
239	8932-8933	Sep. 3, 2013	Brent Dalton	Radiation Sickness; Brent Dalton Comments
240	8934-8937	Sep. 3, 2013	Elizabeth Barris	Radiation Sickness; Elizabeth Barris (Petitioner) Comments
241	8938-8940	Sep. 3, 2013	Olemara	Radiation Sickness; Olemara Comments
242	8941-8943	Aug. 14, 2013	Melissa White	Radiation Sickness; Melissa White Comments

INDEX TO DEFERRED APPENDIX

243	8944-8946	Jun. 4, 2013	Carol Moore	Radiation Sickness; Carol Moore Comments
244	8947-8952	Mar. 7, 2013	Michele Hertz	Radiation Sickness; Michele Hertz (Petitioner) Comments
245	8953-8955	Mar. 4, 2013	B.J. Arvin	Radiation Sickness; B.J. Arvin Reply Comments
246	8956-8959	Feb. 12, 2013	Suzanne D. Morris	Radiation Sickness; Suzanne D. Morris Comments
247	8960-8962	Feb. 7, 2013	Tom Creed	Radiation Sickness; Tom Creed Comments
248	8963-8967	Feb. 6, 2013	Julie Ostoich	Radiation Sickness; Julie Ostoich Comments
249	8968-8981	Feb. 6, 2013	Kathleen M. Sanchez	Radiation Sickness; Kathleen M. Sanchez Comments
250	8982-8985	Feb. 6, 2013	John Edward Davie	Radiation Sickness; John Edward Davie Comments
251	8986-8989	Feb. 6, 2013	Alison L. Denning	Radiation Sickness; Alison L. Denning Comments
252	8990-9012	Feb. 6, 2013	Susan Brinchman, CEP	Radiation Sickness; Susan Brinchman Comments
253	9013-9016	Feb. 6, 2013	Terilynn Langsev	Radiation Sickness; Terilynn Langsev Comments
254	9017-9020	Feb. 6, 2013	Beth Ann Tomek	Radiation Sickness; Beth Ann Tomek Comments
255	9021-9025	Feb. 5, 2013	Sandra Storwick	Radiation Sickness; Sandra Storwick Comments

INDEX TO DEFERRED APPENDIX

256	9026-9029	Feb. 5, 2013	Odessa Rae	Radiation Sickness; Odessa Rae Comments
257	9030-9033	Feb. 5, 2013	Kenneth Linoski	Radiation Sickness; Kenneth Linoski Comments
258	9034-9039	Feb. 6, 2013	Elissa Michaud	Radiation Sickness; Elissa Michaud Comments
259	9040-9043	Feb. 5, 2013	Ella Elman	Radiation Sickness; Ella Elman Comments
260	9044-9047	Feb. 5, 2013	Andrew Swerling	Radiation Sickness; Andrew Swerling Comments
261	9048-9051	Feb. 5, 2013	Natalie Smith	Radiation Sickness; Natalie Smith Comments
262	9052-9055	Feb. 4, 2013	Mana Iluna	Radiation Sickness; Mana Iluna Comments
263	9056-9059	Feb. 4, 2013	Jayne G. Cagle	Radiation Sickness; Jayne G. Cagle Comments
264	9060-9063	Feb. 4, 2013	Mark Summerlin	Radiation Sickness; Mark Summerlin Comments
265	9064-9067	Feb. 4, 2013	Lashanda Summerlin	Radiation Sickness; Lashanda Summerlin Comments
266	9068-9071	Feb. 4, 2013	Kath Mason	Radiation Sickness; Kath Mason Comments
267	9072-9084	Nov. 1, 2013	Daniel Kleiber	Radiation Sickness; Daniel Kleiber Reply Comments
268	9085-9086	Sep.3, 2013	Susan MacKay	Radiation Sickness; Susan MacKay Comments

INDEX TO DEFERRED APPENDIX

269	9087-9091	Mar. 4, 2013	Theresa McCarthy	Radiation Sickness; Theresa McCarthy Reply Comments
270	9092-9093	Jul. 11, 2016	L S Murphy	Radiation Sickness; L S Murphy Comments
271	9094-9096	Aug. 30, 2013	Patricia B. Fisken	Radiation Sickness; Patricia B. Fisken Comments
272	9097-9098	Sep. 3, 2013	Linda Hart	Radiation Sickness; Linda Hart Comments
273	9099-9101	Aug. 19, 2013	E Renaud	Radiation Sickness; E Renaud Comments
274	9102-9108	Aug. 13, 2013	Nicole Nevin	Radiation Sickness; Nicole Nevin Comments
275	9109-9110	Sep. 30, 2016	Robert VanEchaute	Radiation Sickness; Robert VanEchaute Comments
276	9111-9112	Sep. 6, 2016	Daniel Berman	Radiation Sickness; Daniel Berman Comments
277	9113-9116	Sep. 3, 2013	Edna Willadsen	Radiation Sickness; Edna Willadsen Comments
278	9117-9118	Aug. 30, 2013	Susan Molloy	Radiation Sickness; Susan Molloy Comments
279	9119-9120	Sep. 3, 2013	Kathleen Christofferson	Radiation Sickness; Kathleen Christofferson Comments
280	9121-9122	Sep. 3, 2013	Juli Johnson	Radiation Sickness; Juli Johnson Comments
281	9123-9124	Sep. 3, 2013	Annalee Lake	Radiation Sickness; Annalee Lake Comments

INDEX TO DEFERRED APPENDIX

282	9125-9126	Aug. 22, 2013	Alan Marks	Radiation Sickness; Alan Marks Comments
283	9127-9128	Jun. 10, 2013	Peggy McDonald	Radiation Sickness; Peggy McDonald Comments
284	9129-9131	Feb. 26, 2013	Mark Zehfus	Radiation Sickness; Mark Zehfus Reply Comments
285	9132-9137	Feb. 6, 2013	Jennifer Zmarzlik	Radiation Sickness; Jennifer Zmarzlik Comments
286	9138-9142	Feb. 6, 2013	Catherine E. Ryan	Radiation Sickness; Catherine E. Ryan Comments
287	9143-9148	Feb. 6, 2013	L. Meade	Radiation Sickness; L. Meade Comments
288	9149-9150	Sep. 3, 2013	Arthur Firstenberg	Radiation Sickness; Arthur Firstenberg Comments
289	9151-9152	Mar. 5, 2013	Jeromy Johnson	Radiation Sickness; Jeromy Johnson Reply Comments
290	9153-9154	Sep. 26, 2016	Jeanne Insenstein	Radiation Sickness; Jeanne Insenstein Comments
291	9155-9159	Nov. 18, 2013	Angela Flynn	Radiation Sickness; Angela Flynn Reply Comments
292	9160-9162	Sep. 4, 2013	Kathryn K. Wesson	Radiation Sickness; Kathryn K. Wesson Comments
293	9163-9165	Sep. 3, 2013	Diane St. James	Radiation Sickness; Diane St. James Comments
294	9166-9168	Sep. 3, 2013	Christine Hoch	Radiation Sickness; Christine Hoch Comments
295	9169-9180	Sep. 3, 2013	Arlene Ring	Radiation Sickness; Arlene Ring Comments

INDEX TO DEFERRED APPENDIX

296	9181-9182	Sep. 3, 2013	Victoria Jewett	Radiation Sickness; Victoria Jewett Comments
297	9183-9185	Sep. 3, 2013	Michael J. Hazard	Radiation Sickness; Michael J. Hazard Comments
298	9186-9187	Aug. 30, 2013	Melinda Wilson	Radiation Sickness; Melinda Wilson Comments
299	9188-9191	Aug. 30, 2013	Maggi Garloff	Radiation Sickness; Maggi Garloff Comments
300	9192-9199	Sep. 3, 2013	Holly Manion	Radiation Sickness & ADA/FHA; Holly Manion Comments
301	9200-9203	Aug. 22, 2013	James Baker	Radiation Sickness; James Baker Comments
302	9204-9254	Jul. 19, 2013	Deborah Cooney	Radiation Sickness; Deborah Cooney, Verified Complaint, *Cooney v. California Public Utilities Commission et al*, No. 12-cv-06466-CW, U.S.D.C. N.D. Cal. (Dec 17, 2012)
303	9255-9258	Jun. 13, 2013	Mardel DeBuhr	Radiation Sickness; Mardel DeBuhr Comments
304	9259-9260	Jun. 10, 2013	Richard Wolfson	Radiation Sickness; Richard Wolfson Comments
305	9261-9264	Mar. 7, 2013	James E. Peden	Radiation Sickness; James E. Peden Reply Comments
306	9265-9266	Mar. 5, 2013	Carl Hilliard	Radiation Sickness; Carl Hilliard Comments
307	9267-9268	Mar. 4, 2013	Lisa Horn	Radiation Sickness; Lisa Horn Comments

INDEX TO DEFERRED APPENDIX

308	9269-9274	Feb. 27, 2013	Alexandra Ansell	Radiation Sickness; Alexandra Ansell Reply Comments
309	9275-9278	Feb. 25, 2013	Patricia A. Ormsby	Radiation Sickness; Patricia A. Ormsby Reply Comments
310	9279-9282	Feb. 14, 2013	Annette Jewell-Ceder	Radiation Sickness; Annette Jewell-Ceder Reply Comments
311	9283-9286	Feb. 6, 2013	Max Feingold	Radiation Sickness; Max Feingold Comments
312	9287-9300	Feb. 6, 2013	Annallys Goodwin-Landher	Radiation Sickness; Annallys Goodwin-Landher Comments
313	9301-9316	Feb. 4, 2013	Rebecca Morr	Radiation Sickness; Rebecca Morr Comments
314	9317-9320	Feb. 5, 2013	Josh Finley	Radiation Sickness; Alexandra Ansell Reply Comments
315	9321-9331	Feb. 5, 2013	Donna L. Bervinchak	Radiation Sickness; Donna L. Bervinchak Comments
VOLUME 24 – Tabs 316-377				
316	9332-9334	Feb. 5, 2013	Catherine Morgan	Radiation Sickness; Catherine Morgan Comments
317	9335-9338	Feb. 5, 2013	Angelica Rose	Radiation Sickness; Angelica Rose Comments
318	9339-9341	Feb. 5, 2013	Brian J. Bender	Radiation Sickness; Brian J. Bender Comments
319	9342-9343	Jul. 11, 2016	Maggie Connolly	Radiation Sickness; Maggie Connolly Comments

INDEX TO DEFERRED APPENDIX

320	9344-9345	Sep. 3, 2013	Gregory Temmer	Radiation Sickness; Gregory Temmer Comments
321	9346-9347	Sep. 3, 2013	Bernice Nathanson	Radiation Sickness; Bernice Nathanson Comments
322	9348-9350	Sep. 3, 2013	Terry Losansky	Radiation Sickness; Terry Losansky Comments
323	9351-9352	Sep. 3, 2013	Ronald Jorstad	Radiation Sickness; Ronald Jorstad Comments
324	9353-9354	Jul. 8, 2013	Liz Menkes	Radiation Sickness; Liz Menkes Comments
325	9355-9356	Sep. 3, 2013	Katie Mickey	Radiation Sickness; Katie Mickey Comments
326	9357-9360	Sep. 3, 2013	Karen Nold	Radiation Sickness; Karen Nold Comments
327	9361-9362	Jul. 8, 2013	David DeBus, PhD.	Radiation Sickness; David DeBus, Ph.D. Comments
328	9363-9365	Jun. 20, 2013	Jamie Lehman	Radiation Sickness; Jamie Lehman Comments
329	9366-9367	Jun. 12, 2013	Jane van Tamelen	Radiation Sickness; Jane van Tamelen Comments
330	9368-9379	Jun. 10, 2013	Sebastian Sanzotta	Radiation Sickness; Sebastian Sanzotta Comments
331	9380-9383	Mar. 7, 2013	Taale Laafi Rosellini	Radiation Sickness; Taale Laafi Rosellini Reply Comments
332	9384-9387	Mar. 7, 2013	Robert E. Peden	Radiation Sickness; Robert E. Peden Reply Comments

INDEX TO DEFERRED APPENDIX

333	9388-9391	Mar. 7, 2013	Marilyn L. Peden	Radiation Sickness; Marilyn L. Peden Reply Comments
334	9392-9393	Mar. 5, 2013	Doreen Almeida	Radiation Sickness; Doreen Almeida Reply Comments
335	9394-9395	Mar. 5, 2013	Oriannah Paul	Radiation Sickness; Oriannah Paul Comments
336	9396-9397	Sep. 3, 2013	Heather Lane	Radiation Sickness; Heather Lane Comments
337	9398-9399	Aug. 15, 2013	John Grieco	Radiation Sickness; John Grieco Comments
338	9400-9401	Sep. 29, 2016	Linda Kurtz	Radiation Sickness & ADA/FHA; Linda Kurtz Comments
339	9402-9406	Feb. 5, 2013	Lisa Drodt-Hemmele	Radiation Sickness & ADA/FHA; Lisa Drodt-Hemmele Comments
340	9407-9409	Aug. 26, 2013	Robert S Weinhold	Radiation Sickness & ADA/FHA; Robert S Weinhold Comments
341	9410-9411	Jul. 12, 2016	Dianne Black	Radiation Sickness & ADA/FHA; Dianne Black Comments
342	9412-9415	Jul. 13, 2016	Derek C. Bishop	Radiation Sickness & ADA/FHA; Derek C. Bishop Comments
343	9416-9435	Aug. 21, 2013	Steven Magee	Radiation Sickness & ADA/FHA; Steven Magee Comments
344	9436-9437	Sep. 3, 2013	Melissa Chalmers	Radiation Sickness & ADA/FHA; Melissa Chalmers Comments

INDEX TO DEFERRED APPENDIX

345	9438-9440	Aug. 30, 2013	Garril Page	Radiation Sickness & ADA/FHA; Garril Page Comments
346	9441-9444	Sep. 5, 2013	Laddie W. Lawings	Radiation Sickness & ADA/FHA; Laddie W. Lawings Comments
347	9445-9446	Sep. 4, 2018	Fern Damour	Radiation Sickness & ADA/FHA; Fern Damour Comments
348	9447-9449	Aug. 28, 2013	Rebecca Rundquist	Radiation Sickness & ADA/FHA; Rebecca Rundquist Comments
349	9450-9451	Sep. 3, 2013	JoAnn Gladson	Radiation Sickness & ADA/FHA; JoAnn Gladson Comments
350	9452-9453	Jul. 13, 2016	Jonathan Mirin	Radiation Sickness & ADA/FHA; Jonathan Mirin Comments
351	9454-9455	Jul. 12, 2016	Mary Adkins	Radiation Sickness & ADA/FHA; Mary Adkins Comments
352	9456-9458	Sep. 3, 2013	Ian Greenberg	Radiation Sickness & ADA/FHA; Ian Greenberg Comments
353	9459-9462	Sep. 3, 2013	Helen Sears	Radiation Sickness & ADA/FHA; Helen Sears Comments
354	9463-9464	Mar. 4, 2013	Janet Johnson	Radiation Sickness & ADA/FHA; Janet Johnson Comments
355	9465-9467	Aug. 20, 2013	Mr. and Mrs. Gammone	Radiation Sickness & ADA/FHA; Mr. and Mrs. Gammone Comments
356	9468-9475	Sep. 10, 2013	Shelley Masters	Radiation Sickness - Disability; Shelley Masters Comments

INDEX TO DEFERRED APPENDIX

357	9476-9479	Sep. 12, 2016	Tara Schell & Kathleen Bowman	Radiation Sickness; Disability; Tara Schell & Kathleen Bowman Comments
358	9480-9481	Feb. 6, 2013	Patricia Burke	Radiation Sickness; Disability; Patricia Burke Comments
359	9482-9484	Aug. 19, 2013	Deirdre Mazzetto	Radiation Sickness; Disability; Deirdre Mazzetto Comments
360	9485-9486	Mar. 5, 2013	Jim and Jana May	Radiation Sickness; Disability; Jim and Jana May Comments
361	9487-9488	Jun. 10, 2013	Lisa M. Stakes	Radiation Sickness; Disability; Lisa M. Stakes Comments
362	9489-9490	Sep. 3, 2013	Veronica Zrnchik	Radiation Sickness; Disability; Veronica Zrnchik Comments
363	9491-9493	Sep. 12, 2013	J.A. Wood	Radiation Sickness; Disability; J.A. Wood Comments
364	9494-9495	Jul. 3, 2016	Sherry Lamb	Radiation Sickness; Disability; Sherry Lamb Comments
365	9496-9500	Aug. 28, 2013	April Rundquist	Radiation Sickness; Disability; April Rundquist Comments
366	9501-9502	Jul. 21, 2016	Charlene Bontrager	Radiation Sickness; Disability; Charlene Bontrager Comments
367	9503-9506	Jun. 19, 2013	Michelle Miller	Radiation Sickness; Disability; Michelle Miller Comments

INDEX TO DEFERRED APPENDIX

368	9507-9514	Sep. 3, 2013	James C. Barton	Radiation Sickness; Disability; James C. Barton Comments
369	9515-9526	Sep. 3, 2013	Diane Schou	Radiation Sickness; Disability; Diane Schou Comments
370	9527-9532	Jun. 24, 2013	Alison Price	Radiation Sickness; Disability; Alison Price Comments
371	9533-9535	Sep. 10, 2013	Shari Anker	Radiation Sickness; Disability; Shari Anker Comments
372	9536-9538	Aug. 30, 2013	Paul Vonharnish	Radiation Sickness; Disability; Paul Vonharnish Comments
373	9539-9548	Aug. 26, 2013	Heidi Lumpkin	Radiation Sickness; Disability; Heidi F. Lumpkin, Comments
374	9549-9550	Sep. 3, 2013	Kaitlin Losansky	Radiation Sickness; Disability; Kaitlin Losansky Comments
376	9551-9556	Nov. 12, 2012	Monise Sheehan	Radiation Sickness; Disability; Monise Sheehan Testimonial
376	9557-9558	Mar. 1, 2013	Ruthie Glavinich	Radiation Sickness; Disability; Ruthie Glavinich Comments
377	9559-9682	Sep. 3, 2013	Ed Friedman	Radiation Sickness; Testimonials of Nine People; 2013
VOLUME 25 – Tabs 378-404				
378	9683-9771	Sep. 3, 2013	Ed Friedman	Radiation Sickness; Testimonials of Twelve People; 2013
379	9772-9854	Sep. 3, 2013	Ed Friedman	Radiation Sickness; Testimonials of Nine People; 2013

INDEX TO DEFERRED APPENDIX

380	9855-9936	Sep. 28, 2016	Kevin Mottus	Radiation Sickness; Testimonials of Twenty People, Collected by StopSmartMeters; 2013
381	9937-9938	Sep. 3, 2013	Amanda & Ryan Rose	Radiation Sickness: Doctor's Diagnosis Letter for Peter Rose; 2010
382	9939-9940	Jun. 10, 2013	Steven Magee	Radiation Sickness; Doctor's Diagnosis Letter for Steven Magee
383	9941-9964	Sep. 30, 2016	Patricia Burke	European Manifesto in support of a European Citizens' Initiative (ECI)
384	9965-10012	Jul. 7, 2016	Environmental Health Trust	ADA/FHA; Verified Complaint, *G v. Fay Sch., Inc.*, No. 15-CV-40116-TSH (U.S.D.C. Mass. Aug. 12, 2015)
385	10013-10015	Aug. 13, 2013	John Puccetti	ADA/FHA; Organizations; American Academy of Environmental Medicine, Letter to the FCC
386	10016-10018	Feb. 5, 2013	Rachel Nummer	ADA/FHA; Rachel Nummer Comments
387	10019-10023	Feb. 5, 2013	Barbara Schnier	ADA/FHA; Southern Californians for a Wired Solution to Smart Meters Comments
388	10024-10057-	Feb. 5, 2013	Barbara Schnier	ADA/FHA; Opening Brief of Southern Californians for Wired Solutions to Smart Meters, Application 11-03-014 (July 19, 2012)
389	10058-10066	Sep. 2, 2013	Barbara Li Santi	ADA/FHA; Barbara Li Santi Comments
390	10067-10077	Oct. 22, 2013	Kit T. Weaver	ADA/FHA; Kit T. Weaver, Reply Comments

INDEX TO DEFERRED APPENDIX

391	10078-10086	Mar. 3, 2013	Sandra Schmidt	ADA/FHA; Sandra Schmidt Reply Comments
392	10087-10099	Feb. 11, 2013	Antoinette Stein	ADA/FHA; Antoinette Stein Comments
393	10100-10103	Feb. 5, 2013	David Morrison	ADA/FHA; David Morrison Comments
394	10104-10107	Apr. 16, 2014	MK Hickox	MK Hickox Reply Comments
395	10108-10009	Sep. 3, 2013	Annemarie Weibel	ADA/FHA; Annemarie Weibel Comments
396	10110 - 10117	Sep. 3, 2013	Omer Abid, MD, MPH	Individual Rights; Dr. Omer Abid MD. MPH Comments
397	10118-10120	Sep. 2, 2013	John A. Holeton	Individual Rights; John & Pauline Holeton Comments
398	10121-10129	Sep. 2, 2013	Grassroots Environmental Education, Inc. o/b/o Nancy Naylor	Individual Rights; Nancy Naylor Comments
399	10130-10143	Sep. 2, 2013	Deborah M. Rubin	Individual Rights; Deborah M. Rubin Comments
400	10,144-10149	Sep. 2, 2013	Kevin Mottus	Individual Rights; Kevin Mottus Comments
401	10150 - 10157	Aug. 30, 2013	Alexandra Ansell	Individual Rights; Alexandra Ansell Comments
402	10158-10161	Aug. 25, 2013	Steen Hviid	Individual Rights; Steen Hviid Comments
403	10162-10165	Aug. 21, 2013	Molly Hauck	Individual Rights; Molly Hauck Comments

INDEX TO DEFERRED APPENDIX

404	10166-10171	Feb. 5, 2013	Olle Johansson	Individual Rights; Prof. Olle Johansson PhD., Comments
VOLUME 26 – Tabs 405-443				
405	10172-10174	Mar. 4, 2013	R.Paul and Kathleen Sundmark	Individual Rights; R. Paul and Kathleen Sundmark Reply Comments
406	10175-10180	Feb. 5, 2013	Cynthia Edwards	Individual Rights & ADA; Cynthia Edwards Comments
407	10181-10185	Feb. 4, 2013	Diana Ostermann	Individual Rights; Diana Ostermann Comments
408	10186-10193	Jul. 13, 2016	Chris Nubbe	Individual Rights; Chris Nubbe Comments
409	10194-10201	Nov. 17, 2013	Katie Singer	Individual Rights & ADA; Katie Singer Comments
410	10202-10203	Aug. 21, 2013	John Puccetti	Individual Rights; BC Human Rights Tribunal approves smart meter class action, Citizens for Safe Technology
411	10204-10207	Sep. 30, 2016	Catherine Kleiber	Individual Rights; Wireless Technology Violates Human Rights, Catherine Kleiber
412	10208-10212	Oct. 28, 2013	Kate Reese Hurd	Individual Rights; Kate Reese Hurd Comments
413	10213-10214	Sep. 30, 2016	Patricia Burke	Individual Rights; Wireless '"Revolution" Must Be Supported by Scientific Proof of Safety for Human Health and the Environment, Patricia Burke

INDEX TO DEFERRED APPENDIX

414	10215-10216	Sep. 3, 2013	Ed Friedman	Individual Rights; Transcript of Hearing, Vol. 10, Application 11-03-014, Application of Pacific Gas and Electric Company for Approval of Modifications to its SmartMeter™ Program and Increased Revenue Requirements to Recover the Costs of the Modifications, California Public Utilities Commission; Dec. 20, 2012
415	10235-10248	Dec. 1, 2013	Julienne Battalia	Individual Rights; Letter of Complaint and Appeal, and Notice of Liability Regarding 'Smart Meter' and Wireless Networks, Julienne Battalia, Washington State
416	10249-10270	Jul. 7, 2016	Environmental Health Trust	Precautionary Principle; Mobile Phone Infrastructure Regulation in Europe: Scientific Challenges and Human Rights Protection, Professor Susan Perry, (international human rights law) Professor Claudia Roda (Impacts of digital technology on human behavior and social structure)
417	10271-10275	Jul. 11, 2016	Environmental Health Trust	Precautionary Principle; Wi-Fi - Children; Saying Good-Bye to WiFi A Waldorf School Takes a Precautionary Step, Dr. Ronald E. Koetzsch PhD.

INDEX TO DEFERRED APPENDIX

418	10276-10290	Jul. 7, 2016	Environmental Health Trust	Precautionary Principle; Wireless Devices, Standards, and Microwave Radiation in the Education Environment, Dr. Gary Brown, Ed.D. (Instructional Technologies and Distance Education)
419	10291-10294	Nov. 18, 2013	Richard H. Conrad, Ph.D.	Precautionary Principle; Dr. Richard H. Conrad Reply Comments
420	10295-10304	Sep. 3, 2013	Holly Manion	Precautionary Principle; Smart Meters-Firefighters; Letter from Susan Foster to San Diego Gas & Electric, California Public Utilities Commission; Nov. 8, 2011
421	10305-10348	Jul. 7, 2016	Environmental Health Trust	Precautionary Principle; Letter to the Montgomery County Board of Education Members, Theodora Scarato
422	10349-10352	Oct. 30, 2013	Diane Hickey	Precautionary Principle; Diane Hickey Comments
423	10353-10356	Sep. 3, 2013	Monnie Ramsell	Precautionary Principle; Monnie Ramsell Comments
424	10357-10409	Aug. 29, 2013	Kevin Kunze	Precautionary Principle; Kevin Kunze Comments
425	10410-10429	Feb. 6, 2013	Clara De La Torre	Precautionary Principle; Clara de La Torre Comments
426	10430-10431	Sep. 30, 2016	Center for Safer Wireless	Precautionary Principle; Center for Safer Wireless Comments

INDEX TO DEFERRED APPENDIX

427	10432-10440	Sep. 27, 2016	Gary C. Vesperman	Precautionary Principle; Possible Hazards of Cell Phones and Towers, Wi-Fi, Smart Meters, and Wireless Computers, Printers, Laptops, Mice, Keyboards, and Routers Book Three, Gary Vesperman Comments
428	10441-10443	Jul. 11, 2016	Cecelia Doucette	Precautionary Principle; Cecelia Doucette Comments
429	10444-10446	Aug. 31, 2016	Chuck Matzker	Precautionary Principle; Chuck Matzker Comments
430	10447-10460	Sep. 3, 2013	Diane Schou	Precautionary Principle; Dr. Diane Schou PhD, Dr. Bert Schou, PhD., Comments (letter sent to FCC's OET)
431	10461-10465	Sep. 3, 2013	Evelyn Savarin	Precautionary Principle; Evelyn Savarin Comments
432	10466-10468	Jun. 19, 2013	Jamie Lehman	Precautionary Principle; Jamie Lehman, Comments
433	10469-10470	Mar. 7, 2013	Marlene Brenhouse	Precautionary Principle; Marlene Brenhouse, Comments
434	10471-10474	Jul. 11, 2016	Lynn Beiber	Precautionary Principle; Lynn Beiber Comments
435	10475-10489	Sep. 2, 2013	Kevin Mottus	Precautionary Principle; Kevin Mottus Comments
436	10490-10491	Jul.13, 2016	Mary Paul	Precautionary Principle; Mary Paul, Comments
437	10492-10493	Jul. 11, 2016	Stephanie McCarter	Precautionary Principle; Stephanie McCarter Comments

INDEX TO DEFERRED APPENDIX

438	10494-10496	Feb. 4, 2013	Rebecca Morr	Precautionary Principle; Rebecca Morr Comments
439	10497-10505	Feb. 3, 2013	Nancy Baer	Precautionary Principle; Nancy Baer Comments
440	10506-10507	Sep. 2, 2013	Holly LeGros	Precautionary Principle; Holly LeGros Comments
441	10508-10509	Aug. 18, 2013	Loe Griffith	Precautionary Principle; Loe Griffith Comments
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443	10566-10572	Sep. 3, 2013	Leslee Cooper	Leslee Cooper Comments

Prenatal & Children; Doctors and Scientists Letters on Wi-Fi in Schools

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December 12, 2015

Montgomery County Schools
Carver Educational Services Center
850 Hungerford Drive
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cc Montgomery County City Council

Dear Montgomery County School District,

I am a pediatric neurologist and neuroscientist on the faculty of Harvard Medical School and on staff at the Massachusetts General Hospital. I am Board Certified in Neurology with Special Competency in Child Neurology, and Subspecialty Certification in Neurodevelopmental Disorders.

I have an extensive history of research and clinical practice in neurodevelopmental disorders, particularly autism spectrum disorders. I have published papers in brain imaging research, in physiological abnormalities in autism spectrum disorders, and in environmental influences on neurodevelopmental disorders such as autism and on brain development and function.

A few years ago I accepted an invitation to review literature pertinent to a potential link between Autism Spectrum Disorders and Electromagnetic Frequencies (EMF) and Radiofrequency Radiation(RFR). I set out to write a paper of modest length, but found much more literature than I had anticipated to review. I ended up producing a 60 page single spaced paper with over 550 citations. It is available at http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf and it was published in a revised and somewhat shortened form in two parts in the peer reviewed indexed journal *Pathophysiology (2013)*with the title: Áutism and EMF? Plausibility of a pathophysiological link." Please also see the appendix to this letter which contains a summary of this material and includes substantial scientific citations.

More recently I published an article entitled "Connections in Our Environment: Sizing up Electromagnetic Fields," in *Autism Notebook Spring 2015* edition in which I summarized and personalized the information in the . In this article I describe how here is a whole series of problems at the cellular, sub-cellular and metabolic levels and immune levels that have been identified in autism. And interestingly, for every single one of those problems, there's literature about how EMFs can create those kinds of problems.

The argument I made in these articles is not that EMF is proven to cause autism, but rather, that EMF can certainly contribute to degrading the physiological integrity of the system at the cellular and molecular level" – and this in turn appears to contribute to the pathogenesis/causation not only of autism but of many highly common chronic illnesses, including cancer, obesity, diabetes and heart disease.. Please see this article on page 24-25 at the link http://virtualpublications.soloprinting.com/publication/?i=252361

In fact, there are thousands of papers that have accumulated over decades –and are now accumulating at an accelerating pace, as our ability to measure impacts become more sensitive – that document adverse health and neurological impacts of EMF/RFR. Children are more vulnerable than adults, and children with chronic illnesses and/or neurodevelopmental disabilities are even more vulnerable. Elderly or chronically ill adults are more vulnerable than healthy adults.

Current technologies were designed and promulgated without taking account of biological impacts other than thermal impacts. We now know that there are a large array of impacts that have nothing to do with the heating of tissue. The claim from wifi proponents that the only concern is thermal impacts is now definitively outdated scientifically.

Radiofrequency electromagnetic radiation from wifi and cell towers can exert a disorganizing effect on the ability to learn and remember, and can also be destabilizing to immune and metabolic function. This will make it harder for some children to learn, particularly those who are already having learning or medical problems in the first place. And since half of the children in this country have some kind of chronic illness, this means that a lot of people are more vulnerable than you might expect to these issues.

Powerful industrial entities have a vested interest in leading the public to believe that EMF/RFR, which we cannot see, taste or touch, is harmless, but this is not true. Please do the right and precautionary thing for our children.

I urge you to opt for wired technologies in Montgomery County classrooms, particularly for those subpopulations that are most sensitive. It will be easier for you to make a healthier decision now than to undo misguided decisions later.

Thank you.

Martha Herbert, PhD, MD

Selected pertinent publications

Connections in our Environment: Sizing up Electromagnetic Fields by M.R. Herbert (published in Autism Notebook Spring 2015, pp.. 24-25) reviews in two pages key points of the more technical Herbert & Sage Autism-EMF paper

Herbert, M.R. and Sage, C. "Autism and EMF? Plausibility of a Pathophysiological Link". Part 1: *Pathophysiology* , 2013, Jun;20(3):191-209, epub Oct 4, PMID 24095003. Pubmed abstract for Part 1. Part II: *Pathophysiology,* 2013 Jun;20(3):211-34. Epub 2013 Oct 8, PMID 24113318. Pubmed abstract for Part II.

APPENDIX: MORE DETAILED SUMMARY OF THE PATHOPHYSIOLOGY

I became interested in the health and brain effects of electromagnetic frequency (EMF) and radiofrequency radiation (RFR) exposures in relation to my brain research because I was interested in how such exposures might alter brain function. In order to familiarize myself in more detail existing literature on the pathophysiological impacts of EMF/RFR, I coauthored a 40,000 word chapter in the 2012 update of the Bioinitiative, [1] and published an updated 30,000 word version of that paper ("Autism and EMF? Plausibility of a Pathophysiological Link") in 2013 in two parts in the peer reviewed journal *Pathophysiology.* [2, 3] My intention was to assess the plausibility of an association between increasing incidence of autism spectrum disorder and increasing EMF/RFR exposures. Rather than directly address the epidemiological issues, I looked at the parallels between the pathophysiological features documented in autism and the pathophysiological impacts of EMF/RFR documented in the peer-reviewed published scientific literature.

I will include here a brief summary of the paper (prepared for a lay audience) of the features of EMF/RFR that I reviewed (with citations at the end of this letter):

- EMF/RFR stresses cells. It lead to cellular stress, such as production of heat shock proteins, even when The EMF/RFR isn't intense enough to cause measurable heat increase. [4-6]
- EMF/RFR damages cell membranes, and make them leaky, which makes it hard for them to maintain important chemical and electrical differences between what is inside and outside the membrane. This degrades metabolism in many ways – makes it inefficient. [7-15]
- EMF/RFR damages mitochondria. Mitochondria are the energy factories of our cells. Mitochondria conduct their chemical reactions on their membranes. When those membranes get damaged, the mitochondria struggle to do their work and don't do it so well. Mitochondria can also be damaged through direct hits to steps in their chemical assembly line. When mitochondria get inefficient, so do we. This can hit our brains especially hard, since electrical communication and synapses in the brain demands huge amounts of energy.
- EMF/RFR creates "oxidative stress." Oxidative stress is something that occurs when the system can't keep up with the stress caused by utilizing oxygen, because the price we pay for using oxygen is that it generates free radicals. These are generated in the normal course of events, and they are "quenched" by antioxidants like we get

in fresh fruits and vegetables; but when the antioxidants can't keep up or the damage is too great, the free radicals start damaging things.

- EMF/RFR is genotoxic and damages proteins, with a major mechanism being EMF/RFR-created free radicals which damage cell membranes, DNA, proteins, anything they touch. When free radicals damage DNA they can cause mutations. This is one of the main ways that EMF/RFR is genotoxic – toxic to the genes. When they damage proteins they can cause them to fold up in peculiar ways. We are learning that diseases like Alzheimer's are related to the accumulation of mis-folded proteins, and the failure of the brain to clear out this biological trash from its tissues and fluids.
- EMF/RFR depletes glutathione, which is the body's premier antioxidant and detoxification substance. So on the one hand EMF/RFR creates damage that increases the need for antioxidants, and on the other hand they deplete those very antioxidants.[1, 16]
- EMF/RFR damages vital barriers in the body, particularly the blood-brain barrier, which protects the brain from things in the blood that might hurt the brain. When the blood-brain barrier gets leaky, cells inside the brain suffer, be damaged, and get killed. [1, 16, 17]
- EMF/RFR can alter the function of calcium channels, which are openings in the cell membranes that play a huge number of vital roles in brain and body. [18-27]
- EMF/RFR degrades the rich, complex integration of brainwaves, and increase the "entropy" or disorganization of signals in the brain – this means that they can become less synchronized or coordinated; such reduced brain coordination has been measured in autism. [28-40]
- EMF/RFR can interfere with sleep and the brain's production of melatonin. [41-43]
- EMF/RFR can contribute to immune problems. [44-50]
- EMF/RFR contribute to increasing stress at the chemical, immune and electrical levels, which we experience psychologically. [51-57] [17, 58-62] [63-68]

Please note that:

1. There are a lot of other things that can create similar damaging effects, such as thousands of "xenobiotic" substances that we call toxicants. Significantly, toxic chemicals (including those that contain naturally occurring toxic elements such as lead and mercury) cause damage through many of the same mechanisms outlined above.
2. In many of the experimental studies with EMF/RFR, damage could be diminished by improving nutrient status, particularly by adding antioxidants and melatonin. [69-72]

I understand that the concept of electromagnetic hypersensitivity is not always well understood in the medical and scientific communities. Indeed, the inter-individual variability is perplexing to those who would expect a more consistent set of features.

But given the range of challenges I have listed that EMF/RFR poses to core processes in biological systems, and given the inter-individually variable vulnerability across these symptoms, it is really not surprising that there would be subgroups with different combinations of symptom clusters.

It also appears to be the case that the onset and duration of symptoms or even brain response to EMR/RFR can be variable. This again is to be expected given the mediation of these symptoms through a variety of the above-listed pathophysiological processes, many of which differ in scale (ranging from molecular to cellular to tissue and organ) and time course of impact. The different parts of the body also absorb this energy differently, both

because of their biophysical properties and as a function of their state of health or compromise thereof.

Here is a list of subgroups of symptom clusters identified by a group of German physicians, t exemplifies these variability issues:

Group 1 no symptoms
Group 2 sleep disturbance, tiredness, depressive mood
Group 3 headaches, restlessness, dazed state, irritability, disturbance of concentration, forgetfulness, learning difficulties, difficulty finding words
Group 4 frequent infections, sinusitis, lymph node swellings, joint and limb pains, nerve and soft tissue pains, numbness or tingling, allergies
Group 5 tinnitus, hearing loss, sudden hearing loss, giddiness, impaired balance, visual disturbances, eye inflammation, dry eyes
Group 6 tachycardia, episodic hypertension, collapse
Group 7 other symptoms: hormonal disturbances, thyroid disease, night sweats, frequent urge to urinate, weight increase, nausea, loss of appetite, nose bleeds, skin complaints, tumors, diabetes

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3 August 2016

Petaluma City Schools
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Dear Sirs/Madams:

I am a public health physician who served as the Co-Editor of the Bioinitiative Report, published in 2007 as a comprehensive review of the adverse health effects of radiofrequency electromagnetic fields.

There is strong and consistent evidence that excessive exposure to radiofrequency electromagnetic fields has adverse human health effects. Of particular concern is the clear evidence that children are more vulnerable than adults. The best-documented adverse effects are an increase in risk of cancer, but cancers do not appear immediately upon exposure but rather come years later. The National Toxicology Program has within the past couple of months reported that even rats exposed to radiofrequency radiation develop brain cancer! Within a school setting there is increasing evidence that excessive exposures reduce learning ability, which is the last thing one wants in a school. Some children will also develop a syndrome of electrohypersensitivity, where they get headaches and reduced ability to pay attention and learn. While these effects are not nearly as well documented as those relating to cancer, they are particularly important within a school. This is especially the case in a wireless computer classroom, where exposure can be very high. However there will be essentially no exposure in a wired computer classroom.

The exposure levels of the Federal Communications Commission are totally outdated and do not protect the health of the public, especially of children. I urge you to abandon any plans for wireless communication within schools. It is of course critical that all children have access to the Internet, but when this is done through wired connections they will not be exposed to excessive electromagnetic fields.

Yours sincerely,

David O Carpenter

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4 August, 2016

Dear Petaluma City Schools;
Superintendent Gary Callahan and Board of Trustees

Regarding: Wireless technology should not be used in schools or pre-schools due to health risks for children and employees

We have been asked to declare our opinion about wireless technology in schools by parents that are concerned about their children.

Based on current published scientific studies, we urge your administration to educate themselves on the potential risks from wireless technologies in schools, and to choose wired teaching technologies. The well-being and educational potential of children depends on it.

High-speed connectivity to schools is important but it can be a wired connection instead of Wi-Fi. Wireless classroom infrastructure and wireless devices for schoolchildren should be avoided for these reasons:

- Wireless radiofrequency (RF) radiation emissions were classified as a Possible Human Carcinogen (group 2B) by the World Health Organization International Agency for Research on Cancer (IARC) in May 2011. One of the signers, Dr Hardell, was part of the evaluation group.
- The IARC classification holds for *all forms of radio frequency radiation* including RF-EMF emissions from wireless transmitters (access points), tablets and laptops.
- Epidemiological studies show links between RF radiation exposure and cancer, neurological disorders, hormonal changes, symptoms of electrical hypersensitivity (EHS) and more. Laboratory studies show that RF radiation exposure increases risk of cancer, abnormal sperm, learning and memory deficits, and heart irregularities. Foetal exposures in both animal and human studies may result in altered brain development in the young offspring, with disruption in learning, memory and behaviour.
- Recently a report was released from The National Toxicology Program (NTP) under the National Institutes of Health (NIH) in USA on the largest ever animal study on cell phone RF radiation and cancer (http://biorxiv.org/content/biorxiv/early/2016/05/26/055699.full.pdf). An increased incidence of glioma and malignant schwannoma in the heart was found. Interestingly our research group and others have in epidemiological studies shown that persons using wireless phones (both mobile phones and cordless phones; DECT) have an increased risk for glioma and acoustic neuroma. Acoustic neuroma or vestibular schwannoma is the same type of tumour as the one found in the heart, although benign.
- The research showing increased brain cancer risk in humans *has strengthened* since the IARC 2011 classification as new research has been published which repeatedly shows a significant association after RF radiation exposure. In addition, tumour

promotion studies have now been replicated showing cancer promotion after exposures at low levels.

- It is our opinion and that of many colleagues that the current IARC cancer risk classification should move to an *even higher* risk group. The carcinogenic effect has been shown in human and animal studies. Several laboratory studies have shown mechanistic effects in carcinogenesis such as oxidative stress, down regulation of mRNA, DNA damage with single strand breaks.
- In summary RF radiation should be classified as Carcinogenic to Humans, Group 1 according to the IARC classification. This classification should have a major impact on prevention.

The evidence for these statements is based on hundreds of published, peer-reviewed scientific studies that report adverse health effects at levels much lower than current ICNIRP and FCC public safety limits. Compliance with government regulations does not mean that the school wireless environment is safe for children and staff (especially pregnant staff).

As researchers in cancer epidemiology and RF radiation exposures, we have published extensively in this area and it is our opinion that schools should choose wired Internet connections. Multiple epidemiological research studies show that exposures equivalent to 30 minutes a day of cell phone use over ten years results in a significantly increased brain cancer risk.

What will be the health effect for a child exposed all day long in school for 12 years? Wireless networks in schools result in full body low level RF radiation exposures that can have a cumulative effect on the developing body of a child. No safe level of this radiation has been determined by any health agency and therefore we have no safety assurances. Cancers can have long latency periods (time from first exposure until diagnosis) and it will take decades before we know the full extent of health impacts from this radiation. The statistics and effects will be borne by the children you serve.

Wi-Fi in schools, in contrast to wired Internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Promoting wireless technology in schools disregards the current health warnings from international science and public health experts in this field.

We recommend that your school district install wired Internet connections and develop curriculum that teaches students at all ages safer ways to use their technology devices. If cell phones and other wireless devices are used in the school curriculum (as many schools are now doing with Bring your Own Device Policy) then there should be educational curriculum in place and well posted instructions in classrooms so that the students and staff use these devices in ways that reduce exposure to the radiation as much as possible.

Supporting wired educational technologies is the safe solution in contrast to potentially hazardous exposures from wireless radiation.

Respectfully submitted

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August 4, 2016

Petaluma City Schools
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Re: Adverse Effects of Radiofrequency fields

I am writing to express my concern over the increasing exposure of children in schools to Radiofrequency Fields (e.g. from wi-fi, as required for cell phones and iPads, and emitted by cell towers) and the lack of concern expressed by many councils, governments and School Boards on this issue. In particular, justification for the "safety" of radiofrequency fields is placed upon the use of outdated safety standards, based upon tissue heating, whereas it has now been well demonstrated that adverse biological effects occur at far lower levels of radiofrequency fields that do not induce tissue heating, including a recent animal study performed by the National Toxicology Program in the United States which found an increased incidence of brain cancers and other cancers in rats exposed to prolonged Radiofrequency fields.

I am a physician and epidemiologist specializing in cancer etiology, prevention, and screening, expert in epidemiology, and particularly causes of human cancer. I have performed research on ionizing radiation and cancer, electromagnetic fields and cancer, and have served on many committees assessing the carcinogenicity of various exposures, including working groups of the International Agency for Research on Cancer (IARC), widely regarded as providing unbiased assessment on the carcinogenicity of chemicals and other exposure to humans.

In 2011, an IARC working group designated radiofrequency fields as a class 2B carcinogen, a <u>possible</u> human carcinogen. Since that review a number of additional studies have been reported. One of the most important was a large case-control study in France, which found a doubling of risk of glioma, the most malignant form of brain cancer, after two years of exposure to cell phones. After five years exposure the risk was five-fold. They also found that in those who lived in urban environments the risk was even higher. In my view, and that of many colleagues who have written papers on this issue, these studies provide evidence that radiofrequency fields are not just a <u>possible</u> human carcinogen but a <u>probable</u> human carcinogen, i.e. IARC category 2A. It would be impossible to ignore such an assessment in regulatory approaches.

It is important to recognize that there are no safe levels of exposure to human carcinogens. Risk increases with increasing intensity of exposure, and for many carcinogens, even more with increasing duration of exposure. The only way to avoid the carcinogenic risk is to avoid exposure altogether. This is why we ban known carcinogens from the environment and why much effort is taken to get people, particularly young people, not to smoke. We now recognize that exposure to carcinogens in childhood can increase the risk of cancer in adulthood many years later. Further, people vary in their genetic makeup, and certain genes can make some people more susceptible than others to the effect of carcinogens. It is the young and those who are susceptible we should protect.

As an epidemiologist who has done a great deal of work on breast cancer, I have been concerned by a series of case reports from California and elsewhere of women who developed unusual breast cancers in the exact position where they kept cell phones in their bras. These are unusual cancers. They are multifocal, mirroring where the cell phone was kept. Thus in these relatively young women the radiofrequency radiation from very close contact with a cell phone has caused breast cancer.

Not only brain and breast cancers but parotid gland tumors, tumors of the salivary gland, have been associated with prolonged exposure to cell phones.

Given the long natural history of cancer and the fact that human populations have not been exposed for a sufficient length of time to reveal the full adverse effects of radiofrequency fields, it is extremely important to adopt a precautionary approach to the exposure of humans to such fields. An individual, if appropriately informed, can reduce her or his exposure to radiofrequency fields from devices that use wi-fi, but in the case of cell towers, smart meters and wi-fi in schools, the exposure they receive is outside their control. Then, with the people who manufacture these devices and those who promote wi-fi failing to issue adequate health warnings, we are reaching a situation where schools, work places and homes are being saturated with radiofrequency fields.

Thus to avoid a potential epidemic of cancer caused by radiofrequency fields from wi-fi and other devices, we should introduce means to reduce exposure as much as reasonably achievable, use hard wire connections to the internet and strengthen the codes that are meant to protect the public.

Yours sincerely

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Karolinska Institutet
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Stockholm, December 8, 2015

To:
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Dear Madame or Sir,

My name is Olle Johansson, and I am an associate professor, heading the Experimental Dermatology Unit at Sweden's Karolinska Institute in the Department of Neuroscience. I understand you have recently made public pronouncements regarding the safety of Wi-Fi. As a neuroscientist who has been studying the biophysical and epidemiological effects of electromagnetic fields (EMFs) for over 30 years, I believe this designation is short-sighted.

Wireless communication is now being implemented in our daily life in a very fast way. At the same time, it is becoming more and more obvious that the exposure to electromagnetic fields not only may induce acute thermal effects to living organisms, but also non-thermal effects, the latter often after longer exposures. This has been demonstrated in a very large number of **non-ionizing radiation** studies and includes cellular DNA-damage, disruptions and alterations of cellular functions like increases in intracellular stimulatory pathways and calcium handling, disruption of tissue structures like the blood-brain barrier, impact on vessel and immune functions, and loss of fertility. Whereas scientists can observe and reproduce these effects in controlled laboratory experiments, epidemiological and ecological data derived from long-term exposures in well-designed case-control studies reflect this link all the way from molecular and cellular effects to the living organism up to the induction and proliferation of diseases observed in humans. It should be noted that we are not the only species at jeopardy; practically all animals, plants and bacteria may be at stake. Although epidemiological and ecological investigations as such never demonstrate causative effects, due to the vast number of confounders, they confirm the relevance of the controlled observations in the laboratories.

Many times since the early 1980s I have pointed out that the public's usage of cell phones has become the largest full-scale biological and medical experiment ever with mankind, and I was also the first person to firmly point out that this involuntary exposure violates the Nuremberg Code's principles for human experimentation, which clearly states that voluntary

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consent of human subjects is absolutely essential. Among many effects seen, the very serious one is the deterioration of the genome. Such an effect - if seen in a food item under development or in a potential pharmaceutical drug - immediately would completely ban it from further marketing and sale; genotoxic effects are not to be allowed or spread. For these reasons above, we, scientists, can not accept that children undergo an enormous health risk for their present and future, by being exposed to WI-FI in kindergardens or schools (even if the WI-FI masts/routers are not in the children's classroom). The precautionary principle has to be respected. Furthermore, when men place cell phones in their front pocket, or laptops on their laps, it should be noted that experimental studies have demonstrated that after similar exposures there is a decrease in sperm count as well as in the quality of sperm, which is a phenomenon that could affect society's overall ability to procreate in the future. Experiments in mice point to that it may be true already in 5 generations time.

Many other states including France, Russia, Israel and Germany, have employed various precautionary steps and their responses (including labelling cell phones and other transmitting devices with SAR ratings, discouraging the use of cell phones and other wireless gadgets by children, warning parents of the risks, and removing or restricting WiFi in schools and replacing it with hard-wired ethernet) as a result of the *WHO/IARC classification of radiofrequency electromagnetic radiation in 2011 as a Class 2B carcinogen as well as the earlier classification of power-frequent magnetic fields in 2001 also as a Class 2B carcinogen*, the information summarized in the Bioinitiative Reports of 2007 and 2012, and the other considerable international and independent research and reviews, that show adverse biological effects from electromagnetic fields, including heart palpitations, headaches, skin rashes, damage to DNA, mental health effects, impaired concentration, decreased problem-solving capacity, electrohypersensitivity, etc., are about to set a new standard for educational quality with due respect to children's and staff's health.

In the case of "protection from exposure to electromagnetic fields", it is thus of paramount importance to act from a prudence avoidance/precautionary principle point of view. Anything else would be highly hazardous. Total transparency of information is the key sentence here, as I believe the public does not appreciate having the complete truth revealed years after a certain catastrophe already has taken place. For instance, it shall be noted, that today's recommended values for wireless systems, such as the SAR-values, are just recommendations, and not safety levels. Since scientists observe biological effects at as low as 20 microWatts/kg, can it truly be stated that it is safe to allow irradiation of humans at SAR 2 W/kg, or at 100,000 times stronger levels of radiation?

IMBALANCED REPORTING

Another misunderstanding is the use of scientific publications (as the tobacco industry did for many years) as 'weights' to balance each other. But one can NEVER balance a report showing a negative health effect with one showing no effect. This is a misunderstanding which, unfortunately, is very often used both by the industrial representatives as well as official authorities to the detriment of the general public. True balance would be reports showing negative health effects against *exact replications* showing no or positive effects. However, this is not what the public has been led to believe.

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NEED FOR INDEPENDENT RESEARCH
In many commentaries, debate articles and public lectures - for the last 20-30 years – I have urged that completely independent research projects must be inaugurated immediately to ensure our public health. These projects must be entirely independent of all types of commercial interests; public health can not have a price-tag! It is also of paramount importance that scientists involved in such projects must be free of any carrier considerations and that the funding needed is covered to 100%, not 99% or less. This is the clear responsibility of the democratically elected body of every country.

WHO/INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC), 2011
Very recently (in Lyon, France, May 31, 2011) the WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer. This should be added to the previous (2001) 2B classification of power-frequent (ELF) electromagnetic fields – emitted at high levels from handheld gadgets, such as eReaders and mobile phones – as a risk factor for childhood leukemia. Given the 2001 very close votes (9 to 11) for moving it to 2A and all the new knowledge that has accumulated since 2001, today the association between childhood leukemia and power-frequent (ELF) electromagnetic fields would definitely be signed into the much more serious 2A (“probably carcinogenic”) category. So, the ‘red flag’ is – unfortunately – flying very high.

INVOLUNTARY EXPOSURE
According to Article 24 of the UNICEF’s Child Convention “children have the right to … a clean and safe environment, and information to help them stay healthy”. We must all ensure that this article never is violated. This is about our social responsibility, and is very much a public health issue.

In summary, electromagnetic fields may be among the most serious and overlooked health issues today, and having these fields checked and reduced/removed from schools and kindergardens may be essential for health protection and restoration, and is a must for persons with the functional impairment electrohypersensitivity as for children who are more fragile (cf. Belyaev I, Dean A, Eger H, Hubmann G, Jandrisovits R, Johansson O, Kern M, Kundi M, Lercher P, Mosgöller W, Moshammer H, Müller K, Oberfeld G, Ohnsorge P, Pelzmann P, Scheingraber C, Thill R, "EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses", Rev Environ Health 2015; 30: 337–371). In addition, as recently discussed in a think-tank group here in Stockholm, it is very important to constantly educate oneself and participate in the general debate and public discussions to keep the information build-up active. Thus, it is of paramount importance to keep the "kettle boiling", never blindly trusting or accepting given 'facts', but only read and think for yourself and for your loved ones. Only so you can arrive at a genuinely working precautionary principle.

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CONCLUSION

In conclusion, wireless systems, such as Wi-Fi routers or cell towers, and their electromagnetic fields, can not be regarded as safe in schools, but must be deemed highly hazardous and unsafe for the children as well as for the staff.

I encourage governments and local health and educational bodies to adopt a framework of guidelines for public and occupational EMF exposure that reflect the Precautionary Principle. As noted, the Precautionary Principle states when there are indications of possible adverse effects, though they remain uncertain, the risks from doing nothing may be far greater than the risks of taking action to control these exposures. The Precautionary Principle shifts the burden of proof from those suspecting a risk to those who discount it — as some nations have already done. Precautionary strategies should be based on design and performance standards and may not necessarily define numerical thresholds because such thresholds may erroneously be interpreted as levels below which no adverse effect can occur.

Some 100 years back, we learned the hard lessons of ionizing radiation and the need for strict health protections – now we must openly face the possibility that we must take a seat in life's school and learn again. This time it is about non-ionizing radiation.

Based on all of the above, I strongly urge you to reconsider your public stance on the safety of Wi-Fi, cell towers, and similar systems in schools as their non-ionizing radiation emissions very likely are hazardous and unsafe for students, staff and teachers.

With my very best regards
Yours sincerely
Olle Johansson

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January 3, 2016

Dear Montgomery County COO Dr. Andrew Zuckerman, Interim Superintendent Larry Bowers, Board of Education and Office of Technology;

I have been asked to comment on the MCPS Statement Concerning Deployment of Wireless Computing Technologies. I am happy to do so.

The first paragraph in that statement is not relevant to the issue at hand because it is perfectly possible to use wired communication for such education. This document is being produced on a computer on which I only use wired communication, connecting to the internet, connecting to my printer and for other purposes, as well.

The 2nd and 3rd paragraphs of your statement may well be technically correct. However these give us no assurance whatsoever of safety of Wi-Fi fields. The FCC guidelines as are many other such guidelines, are based on the assumption that only heating effects of microwave/lower frequency EMFs can have biological effects. However that assumption has been falsified by thousands of studies published from the 1950s to the present, each showing that non-thermal levels of exposure often produce biological effects. For example, in 1971, the U.S. Office of Naval Medical Research produced a document reporting over 100 different non-thermal effects [1], listing 40 apparent neuropsychiatric changes produced by non-thermal microwave frequency exposures, including 5 central/peripheral nervous system (NS) changes, 9 central NS effects, 4 autonomic system effects, 17 psychological disorders, 4 behavioral changes and 2 misc. effects [1]. It also listed cardiac effects including ECG changes and cardiac necrosis as well as both hypotension and hypertension, and also 8 different endocrine effects.

Changes affecting fertility included tubular degeneration in the testis, decreased spermatogenesis, altered sex ratio, altered menstrual activity, altered fetal development, programmed cell death (what is now known as apoptosis) and decreased lactation. Many other non-thermal changes were also listed for a total of over 100 non-thermal effects. They also provided [1] approximately 2000 citations documenting these various health effects. That was almost 45 years ago and is only the beginning of the evidence for the existence of non-thermal effects. My own recent paper [2] shows that widespread neuropsychiatric effects are caused by non-thermal exposures to many different microwave frequency electromagnetic fields (EMFs).

Tolgskaya and Gordon [3] in 1973 published a long and detailed review of effects of microwave and lower frequency EMFs on experimental animals, mostly rodents. They report that non-thermal exposures impact many tissues, with the nervous system being the most sensitive organ in the body, based on histological studies, followed by the heart and the testis. They also report effects of non-thermal exposures on liver, kidney, endocrine and many other organs. The nervous system effects are very extensive and include changes many changes in cell structure, disfunction of synaptic connections between neurons and programmed cell death and are discussed in Refs. [2,3] and more modern studies reporting extensive effects of such non-thermal EMF exposures on the brain are also cited in [2]. There are also many modern studies showing effects of non-thermal exposures on fertility in animals.

The Raines 1981 National Aeronautics and Space Administration (NASA) report [4] reviewed an extensive literature based on occupational exposures to non-thermal microwave EMFs. Based on multiple studies, Raines [4] reports that 19 neuropsychiatric effects are associated with occupational microwave/ radiofrequency EMFs, as well as cardiac effects, endocrine including neuroendocrine effects and several other effects.

I reviewed many other scientific reviews on this topic, each of which clearly supports the view that there are various non-thermal health impacts of these EMFs [5]. In 2015, 206 international scientists signed a statement sent to the United Nations Secretary General and to member states, stating that international safety guidelines and standards are inadequate to protect human health [6]. Each of these 206 scientists from 40 countries had scientific publications on biological effects of such EMFs and therefore each is well qualified to judge this. ***It can be seen from this statement to the UN, that there is a strong scientific consensus that current safety guidelines and standards are inadequate because they do not take into consideration all of the non-thermal health effects produced by various EMF exposures.***

That scientific consensus also rejects, therefore, the FCC EMF guidelines, guidelines that cannot be defended despite your own attempt to do so in MCPS Statement Concerning Deployment of Wireless Computing Technologies.

It can be seen from the previous paragraphs, that the following non-thermal effects of EMF exposures are well documented:

- Widespread neuropsychiatric effects
- Several types of endocrine (that is hormonal) effects
- Cardiac effects impacting the electrocardiogram (Note: these are often associated with occurrence of sudden cardiac death)
- Male infertility

However, there are many additional types of biological changes produced by non-thermal EMF exposures (reviewed in 5,7] including:

- Oxidative stress
- Changes in calcium fluxes and calcium signaling
- Several types of DNA damage to the cells of the body, including single strand and double strand DNA breaks and 8-OH-guanine in DNA
- Cancer (which is undoubtedly caused, in part, by such DNA damage)
- Female infertility
- Lowered melatonin; sleep disruption
- Therapeutic effects of EMFs when they are highly controlled and focused on a specific part of the body

It can be seen from the above, that each of the things that we most value as individuals and as a species are being attacked by non-thermal microwave frequency EMFs [5.7]:

- **Our Health**
- **Our brain function**
- **The integrity of our genomes**
- **Our ability to produce healthy offspring**

I want to emphasize that the specific health effects listed above are **not** the only things that are likely to be impacted by non-thermal EMF exposures, they are however the best documented such effects.

While it has been clear for many years that there are many non-thermal health effects of microwave frequency EMFs, it has not been clear until about 2 ½ years ago, how these effects are produced by such exposures. I stumbled onto the mechanism in 2012 and published on it in mid-2013. This 2013 paper [8] was honored by being placed on the Global Medical Discovery web site as one of the most important medical papers of 2013. At this writing, it has been cited 61 times according to the Google Scholar database, with over 2/3rds of those citations during 2015. So clearly it is having a substantial and rapidly increasing impact on the scientific literature. I have given 26 professional talks, in part or in whole on EMF effects in 10 different countries over the last 2 1/4 years. So it is clear that there has been a tremendous amount of interest in this research.

What the 2013 study showed [8], was that in 24 different studies (and there are now 2 more that can now be added [2]), effects of low-intensity EMFs, both microwave frequency and lower frequency EMFs could be blocked by calcium channel blockers, drugs that block what are called voltage-gated calcium channels (VGCCs). There were a total of 5 different types of calcium

channel blocker drugs used in these studies, with each type acting on a different site on the VGCCs and each thought to be highly specific for blocking VGCCs. What these studies tell us is that these EMFs act to produce non-thermal effects by activating the VGCCs. Where several effects were studied, when one of them was blocked or greatly lowered, each other effect studied was also blocked or greatly lowered. This tells us that the role of VGCC activation is quite wide – many effects go through that mechanism, possibly even all non-thermal effects in mammals. There are a number of other types of evidence confirming this mechanism of action of microwave frequency EMFs [2,]. Each of the 11 health impacts caused by non-thermal EMF exposures can be explained as being produced by indirect effects of VGCC activation [5,7].

It is now apparent [7] that these EMFs act directly on the voltage sensor of the VGCCs, the part of the VGCC protein that detects electrical changes and can open the channel in response to electrical changes. The voltage sensor (and this is shown on pp. 102-104 in [7]) is predicted, because of its structure and its location in the plasma membrane of the cell, to be extraordinarily sensitive to activation by these EMFs, about 7.2 million times more sensitive than are single charged groups elsewhere in the cell. What this means is that arguments that EMFs produced by particular devices are too weak to produce biological effects, are immediately highly suspect because the actual target, the voltage sensor of the VGCCs is extremely sensitive to these EMFs. **Because heating is mostly produced by forces on these singly charged groups elsewhere in the cell, limiting safety guidelines to heating effects means that these guideline allow exposures that are something like 7.2 million times too high**.

Why then does the FCC stick with these totally unscientific safety guidelines? That is the 64 billion dollar question. The FCC has been shown, in a long detailed document published by Harvard University Center for Ethics, to be a “captured agency”, that is captured by the telecommunications industry that the FCC is supposed to be regulating [9; can be obtained full text from web site listed in 9]. So perhaps the failure of the FCC to follow the extensive science in this important area, can be understood. Of course, what that means is that the FCC is completely failing in its role of protecting the public and it is a major blunder, therefore for either you or any other organization to depend on the FCC guideline as a reliable predictor of impacts of EMFs in humans.

So what is known about health impacts of Wi-Fi EMFs?

Table 1. The following Table summarizes various health impacts of Wi-Fi EMF exposures:

Citation(s)	**Health Effects**
[10,11,12,13,14,15,16]	Sperm/testicular damage, male infertility
[10,15,17,18,19,20]	Oxidative stress
[20]	Calcium overload

[11,12,20]	Apoptosis (programmed cell death)
[17]	Melatonin lowering; sleep disruption
[10,13]	Cellular DNA damage
[21]	MicroRNA expression (brain)
[18]	Disrupts development of teeth
[22]	Cardiac changes, blood pressure disruption; erythrocyte damage; catecholamine elevation
[23,24]	Neuropsych changes including EEG
[25]	Growth stimulation of adipose stem cells (role in obesity?)

Each of the effects reported above in 2 to 7 studies have an extensive literature for their occurring in response to various other microwave frequency EMFs so it should be clear that these observations on Wi-Fi exposures are highly probable to be correct. These include (see Table 1) findings that Wi-Fi exposures produce impacts on the testes leading to lowered male fertility; oxidative stress; intracellular calcium overload; apoptosis (a process that has an important causal role in neurodegenerative diseases); cellular DNA damage; neuropsychiatric changes including EEG changes. Each of these are very serious and oxidative stress has causal roles in many different human diseases; intracellular calcium overload has many different consequences – for example, it has a central role in causing neurodegenerative diseases; cellular DNA damage can cause cancer and produce mutations that impact future generations (if there are any). Other Wi-Fi effects each only documented by a single study are also effects where a variety of other non-thermal microwave EMFs also cause these, as shown by extensive literature on each of them. These include: melatonin lowering and sleep disruption; and the effects reported by Saili et al [22] cardiac changes, blood pressure disruption; erythrocyte damage; catecholamine elevation. So these may well be correct observations as well despite having only a single Wi-Fi specific study for each.

Summary:

1. The EMF safety guidelines supported by the FCC and others assume that only heating effects need be of concern. These assumptions have been known to be false for at least 45 years and there is a scientific consensus on this, that has lead to the petition by 206 highly qualified international scientists to the UN stating that current safety guidelines are inadequate.
2. We now know that low intensity non-thermal exposures work via VGCC activation and that indirect effects of such VGCC activation can produce each of the health effects that have been widely reported to occur in response to such EMF exposures for something like 60 years. These attack:
    a. **Our health**

b. Our brain function
c. The integrity of our genomes
d. Our ability to produce healthy offspring

3. The voltage sensor of the VGCCs is stunningly sensitive to such low intensity EMFs, about 7.2 million times more sensitive than are singly charge groups elsewhere in our cells. The consequence of this is that safety guidelines allow exposures that are very roughly 7.2 million times too high.
4. The FCC has been shown, in a detailed Harvard University study, to be a Captured Agency, captured by the industry that it is supposed to be regulating. This provides an additional reason to be very highly skeptical about all FCC safety guidelines.
5. 15 studies have each shown health effects of Wi-Fi, most of which have also been shown to occur in response to low intensity exposures to other types of microwave frequency EMFs. These are likely to have massive health effects by producing male infertility (female infertility has not been studied in response to Wi-Fi), oxidative stress (involved in dozens of human diseases), cellular DNA damage (possibly leading to both cancer and mutations in future generations), life threatening cardiac effects, cellular apoptosis and also intracellular calcium overload (with both of these possibly leading to neurodegenerative diseases), various neuropsychiatric changes and many others.

It is my view that it is sheer insanity to fail to see the threat to our and to all human civilization by continuing to ignore the threats from such EMFs, starting with Wi-Fi.

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Board Member
Los Angeles Unified School District,
Board of Education

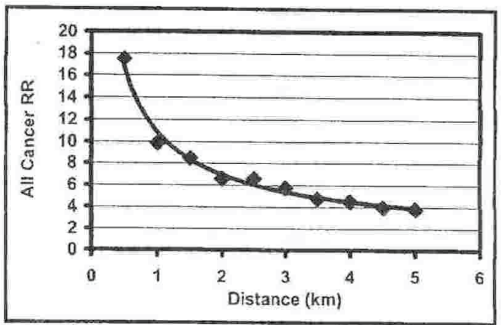
Re: Health effects of cell tower radiation

As an active researcher on biological effects of electromagnetic fields (EMF) for over twenty five years at Columbia University, as well as one of the organizers of the 2007 online Bioinitiative Report on the subject, I am writing in support of a limit on the construction of cell towers in the vicinity of schools.

There is now sufficient scientific data about the biological effects of EMF, and in particular about radiofrequency (RF) radiation, to argue for adoption of precautionary measures. We can state unequivocally that EMF can cause single and double strand DNA breakage at exposure levels that are considered safe under the FCC guidelines in the USA. As I shall illustrate below, there are also epidemiology studies that show an increased risk of cancers associated with exposure to RF. Since we know that an accumulation of changes or mutations in DNA is associated with cancer, there is good reason to believe that the elevated rates of cancers among persons living near RF towers are probably linked to DNA damage caused by EMF. Because of the nature of EMF exposure and the length of time it takes for most cancers to develop, one cannot expect 'conclusive proof' such as the link between helicobacter pylori and gastric ulcer. (That link was recently demonstrated by the Australian doctor who proved a link conclusively by swallowing the bacteria and getting the disease.) However, there is enough evidence of a plausible mechanism to link EMF exposure to increased risk of cancer, and therefore of a need to limit exposure, especially of children.

EMF have been shown to cause other potentially harmful biological effects, such as leakage of the blood brain barrier that can lead to damage of neurons in the brain, increased micronuclei (DNA fragments) in human blood lymphocytes, all at EMF exposures well below the limits in the current FCC guidelines. Probably the most convincing evidence of potential harm comes from living cells themselves when they start to manufacture stress proteins upon exposure to EMF. The stress response occurs with a number of potentially harmful environmental factors, such as elevated temperature, changes in pH, toxic metals, etc. This means that ***when stress protein synthesis is stimulated by radiofrequency or power frequency EMF, the body is telling us in its own language that RF exposure is potentially harmful.***

There have been several attempts to measure the health risks associated with exposure to RF, and I can best summarize the findings with a graph from the study by Dr. Neil Cherry of all childhood cancers around the Sutro Tower in San Francisco between the years 1937 and 1988. Similar studies with similar results were done around broadcasting antennas in Sydney, Australia and Rome, Italy, and there are now studies of effects of cellphones on brain cancer. The Sutro tower contains antennas for broadcasting FM (54.7 kW), TV (616 kW) and UHF (18.3 MW) signals over a fairly wide area, and while the fields are not uniform, and also vary during the day, the fields were measured and average values estimated, so that one could associate the cancer risk with the degree of EMF exposure.



The data in the figure are the risk ratios (RR) for a total of 123 cases of childhood cancer from a population of 50,686 children, and include a 51 cases of leukaemia, 35 cases of brain cancer and 37 cases of lymphatic cancer. It is clear from the results that the risk ratio for all childhood cancers is elevated in the area studied, and while the risk falls off with radial distance from the antennas, as expected, it is still above a risk ratio of 5 even at a distance of 3km where the field was 1μW/cm^2. This figure is what we can expect from prolonged RF exposure. In the Bioinitiative Report, we recommended 0.1μW/cm^2 as a desirable precautionary level based on this and related studies, including recent studies of brain cancer and cellphone exposure.

As I mentioned above, many potentially harmful effects, such as the stress response and DNA strand breaks, occur at nonthermal levels (field strengths that do not cause a temperature increase) and are therefore considered safe. It is obvious that the safety standards must be revised downward to take into account the nonthermal as well as thermal biological responses that occur at much lower intensities. Since we cannot rely on the current standards, it is best to act according to the precautionary principle, the approach advocated by the European Union and the scientists involved in the Bioinitiative report. In light of the current evidence, the precautionary approach appears to be the most reasonable for those who must protect the health and welfare of the public and especially its most vulnerable members, children of school-age.

Sincerely yours,

Martin Blank, Ph.D.
Associate Professor of Physiology and Cellular Biophysics

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MCPS Interim Superintendent Larry Bowers
MCPS Board of Education
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December 13, 2015

Dear Montgomery County COO Dr. Andrew Zuckerman, Interim Superintendent Larry Bowers, Board of Education and Office of Technology;

In my capacity as a pediatric occupational therapist, biologist, international speaker, and author on the subject of the impact of technology on child development and learning, I'm writing to you on behalf of students, teachers, and parents requesting you reconsider the use of devices which operate using wireless radiation.

Please find below guiding principles regarding managed balance between technology and healthy activity, as well as information on wireless radiation. More judicious use of educational based technologies is a safe manner, will serve to ensure sustainable futures for all children. Reversion to Ethernet or fiber optic cable devices, until such time as the World Health Organization deems wireless to not be harmful to young children, is recommended.

Guiding principles for the use of educational based technology in school environments.

Minimize Risk and Maximize Safety.

- Wireless radiation has not been proven safe (WHO 2011).
- Recent research indicates wireless radiation causes harmful effects to adult humans (Avendano 2012, Hardell 2013).
- Long term effects of wireless radiation on children are unknown at this time (AAP 2013).
- Children have thinner skulls, more aqueous bodies, and have rapidly developing cells, indicating they are exceedingly more vulnerable to harmful effects from wireless radiation than adults (AAP 2013, C4ST 2015).
- The American Academy of Pediatrics and the Canadian Pediatric Society recommends no more than 1-2 hours total technology use per day, including

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educational technology. Many schools exceed these expert guidelines (AAP 2014).

Weigh Risk vs. Benefit.

- Education technology is not evidence based and is laden with conflict of interest e.g. manufacturers claims are financially motivated, and are not substantiated by university level research.
- Traditional and standardized teaching methods have substantive research support and evidence, yet are being rapidly replaced with education technology.

Ensure adequate foundational skills prior to use of technology.

Children need to balance the following 4 critical factors with technology, to optimize development and learning. Time spent with technology adversely affects these factors.

- *Movement:* stimulates vestibular, proprioceptive and cardiovascular systems.
- *Touch:* stimulates parasympathetic system for lowered cortisol and adrenalin.
- *Human Connection:* activates parasympathetic system; a life sustaining force.
- *Nature:* attention restorative, improves learning, erases effects of technology.
- *See video:* Message to Schools on EdTech

Risks associated with the use of technology by children are as follows:

- *Sedentary nature* of technology use is causally related to the recent rise in obesity/diabetes, developmental delay and learning difficulties (Tremblay 2011, HELP EDI Mapping 2009/13, Ratey 2008, PISA 2012).
- *Isolating factor* of technology use is associated with escalation in social impairments, mental illnesses (including adhd and autism), and self-regulation difficulties (Houtrow 2014).
- *Overstimulation* from technology use is a causal factor in rise in attention deficit, aggression, sleep disturbance, and chronic stress from hyper-arousal of the sympathetic nervous system (Christakis 2004, Gentile 2009, Markman 2010, Bristol University 2010).
- *Neglect* of students by teachers and support staff who are engaged in their own personal technology, is unfortunately common.
- Consequently, the risks associated with using education technology far outweigh the dubious benefits.

When In Doubt, Act With Caution.

- Existing research on harmful effects of wireless radiation on *adults*, indicates taking a cautionary approach when considering same radiation exposure to *children* (AAP 2014).

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- Rapid cell turnover in children creates particular concern regarding potential DNA damage from wireless radiation, and consequent susceptibility to cancer. While rise in cancer incidence is becoming more apparent, rise in rates of cancer in children will not be observable until adulthood.
- Removal of wireless radiation and reversion to Ethernet cabled devices, will ensure immediate and long term safety to all students, teachers, and support staff.
- Defaulting to a remote authority regarding removing wireless radiation from schools, is not acting in the best interests of students and staff, and may not be defensible in a court of law.

Montgomery County's statement that the radiofrequency levels in schools "is compliant" with federal regulations *does not* assure safety to the students in your care. The current proposed technology plan to further increase the use of screens in classrooms on a daily basis, clearly does not support children's healthy development.

The implications of failure of schools to act with caution now regarding wireless radiation and technology, could potentially be horrific in both scope and magnitude, and may constitute neglect of children. Please act now to safeguard your children's future.

Respectfully,

CRowan

Cris Rowan, BScBi, BScOT, SIPT, AOTA Approved Provider
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Montgomery County Board of Education
Montgomery County Schools
Carver Educational Services Center
850 Hungerford Drive
Rockville, MD 20850

January 20, 2016

Dear Montgomery County Board of Education,

Concerned parents in your school district have asked me to write to you regarding the health risks of wireless radiofrequency radiation exposure in the classroom. Based on what I have been told, I want to urge you to halt programs that currently have students use their own phones in ways that expose their eyes and brains to levels of radiation that have never been tested for safety.

I was Founding Director of the Board on Environmental Studies and Toxicology of the U.S. National Research Council, and Founding Director of the Center for Environmental Oncology at the University of Pittsburgh Cancer Institute. President Clinton appointed me to the Chemical Safety and Hazard Investigation Board, and I am former Senior Advisor to the Assistant Secretary for Health in the Department of Health and Human Services. I founded the non-profit Environmental Health Trust in 2007 to provide basic research and education about environmental health hazards. Our scientific team is currently focusing on the health risks of radiofrequency radiation as an important public health issue.

Many people are unaware that cell phones and wireless laptops and tablets function as two-way microwave radios. A typical classroom might have the following scenario: every student has a laptop--which is typically tested for use 8 inches from an adult male body--a cell phone in the pocket--which is also tested at a minimum distance from an adult male body-- and a network transmitter on the ceiling and possibly a cell tower outside next to the sports field. All these devices emit microwave radiation which can be readily absorbed into children's bodies and brains.

Manufacturers specifically recommend that cell phones be used “as tested”—at this little-known minimum distance from the body. Recently, *Consumer Reports* in November advised that people should not keep phones in the pocket—advice that few children or adults appreciate. *These devices have never been tested for safety with children.* Accumulating research indicates that long-term exposure to low levels over long lifetimes could pose a serious risk to our health.

Regarding tested distances for using laptops, the Federal Communications Commission (FCC) states that laptops and computers are "mobile devices are transmitters designed to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons." The body in this instance refers to a large male weighing more than 200 pounds and standing six feet tall.

As the county is preparing to increase student use of Chromebooks, please be aware that the Samsung Chromebook manual states:
"United States of America USA and Canada Safety Requirements and Notices

- Do not touch or move antenna while the unit is transmitting or receiving.
- Do not hold any component containing the radio such that the antenna is very close or touching any exposed parts of the body, especially the face or eyes, while transmitting.
- Regardless of the power levels, care should be taken to minimize human contact during normal operation.
- This device should be used more than 20 cm (8 inches) from the body when wireless devices are on and transmitting.
- FCC Statement for Wireless LAN use: *"While installing and operating this transmitter and antenna combination the radio frequency exposure limit of 1mW/cm2 may be exceeded at distances close to the antenna installed. Therefore, the user must maintain a minimum distance of 20cm from the antenna at all times."*

As one of the leaders in educational policy of this nation, your school district has an opportunity to set an example for school districts nationwide by installing safer technology in classrooms and educating students, teachers and staff about tested distances that devices should be used to reduce radiation. A number of public and private schools have already implemented such policies. Just as we provide children with seat belts and bike helmets, a precautionary approach to wireless is recommended by many scientists and governments worldwide.

For more information about all of these issues, please read cell phone instructions for various models at http://showthefineprint.org. Our newly posted Ebook also details fine print safety instructions in wireless device user manuals.

When children use these devices close to their bodies, they are exceeding these safety instructions, and exposing themselves to radiofrequency (RF) radiation levels which can exceed our government FCC RF radiation exposure limits. The FCC RF exposure limit was designed to protect the public from the thermal (heating) effects of acute exposure to RF energy. The FCC states, "Tissue damage in humans could occur during exposure to high RF levels because of the body's inability to cope with or dissipate the excessive heat that could be generated. Two areas of the body, the eyes and the testes, are particularly vulnerable to RF heating because of the relative lack of available blood flow to dissipate the excess heat load."

CHILDREN ABSORB MORE RADIATION THAN ADULTS

Our recently published research in the IEEE *Spectrum* with investigators at the Federal Universities of Brazil provides new state-of-the-art radiation exposure brain modeling which confirms that substantially higher radiofrequency radiation doses occur in younger children as compared to adults even where products comply with tested guidelines developed for adults.

FCC REGULATIONS ARE OUTDATED

FCC exposure limits were set more than 19 years ago and were based on decades-old research. The Government Accountability Office published a 2012 Report that calls on the FCC to formally reassess their current RF energy (microwave) exposure limits, stating that the "FCC RF energy exposure limit *may not* reflect the latest research." I encourage you to read scientific submissions to FCC Proceeding Number 13-84 at http://bit.ly/1aGxQiq. It is unknown when the FCC will make a ruling, however, *until that time* the current outdated FCC limits are *not reflective* of the current state of science.

FCC REGULATIONS DO NOT PROTECT THE PUBLIC FROM BIOLOGICAL EFFECTS

As the California Medical Association states in their 2014 Resolution calling for updated FCC Regulations, "peer reviewed research has demonstrated adverse biological effects of wireless EMF [electromagnetic fields] including single and double stranded DNA breaks, creation of reactive oxygen species, immune dysfunction, cognitive processing effects, stress protein synthesis in the brain, altered brain development, sleep and memory disturbances, ADHD, abnormal behavior, sperm dysfunction, and brain tumors."

In May 2015, over 200 scientists who have authored more than 2,000 articles on this topic appealed to the United Nations to address "the emerging public health crisis" related to cellphones and other wireless devices, urging that the United Nations Environmental Programme (UNEP) initiate an assessment of alternatives to current exposure standards and practices that could substantially lower human exposures to non-ionizing radiation. These scientists state that "the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, " and are " insufficient to protect public health." They also state that "the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF." Please see their website at https://emfscientist.org.

INCREASED CANCER RISK

Wireless radiofrequency radiation was classified as a Class 2B "Possible Human Carcinogen" by the World Health Organization's International Agency for Research on Cancer in 2011. According to many scientists, evidence *has increased* since 2011, indicating that cell phone and wireless radiation should be classified as a "probable carcinogen." Those exposed at younger ages show four to eight times increased cancer risk. Replicated research just published in Biochemical and Biophysical Research Communications indicates that radiofrequency acts as a *tumor promoter* at low to moderate levels.

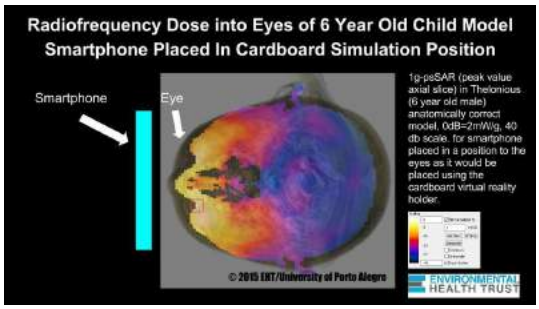
CONCERN FOR PREGNANT STUDENTS AND STAFF

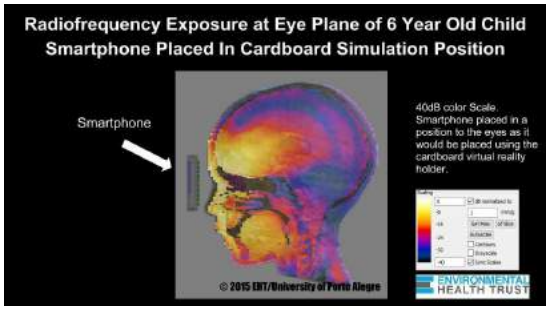
Pregnant students and staff are especially at risk from wireless because the fetus is the most vulnerable to toxic exposures. Several experimental studies are showing irreversible changes after prenatal exposure to cell phone and wireless radiation such as altered brain functioning, decreased brain cells and altered reproductive organ development. More than 100 physicians, scientists and public health professionals joined together to express their concern about the risk that wireless radiation poses to pregnancy and now *urge pregnant women to limit their exposures*. Please read these scientists BabySafe Joint Statement

VIRTUAL TECHNOLOGY RESULTS IN HIGHER EXPOSURES TO THE EYE AND BRAIN

Most recently, I was contacted by a parent in your district about the virtual reality devices now used in MCPS classrooms to go on a virtual "field trip." As indicated by online instructions, this experience involves using smartphones placed directly in front of the child's eyes so that they can directly watch a fascinating video of faraway lands. The smartphone is streaming radiation throughout the classroom from the teacher's iPad for the entire "field trip."

Please be aware that FCC regulations set decades ago did not utilize science that looks at the effects from cell phones on different body tissues such as the eyes. Upon hearing about this issue, I contacted EHT-associated scientists at federal universities of Brazil who do state-of-the-art computer modeling. I asked them to position the phone as it would be in the virtual reality cardboard for use in front of the child's eyes and assess the microwave radiation. The yellow and orange color show the highest exposures.





My colleagues and I are sharing this work with you today because we believe you should have more information about microwave radiation exposures that will take place through this system.

This research image above utilizes a sophisticated computer system that the U.S. Food and Drug Administration (FDA) currently applies to evaluate medical devices. It simulates the radiation absorption into *anatomically correct models*--something that currently used systems for testing phones and devices cannot do. In a study from Memorial Sloan-Kettering Cancer Center, radiation physicist David Gultekin, working with Bell Labs electrical engineer Lothar Moeller, reported that normal working cell phones can create tiny hotspots within brain tissue. Unlike other organs, eyes do not have circulation to effectively carry away heat.

In addition to the impact from the microwave radiation, there could also be impacts to a child's retina from the blue light emitted by the screen. Youths under the age of 20, and especially very young children,

have little or no yellowing of the lens (which helps protect the adult eye). Therefore, blue light (or UV) which enters the eye is unfiltered in children and strikes the retina at full-strength exposing not only the retina, but the lens to possible damage over the long time. Such injury may not be evident until later in time.

In 2010, Andreas Christ and team reported that children's hippocampus and hypothalamus absorbs 1.6–3.1 times higher and the cerebellum absorbs 2.5 times higher microwave radiation compared to adults; children's bone marrow of the skull absorbs 10 times higher microwave radiation than in adults, *and children's eyes absorb much higher microwave radiation than adults.* A recent Deans' Lecture I delivered to University of Melbourne provides an overview on this research.

SIMPLE STEPS WILL PROTECT CHILDREN

Compelling research raises the possibility of very serious harm to children from radiofrequency radiation exposures well below "FCC compliant" levels. Legal does not mean safe. Based on the preliminary work that I share with you here, I urge you to forgo the use of such devices such as virtual reality cardboard as there is no research that has considered their impact on children's eyes. At this time, the smart choice for school decision makers is to act now and reduce radiofrequency wireless exposures. In fact, many countries (over 20) and health authorities worldwide recommend reducing radiofrequency radiation to children.

More recently, the Cyprus Government's National Committee on Environment and Children's Health released a video about reducing wireless and I invite you to watch this excellent example of responsible action at this link https://www.youtube.com/watch?v=H43IKNjTvRM .

I understand that your county has a Bring Your Own Device policy whereby cell phones are not only allowed *in* the classroom but are actively used in the curriculum. As I have been told, students in film class might use their cell phones to take footage to create a movie, and in some math classes they use their cell phones as a calculator. Advice should be routinely provided to any student using a wireless device at school about *how to reduce exposures*. For example, if phones are used on airplane mode, and wireless is turned off on computers then these devices will neither send nor receive microwave radiation.

When powered on, phones undergo short bursts of microwave radiation up to 900 times per minute, *whether or not the phone is being used for talking.* Once teachers and students are educated on how they can simply turn their phone onto airplane mode, then they can use the phone in the classroom *without* being exposed to unnecessary radiofrequency radiation.

Likewise, laptops such as Chromebooks are also emitting constant radiation and at much higher levels when a student is streaming video or using cloud based applications. Laptops can easily be hardwired to ethernet so that students can safely use the internet without radiation emissions. Please review the Best Practices for Low EMF in Schools developed by the Northeast Collaborative For High Performing Schools which details how schools can reduce exposure to radiofrequency fields and still have full internet connectivity.

Along with the recommendation of over 200 scientists (see https://emfscientist.org) and health authorities worldwide, I recommend that the best course of action is to take simple precautions—as many nations already currently advise. *Children's exposures to wireless radiation should be reduced as much as possible.* We have a responsibility to act now to reduce children's exposure to radiofrequency radiation. Children's nervous, immune and reproductive systems are rapidly developing and, along with pregnant women, children deserve an abundance of caution.

As several colleagues and I wrote in a letter to the U.S. Secretary of Education just a few months ago, we recommend your school district do the following:

1. **Raise school community awareness through new educational curriculum:** Students, teachers and their families should be given information on wireless health risks and simple precautionary steps they can take to protect their health. It is important to teach children how to use technology both safely and more responsibly in order to protect their health and wellbeing.

2. **Install a safe communication and information technology infrastructure in schools to meet educational needs:** Solutions exist to reduce exposures to wireless emissions and mitigate the health risk. Low-EMF Best Practices have been developed, allowing educational needs to be met with safer, hard-wired Internet connections, which are also faster and more secure.

Low-EMF Best Practices are the solution that allows for full communication, information access and learning tools use in the classroom while minimizing unnecessary health risks. Your district can thoughtfully integrate safe technology into every classroom while responsibly safeguarding the health of every generation.

I fully understand that this information has not been widely understood. I would be happy to provide or develop an online technical briefing to your senior staff to assist you as you make decisions today that will affect the health of students for the rest of their lives.

Yours respectfully,

Devra Davis, PhD MPH
President and Founder
Environmental Health Trust
Visiting Professor of Medicine
The Hebrew University, Hadassah Medical Center
Associate Editor, Frontiers in Radiation and Health
ehtrust.org

UNIVERSITY AT ALBANY
State University of New York
Institute for Health and the Environment
WHO Collaborating Center in Environmental Health

July 28, 2014

Board of Trustees
Fay School
48 Main Street
Southborough, MA 01772

Re: Advisability of WiFi in schools

Dear Sirs/Madams:

This is concerning potential adverse health effects associated with exposure to radiofrequency/microwave (RF/MW) radiation, specifically that from wireless routers and wireless computers. I am writing to express concern that students at your school are experiencing electrosensitivity symptoms from these technologies.

I am a public health physician who has been involved in issues related to electromagnetic fields (EMFs) for several decades. I served as the Executive Secretary for the New York Powerline Project in the 1980s, a program of research that showed that children living in homes with elevated magnetic fields coming from powerlines suffered from an elevated risk of developing leukemia. I served as Director of the Wadsworth Laboratory of the New York State Department of Health, as well as Dean of the School of Public Health at the University at Albany/SUNY. I have edited two books on effects of EMFs, ranging from low frequency fields to radiofrequency/ microwave radiation, or the kind emitted by WiFi routers, cell phones, neighborhood antennas and wireless computer equipment. I served as the co-editor of the BioInitiative Report 2012 (Bioinitiatve.org), a comprehensive review of the literature showing biological effects at non-thermal levels of exposure, much of which has since been published in the peer-reviewed journal, *Pathophysiology* (attached). Also, I served on the President's Cancer Panel that examined radiation exposures as they relate to cancer risk, in 2009, and a report from that testimony is also attached. Thus, this is a subject which I know well, and one on which I take a public health approach rooted in the fundamental principle of the need to protect against risk of disease, even when one may not have all the information that would be desirable.

There is clear and strong evidence that intensive use of cell phones increases the risk of brain cancer, tumors of the auditory nerve and cancer of the parotid gland, the salivary gland in the cheek by the ear. The evidence for this conclusion is detailed in the attached publications. The WHO's International Agency for Research on Cancer has also classified the radiation from both cell phones and WiFi as a Class 2B "Possible Carcinogen" (2011). WiFi uses similar radio-frequency radiation as cell phones (in the 1.8 to 5.0 GHz range). The difference between a cell phone and a WiFi environment, however, is that while the cell phone is used only intermittently, and at higher power, a WiFi environment is continuous, and transmitting even when not being used. In addition, WiFi transmitters are indoors, where people (and in this case, children) may be very close by, or certainly close to devices using the WiFi, such as wireless computers, iPads and smart boards, the radiation from which can be intolerable to sensitive people.

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www.albany.edu/ihe

Furthermore, commercial routers, like those in schools, operate at much higher wattage than consumer routers. They are designed to penetrate through materials like cement, wood and brick, to handle dozens to hundreds of users, and to reach into outdoor areas, so industrial grade routers are of much greater concern.

An additional consideration to appreciate is that it is not only the power of wireless radiation that causes biological dysregulation, but the frequencies, pulsing, amplitude, and the quantity and kind of information being transmitted that can have effects as well. These 'non-thermal effects' have been shown in thousands of studies to be biologically active, and may be more important than the effects from the power. Thus, while a router may be in the ceiling, or not right next to a student, teacher or administrator, the known biological and health effects, particularly the non-thermal ones, are still very much occurring.

Finally, while acute electrosensitivity symptoms, like the ones I understand your students are experiencing, are of course of great concern (such as cognitive effects impairing attention, memory, energy levels, and concentration; cardiac irregularities, including in children; or, headaches or other symptoms in students wearing braces), the full effects for society from chronic and cumulative exposures are not known at this time. Given what we do know, however, including the DNA effects, I must, as a public health physician, advise minimizing these exposures as much as possible. Indications are that cell phones and wireless technologies may turn out to be a serious public health issue, comparable to tobacco, asbestos, DDT, PCBs, pesticides and lead paint, or possibly worse given the ubiquitous nature of the exposures. While unfortunately we must wait for federal regulation to catch up with the science, the prudent thing to do in the interim would be to exercise precaution at every opportunity.

Computers and the world-wide web have tremendous value in education, but the value also depends on how these are used in numerous respects. As wired internet connections do not pose radiation risk, are readily available, are faster and more secure than WiFi, and are now even available for certain tablets, I highly recommend you factor the risks I have described into your technology planning. At the same time, I would urge you to take the complaints of your students very seriously, and potentially involve the school nurse and teachers in helping to assess the extent of the electrosensitivity problem among students at the school.

An excellent reference on the EMF and electrosensitivity science is "Electrosensitivity and Electrohypersensitivity—A Summary" (2013) authored by M.J. Bevington and available through Electrosensitivy-U.K. (www.es-uk.info/)

If I can be of further help, please do not hesitate to call.

Yours sincerely,

David O Carpenter

David O. Carpenter, M.D.
Director, Institute for Health and the Environment
University at Albany

Enclosures

Martin Blank, PhD
Department of Physiology and Cellular Biophysics
Columbia University
New York, NY 10032

July 25, 2014

Mr. Thomas McKean, President, Board of Trustees
Mr. James Shay, President-Elect, Board of Trustees
Fay School
48 Main Street
Southborough, MA01772

To the Board of Trustees,

It has been brought to my attention that school children have become symptomatic at your school after installation of WiFi. I am writing to express my concern and to encourage you to review the independent science on this matter.

I can say with conviction, in light of the science, and in particular in light of the cellular and DNA science, which has been my focus at Columbia University for several decades, putting radiating antennas in schools (and in close proximity to developing children) is an uninformed choice. Assurances that the antennas are within 'FCC guidelines' is meaningless today, given that it is now widely understood that the methodology used to assess exposure levels only accounts for one type of risk from antennas, the thermal effect from the power, not the other known risks, such as non-thermal frequencies, pulsing, signal characteristics, etc. They fail also to consider multiple simultaneous exposures from a variety of sources in the environment, and cumulative exposures over a lifetime. Compliance with FCC guidelines, thus, unfortunately, is not in any way an assurance of safety today, as the guidelines are fundamentally flawed. Until the guidelines and advisories in the U.S. are updated, the intelligent thing for your Board of Trustees to do is to exercise the Precautionary Principle and hard wire all internet connections.

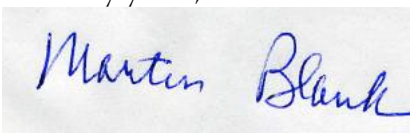
I know this might be disappointing to hear, as I understand you have invested in the WiFi. But there is no amount of money that could justify the added physiological stress from wireless antenna radiation and its many consequences, most in particular for children. Our research has shown that the cellular stress response, a protective reaction that is indicative of cellular damage, occurs at levels that are deemed 'safe'. Many other harmful reactions have been reported, such as the impairment of DNA processes that can account for the observed increased risk of cancer, as well as the potential cognitive decline, and sleep effects that may be due to impairment of the blood brain barrier. The DNA effects are of particular concern for future generations, an area of research that is just beginning to raise alarms. As with other environmental toxic exposures, children are far more vulnerable than adults, and they will have longer lifetimes of exposure.

The science showing reasons for concern about the microwave radiation emitted by antennas is abundant and there will be a day of reckoning. As I explain in my recent book,

Overpowered, The Precautionary Principle instructs us that in the face of serious threats, a lack of scientific 'certainty' never justifies inaction. The changes occurring at the molecular level, and known associations with many diseases, are sufficient at this time to give us pause and to recommend minimizing exposures to these fields, in our homes, schools, neighborhoods and workplaces. There is significant potential for risk, and to very large numbers of people, and the effects are occurring nonetheless whether or not we are noticing them.

I recommend you hardwire the internet connections at your school, and also encourage students to use hard wired connections at home for internet access, as well as for all computer equipment connections and voice communications.

Sincerely yours,



Martin Blank, PhD
mb32@columbia.edu,

Martin Blank, PhD, Special Lecturer and (ret.) Associate Professor, Columbia University, Department of Physiology and Cellular Biophysics. Dr. Blank is a leading expert in the effects of electromagnetic fields on DNA and biology, and Past President of the Bioelectromagnetics Society. He holds two PhDs, in physical chemistry and in colloid science, an interdisciplinary field involving chemistry, physics and nanoscience. Dr. Blank was author of the BioInitiative Report's section on the impact of electromagnetic fields on Stress Proteins; Editor of the journal *Pathophysiology*'s special issue on Electromagnetic Fields (2009); and co-author of "Electromagnetic fields and health: DNA based dosimetry" (2012), which recommends a new way of assessing the biological impact of electromagnetic fields across the spectrum, using DNA. Dr. Blank's book, *"Overpowered—What Science Tells Us About the Dangers of Cell Phones and Other WiFi-Age Devices",* was published in 2014.

Wi-Fi in Schools

Are We Playing It Safe With Our Kids?

"Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes." American Academy of Pediatrics Letter to FCC August 29, 2013 (20)

By Cindy Russell, MD
VP of Community Health, SCCMA

Industry has been quite successful in creating magically useful wireless technologies such as cell phones, Ipads, Wi-Fi, and now wearable tech devices such as Google glasses, we all love. Many of these handy gadgets have now reached the typical classroom across the globe. It has become apparent, however, that there are substantial downsides to being too connected to technology and as safety concerns mount, governments such as France and Israel are backing away from the blind adoption of wireless technology in schools, especially for young children.

These devices are cool and convenient, however there remains nagging questions of overuse and safety as the application of these devices has increased to the point we are literally exposed 24 hours a day to this radiation. Wireless microwaves come from many sources both at work and at home.

An increasing number of physicians, scientists, and parents are concerned about long term health effects from Wi-Fi in schools. (42)(43)(44)(49) As any parent knows, computers now are as ubiquitous in schools as they are at work. From kindergarteners on up kids are required to learn computer skills in order to take core testing online. There is a push to enable students to be connected to the internet 24/7 to take photos, email documents, and research a topic. In schools, wired connections for computers have been rapidly being eliminated to install wireless systems that connect students both indoors and outdoors on campus.

Europe and some schools in the U.S. are taking a different more precautionary approach and going back to the future with wired plug in computers. Studies have also cast doubt on some of the benefits of classroom computers and warned of the new age of "Digital Dementia" which has now crept into Korean youth due to the heavy use of electronic gadgets. (17)(48)

Professors in college are banning computers during lectures and finding students learn more. (38) (39)

CHILDREN ARE MORE VULNERABLE THUS NEED MORE PROTECTION

Children have several organ systems that are immature at birth and are thus much more sensitive to toxic exposures. The human brain, one of the top vital organs, is far from being a finished product in youth. Long-term structural maturation of the nervous system is required for successful development of cognitive, motor, and sensory functions. Neuronal axons – long thin projections from the nerve cell – act as electronic transmission lines. Axons in major pathways of the brain continue to develop throughout childhood and adolescence. Myelin is the insulation surrounding individual nerves protecting it from outside electrical charges. The process of myelination is much faster the first two years but continues into adulthood. (16) Children have thinner skulls (29), their immune systems are undeveloped, their cells are dividing more rapidly, thus, they are more vulnerable to EMF radiation and other carcinogens. They also have a longer cumulative exposure to all toxins including EMF radiation.

CURRENT WIRELESS SAFETY STANDARDS AND MICROWAVING POTATOES

Wireless devices work on high frequency microwaves similar to the microwave you use to cook food with. It is with less power but substantial research (1)(2)(3)(4) demonstrates that even at low power within the current safety standards these microwaves can cause biologic harm to plants, animals, and cellular structures. Current Federal Communications Commission (FCC) standards are based only on heat generated by the device, not on adverse biological effects seen in hundreds of studies and at much lower levels.

Our own CMA supports reassessment of EMF standards. The California Medical Association, in 2014, passed a resolution as follows:

> "Resolved 1:That CMA supports efforts to re-evaluate microwave safety exposure levels associated with wireless communication devices, including consideration

Continued on page 18

of adverse nonthermal biologic and health effects from non-ionizing electromagnetic radiation used in wireless communications and be it further

Resolved 2: That CMA support efforts to implement new safety limits for wireless devices to levels that do not cause human or environmental harm based on scientific research.

ADVERSE EFFECTS DEMONSTRATED IN PEER REVIEWED PUBLISHED RESEARCH (2)

- DNA with single and double stranded breaks
- Leakage of the blood brain barrier (two hours of cell phone exposure causes 7+ days of albumin leakage)
- Stress protein production in the body indicating injury
- Infertility/reproductive harm
- Neurologic harm with direct damage to brain cells
- Lowering of melatonin levels
- Immune dysfunction
- Inflammation/oxidation.

PLAUSIBLE MECHANISM FOUND FOR EMF MICROWAVE EFFECTS

Dr. Martin Pall, Professor Emeritus of Biochemistry, Washington State University has studied how electromagnetic fields impact the cells of our bodies. His 2013 paper on this subject highlights a major biological mechanism of action of EMF microwave radiation on cell structure. His work, along with two dozen prior studies, demonstrated that EMF microwave radiation effects cellular calcium channels and this can be inhibited with calcium channel blockers. "A whole series of biological changes reportedly produced by microwave exposures can now be explained in terms of this new paradigm of EMF actions via Voltage Gated Calcium Channels (VGCC) activation." (14)(15)

EMF AFFECTS ON WILDLIFE: BIRDS, BEES, AND TOMATO PLANTS

Bird researchers in Germany found that their migratory European Robins lost their sense of navigation when in the city. (5) This was found to be due to the EMF radiation interfering with the bird's special internal magnetic compass. They replicated the experiment over seven years before publishing the results in the prestigious journal *Nature*.

John Phillips and others have found that newts, sea turtles, and migratory birds use a magnetic compass to navigate long distances and this can be interrupted by low levels of EMF. (6)(7) A review of effects on cell towers and wireless devices showed that beehives can have rapid colony collapse with exposure to cell phone radiation. (8)

Plants have been shown to have stress response to EMF from wireless devices. (9)(10) (22) In tomatoes exposed for short duration, the stress response seen by exposure to EMF was prevented by administration of calcium counteracting drugs. (11) Even simple high school science experiments document abnormal seed growth near Wi-Fi routers. (19) There appear to be adverse biological effects of this seemingly harmless radiation.

HUMAN ELECTROSENSITIVITY: IS IT REAL?

There is varied opinion about those who state they are sensitive to EMF. Scientific research has not given a definitive answer, nevertheless, many seem to suffer from vague and often disabling symptoms they feel in the presence of EMF. Exposure to EMF radiation in some people reportedly causes headaches, memory problems, fatigue, sleep disorders, depression. This is so significant for some people that they have to live in a very low EMF environment to feel normal. (25)

Sweden recognizes electro-sensitivity as a functional impairment and estimates that about 3% of the population suffers from this. (23)(24) Dr. Magda Havas found in replicated studies that some EMF sensitive individuals heart rates increased with wireless devices turned on in double blind study. (12)(26) Researchers at Louisiana State University, in 2011, studied a self reported EMF sensitive physician and found "In a double-blinded EMF provocation procedure specifically designed to minimize unintentional sensory cues, the subject developed temporal pain, headache, muscle twitching, and skipped heartbeats within 100 s after initiation of EMF exposure ($p < .05$)." They concluded that "EMF hypersensitivity can occur as a bona fide environmentally inducible neurological syndrome." (27)

In May 2011, the International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B).(30)

Genius and Lipp reviewed the current literature on EHS, in 2011, and point to several explanations for this multisystem phenomenon, including toxicant induced loss of tolerance as many with EHS symptoms had high levels of PCB's possibly causing immune dysfunction. Scientific research also identifies an inflammatory response with cytokine production. Another aspect of research points to catecholamine and adrenal gland dysfunction. In addition, heavy metal toxicity has also been proposed as contributing to EHS. (28)

The Austrian Medical Association feels Electrohypersensitivity is a real phenomenon and in 2012 published Guidelines for EMF and Electro-hypersensitivity. They state the primary method of treatment should consist in the prevention or reduction of EMF exposure, taking care to reduce or eliminate all sources of EMF if possible. (32)

GOVERNMENT ACTIONS ON WI-FI IN SCHOOLS

While much of the U.S. is marching forward with Wi-Fi in schools, Europe is changing direction, as indicated by the policies listed below. (45) Internationally there is wide disagreement in standards. The U.S. and Canadian limits are 1000 microwatts/cm2. China and Russia are 10 microwatts/cm2. Belgium is 2.4 microwatts/cm2, and Austria is 0.001 microwatts/cm2. The Bioinitiative Report 2012 recommendation for "No Observable Effect" is 0.0003 microwatts/cm2. Cosmic background EMF we evolved with is <0.00000000001 microwatts/cm2. (2)

COUNCIL OF EUROPE PARLIAMENT ASSEMBLY 2011 EMF MICROWAVE POLICY : "THE POTENTIAL DANGERS OF ELECTROMAGNETIC FIELDS AND THEIR EFFECT ON THE ENVIRONMENT"

The report notes "other non-ionizing frequencies, whether from ex-

tremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications, and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects, and animals, as well as the human body, even when exposed to levels that are below the official threshold values."

The Council calls for a number of measures to protect humans and the environment, especially from high-frequency electromagnetic fields. One of the recommendations is to "take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumors". (37)

IN FRANCE: A NEW NATIONAL LAW BANS WI-FI IN NURSERY SCHOOLS

In January 2015, France passed a landmark law that calls for precaution with wireless devices for children and the general public. (34)(35) It calls for:

1. Wi-Fi banned in nursery schools.
2. Wi-Fi routers should be turned off in school when not in use.
3. Schools are informed when new tech equipment is installed.
4. Citizens will have access to environmental cell tower radiation measurements near homes.
5. There will be continued research conducted into health effects of wireless communications.
6. Information on reducing exposure to EMF radiation is mandatory in the contents of the cell phone package.
7. Wi-Fi hotspots are labeled.

ISRAELI MINISTRY OF EDUCATION ISSUE GUIDELINES TO LIMIT WI-FI IN SCHOOLS

On August 27, 2013, the Israeli Ministry of Education issued new guidelines regarding Wi-Fi use in schools. (33) The guidelines will:

1. Stop the installation of wireless networks in classrooms in kindergarten.
2. Limit the use of Wi-Fi between first and third grades. In the first grade, students will be limited to use Wi-Fi to study for one hour per day and no more than three days per week. Between the first and third grades, students will be limited to use Wi-Fi up to two hours per day for no more than four days per week.
3. To limit unnecessary exposure teachers will be required to turn off mobile phones and Wi-Fi routers when they are not in use for educational purposes.
4. All Wi-Fi equipment be tested for compliance with safety limits before and after installation in an Israeli school.
5. Desktop computers and power supplies be kept at least 20 cm from students.

2012 THE RUSSIAN COMMITTEE ON NON-IONIZING RADIATION PROTECTION OFFICIALLY RECOMMENDED THAT WI-FI NOT BE USED IN SCHOOLS.

2011 THE RUSSIAN COMMITTEE ON NON-IONIZING RADIATION PROTECTION (RNCNIRP) RELEASED THEIR RESOLUTION ENTITLED "ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECTS ON CHILDREN AND TEENAGERS."

According to the opinion of the Russian National Committee on Non-Ionizing Radiation Protection, the following health hazards are likely to be faced by the children mobile phone users in the nearest future: disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to the stress, increased epileptic readiness. (36)

Expected (possible) remote health risks: brain tumors, tumors of acoustical and vestibular nerves (in the age of 25-30 years), Alzheimer's

Continued on page 20

disease, "got dementia", depressive syndrome, and the other types of degeneration of the nervous structures of the brain (in the age of 50 to 60).

PLAYING IT SAFE FOR OUR KIDS

A healthy and safe learning environment is a cornerstone of education. Current FCC standards are obsolete and inappropriate as they are based only on heat effects, not biological effects. They give us a false sense of security. There may be higher EMF levels at school than at home as routers are more powerful. Cumulative Effects on DNA or cell structures are not taken into consideration in any safety standard. Because of the long-term exposure to EMF microwave radiation this generation is experiencing, they will be at higher risk for potential health problems. We will not know what happens to our progeny's DNA until our grandchildren are born.

Considering there has been a more precautionary approach internationally to microwave radiation exposure and the trend is toward less exposure in schools, especially to vulnerable populations such as children, it makes sense to re-evaluate our wireless schools. We buckle our seat belts and wear a helmet when we ride bikes even though we don't know if we will get in an accident. Although not all the issues of wireless microwaves are understood, there is enough science to understand it acts as a toxicant at even low levels that fall within current safety standards. We also know that decades of research precedes meaningful regulation in the area of toxins, thus the only reasonable approach is precautionary.

In addition, we need to be thoughtful about how much our kids should use computers and what this is doing not only to them, but to our society as a whole. We get starry eyed with every new wireless gadget, however, in "Alone Together" Sherry Turkle expertly addresses the rise in isolation, loneliness, lack of privacy, and increasing pressure on students in this age of invasive technology. Her thorough and non-judgmental scientific investigation of the psychological effects of computers makes us aware that we need to take care that we do not replace real human connection with a "virtual reality" that will redirect us in an unhealthy direction.

As physicians and parents, we understand that decisions we make today may have far reaching consequences in the future for our kids. Let's play it safe for them right now.

RECOMMENDATIONS FOR SCHOOLS

1. **Wired internet connections** like we used to have are the safest and possibly cheapest option – all the benefits of the internet without the risk.
2. **Wireless devices**, but with an on/off switch in each room so teachers can use only when needed for educational purposes.
3. **Limit Wi-Fi** use, especially in younger grades.
4. **Cell phones stay off and in the backpacks during class** and on the campus during school hours.
5. **Have EMF and electrical measurements done by one or more qualified, experienced consultants before and after any installation**. Understand you may need to increase your knowledge of low and high frequency electromagnetic fields and limits to accurately interpret the reports. The Bioinitiative Report is a very useful compendium that has recommendations for safer levels.
6. **Support efforts by governments to provide independent standardized transparent research to define safe limits in all the different wireless frequencies used commercially**. This could lead to less EMF emissions and safer wireless devices.

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STEPHEN T. SINATRA M.D., F.A.C.C.
F.A.C.N., C.N.S., C.B.T.,
Integrative Metabolic Cardiology

July 16, 2014

Chairman and Trustees
Fay School
48 Main Street
Southborough, MA 01772

RE: Wi-Fi in Schools

Dear Chairman and Trustees:

I am writing this letter on behalf of concerned parents of children who are attending schools with Wi-Fi technology. I'm a cardiologist and co-founder of Doctors for Safer Schools, an organization dedicated to informing teachers, parents and superintendents about the uncertainty and possible environmental health hazards of Wi-Fi technologies.

The heart is a delicate and complex electromagnetic organ that can be adversely affected by exogenous signals from wireless technology and microwave radiation. For this reason it is unwise to expose students and teachers to Wi-Fi radiation for internet access, especially when safer alternative wired options are available. Children are particularly vulnerable to this radiation and the incidents of cardiovascular events including sudden cardiac arrest, seems to be increasing, especially among young athletes (up to the age of 19). In some cases this is due to undetected heart defects, blunt trauma to the heart in contact sports, and heat stress during strenuous exercise, but in instances these irregularities may be exacerbated by or due to microwave signals interfering with the autonomic nervous system that regulates the heart.

I know this because I am a board certified cardiologist and have been a Fellow of the American College of Cardiology since 1977. At the Manchester Memorial Hospital in Connecticut, I served in several roles, including Chief of Cardiology, Director of Cardiac Rehabilitation, and Director of Medical Education.

In both Canada and the United States a large number of students are complaining that they feel unwell in classrooms that have Wi-Fi technology. These complaints have been investigated and what emerges is the following:

1. Symptoms common among these students include headaches, dizziness, nausea, feeling faint, pulsing sensations or pressure in the head, chest pain or pressure, difficulty

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concentrating, weakness, fatigue, and a racing or irregular heart accompanied by feelings of anxiety. These symptoms may seem diverse but they indicate autonomic dystonia or dysfunction of the autonomic nervous system.

2. Symptoms do not appear in parts of the school that do not have this technology (Wi-Fi-free portables) and they do not appear in homes that do not have wireless technology.

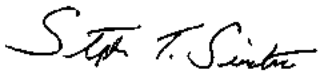
3. We know that the heart is sensitive to and can be adversely affected by the same frequency used for Wi-Fi (2.4 GHz) at levels a fraction of federal guidelines (less than 1%) and at levels that have been recorded in two Ontario schools with Wi-Fi technology.

4. The incidence of sudden cardiac arrests (SCA) among young athletes is increasing and doctors don't know why. In one small Ontario community, the number of students experiencing SCA is disturbingly high. Whether WiFi and nearby cell phone antennas exacerbate SCA needs to be investigated further before students are subjected to these fields.

In conclusion it is unwise to install wireless technology (WiFi) in schools. We do not know what the long-term effects of low-level microwave radiation are on students and teachers. The safety of this technology on children has not been tested and I would advise that you follow the precautionary principle that states the following:
"*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*"
(Rio Conference 1992).

The principle implies that we have a social responsibility to protect the public from exposure to harm, when scientific investigations have found a plausible risk. That "plausible risk" exists for microwave radiation at very low levels. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result. In some legal systems the application of the precautionary principle has been made a statutory requirement.

Sincerely,



Stephen T. Sinatra, M.D., F.A.C.C., F.A.C.N., C.N.S

Karolinska Institutet
Department of Neuroscience
Experimental Dermatology Unit

Stockholm, July 24, 2014

Mr. Thomas McKean, President, Board of Trustees
Mr. James Shay, President-Elect, Board of Trustees
Fay School
48 Main Street
Southborough, MA 01772

Ladies and Gentlemen,

It has been brought to my attention that children in your school are physically being impacted by radiation from WiFi antennas, and that some of the student's reactions have been severe. I was concerned to learn this. It is unwise to chronically expose children to this type of radiation, as their bodies are more sensitive than adults and the radiation has been shown to impair not just physiological functioning but cognitive function and learning.

Radiation of the kind emitted by WiFi transmitters impacts attention, memory, perception, learning capacity, energy, emotions and social skills. There is also diminished reaction time, decreased motor function, increased distraction, hyperactivity, and inability to focus on complex and long-term tasks. In some situations, children experience cardiac difficulties. In one Canadian school district, incidence of cardiac arrest in children was 40x the expected rate, and defibrillators have had to be placed at each school. Online time, particularly multi-tasking in young children, has been linked with a chronically distracted view of the world preventing learning critical social, emotional and relational skills. There is a physiological as well as psychological addiction taking place. I am sure, that as stewards of the lives of the children in your charge, you would not wish any of these outcomes.

Given the large and growing body of science indicating biological and health effects from the radiation emitted by antennas, it would be most imprudent at this time to permit wireless antennas on—or inside—your property. Understand the FCC exposure guidelines only protect against the acute power density, or acute thermal, effects, and they do nothing to protect against the other aspects of the radiation's risk, such the frequencies, amplitude, pulsing, intensity, polarity and biologically disruptive information content. Thus, until the FCC establishes guidelines for the non-thermal effects, any reliance by your school on current FCC guidelines, based solely on *thermal effects* would necessarily be incomplete. I urge a school of your caliber to be a leader on this issue, and appreciate that two wrongs do not make a right.

I enclose for your review the transcript of the Seletun Scientific Statement laying out the key concerns on this topic. If I can be of further help, please, do not hesitate to be in touch.

Yours truly,

Olle Johansson, Associate Professor
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CC: cheemf@lists.healthandenvironment.org
Sent: 2/8/2013 2:21:54 P.M. Pacific Standard Time
Subj: [cheemf] Adoption of Wi-Fi in Los Angeles USD classrooms

TO: Los Angeles Unified School District (LAUSD)

FROM: Joel M. Moskowitz, Ph.D.
Director, Center for Family and Community Health
School of Public Health
University of California, Berkeley

RE: Adoption of Wi-Fi in Classrooms

DATE: February 8, 2013

Based upon my review of the research of the health effects associated with exposure to radiofrequency (RF) electromagnetic radiation (EMR), especially microwave radiation, I feel compelled to register my concern that adoption of Wi-Fi in LAUSD classrooms is likely to put at risk the health of many students and employees in the District.

In December, Dr. Gayle Nicoll of URS Corporation asked me to serve as an expert reviewer for a report that URS prepared for the LAUSD regarding the adoption of Wi-Fi in classrooms. Since Ms. Nicoll could not assure me that URS has no conflicts of interest, I turned down her request and sent her references to recent studies about Wi-Fi radiation. I cc:ed Board members and key staff as I was concerned about the health risks of unnecessarily subjecting 660,000 children to 13,000 hours of Wi-Fi microwave radiation during their K-12 school years.

Although I have not seen the URS report, I imagine it is based on the FCC's outmoded 1996 safety standards which only protect the public from the **thermal risk of RF EMR exposure** (i.e., from heating of tissue). For the past three years, in numerous media interviews I have been calling on the FCC to strengthen its standards and testing procedures to protect the public and workers from the low-intensity, **non-thermal risks of RF EMR exposure** that have been reported in hundreds, if not thousands, of research studies. These include increased risk of neurological and cardiovascular problems, sperm damage and male infertility, reproductive health risks, and cancer.

The **precautionary principle** should be applied to this critical policy decision. This principle, developed at a U.N. environmental conference in 1992 states that in the absence of scientific consensus if an action has a suspected risk of causing harm, the burden of proof it is not harmful falls on those taking the action, and all reasonable measures to reduce the risk must be taken.

Internet access can be provided to students through wires or optical fiber without installing Wi-Fi in the classrooms.

For further information, please see my **Electromagnetic Radiation Safety web site** at http://saferemr.blogspot.com where I have archived news releases and links to recent reports by major scientific groups and political agencies.

Sincerely,

Joel M. Moskowitz, Ph.D.

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December 1, 2015

Montgomery County Schools
Carver Educational Services Center
850 Hungerford Drive
Rockville, MD 20850

Attention: Dr. Andrew Zuckerman, Chief Operating Officer
MCPS Board of Education Members

This letter of comment has been prepared after reviewing the *Montgomery County Public Schools Radiofrequency (RF) Summary Monitoring Report* dated July 2015 produced by AECOM Environment.

1) The instrument cited as being used for the peak measurements in section 7, a Narda SRM-3006, is not suitable to measure the very short (1 millisecond) spikes typically found in WiFi 802.11n communication. As stated on page 7-1, each data sweep takes 550 milliseconds, making the instrument unsuitable for reliably logging the short bursts typical in 802.11n WiFi communications. Palit et al conclude that 50% of the uplink traffic will be in bursts shorter than 2 milliseconds. The peak levels of those packets will not be reliably logged by a device with a 550 millisecond sweep time.

Palit et al, 2012. Anatomy of WiFi Access Traffic of Smartphones and Implications for Energy Saving Techniques. International Journal of Energy, Information and Communications, Vol. 3, Issue 1.

2) Even the average-level tests seem inconsistent with engineering reality. Figure 7.1 shows a background noise level mostly flat between 2.4GHz and 5.8Ghz. That noise (typically -70dBm) is generally consistent with the internal thermal noise in a quality wide-band measuring instrument. Two tiny peaks out of that noise are represented to be the "*average electric field generated at one foot away from an AP in use at Beverly Farms Elementary School*." Even with just the 802.11n beacon-frame idling, the peak field a foot away from an access point should be a million times higher than the levels of figure 7.1. Why do we just see a blip on the chart? Clearly some unusual 'averaging' has occurred, yet the parameters of that averaging, and the potential clinical implications of that averaging, are not noted in the annotation to the Figures. Further, Figure 7.2 shows a background noise level some 10dB higher than figure 7.1, something that would be very unusual in measurements at these Gigahertz frequencies.

3) The RF exposure estimates are additionally inadequate because, in reality, there is no way to meet the distancing that AECOM's report bases it's measurements on for an individual student. In normal use, kids hover over devices. They hug them to the body. They put them in their laps at lunchtime, on the couch and in bed doing homework. It is entirely unrealistic to expect teachers and parents to guarantee that students always keep their Chromebooks at some arbitrary distance during use.

4) The report concludes with classroom RF measurement comparisons to an outdated 2007 BioInitiative Report recommendation of 0.1 uW/cm2. (Section 7). Graphics need to be re-drawn with comparisons to the 2012 recommended BioInitiative level, and do so not only for a 12" spacing, but also for the one-inch distance measured from the Chromebook (Figure 7-3 and 7-4). Using an arbitrary 12" distance to report and compare to either the 2007 or 2012 BioInitiative recommendations will seriously underestimate RF exposures since students don't always (or even typically) maintain a foot of distance. Their 'leaning in' and having to place their faces close to the device is common usage, and is unavoidable.

5) The methodology is not specific as to the number of operating devices and clustering of students at work – which is necessary to characterize exposures from a room full of operational wireless devices. Figure 2.1 shows multiple wireless devices connected to one wireless router. Measuring one or several Chromebooks rather than one Chromebook for each of the 25-35 students plus router isn't how a normal classroom operates. It **does not** produce RF measurements of a typical class using many wireless devices at once, so this is a fundamental flaw. It will underestimate RF exposures.

6) There is also a comment to be made here about the setup – how does this methodology reasonably reflect how smaller or younger children with short arms and torsos actually use tablets? What RF exposures they can expect to receive? The likely consequence to the measurements is greater exposure. Unless the students are using chopsticks instead of their fingers, or are using wired keyboards that increase the distance to the wireless device, RF exposures will be worse for the younger or smaller-stature students.

7) This Report appears to legitimize MCSD's use of wireless in the classroom by asserting compliance with the 2007 BioInitiative Report recommendation, yet the report does not mention the significant revision of that threshold in the years between 2007 and 2012. Both BioInitiative Reports clearly state that their recommendations are interim and 'that they may have to go lower.' Recent studies of students reporting headache, irritability, concentration and behavior problems at levels as low as 0.003-0.006 uW/cm2, indicate that neither BioInitiative Report threshold may be low enough to assure safety. As the co-editor of the BioInitiative Reports, and a founding member of the BioInitiative Working Group, the way in which our work has been invoked is not consistent with the findings of the BioInitiative Reports overall. The conclusions of this report cannot be said to give a positive assertion of safety because of the degree of uncertainty over whether the testing equipment was adequate (we believe it was not); the lack of comparison data; and the failure to measure RF exposures at realistic distances from the student(s).

8) Correct BioInitiative citations are:

BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation at

www.bioinitiative.org, December 31, 2012.

BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF) at www.bioinitiative.org, August 31, 2007

CONCLUSION

The data in this report cannot therefore be used to infer safety, or lack of safety, of children in any of the tested locations.

Respectfully submitted,

Cindy Sage. MA
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Director, Autoimmunity Research Foundation,
Senior Member IEEE,
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Fellow, European Association for Predictive, Preventive and Personalised Medicine (Brussels)
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trevor.m@trevormarshall.com

September 22, 2014

On behalf of the BioInitative Working Group, we are writing to express our concern about the views expressed by CEOs from Google, Dell, Apple, Adobe, eBay, Facebook, the George Lucas Educational Foundation and others to the FCC supporting wireless technologies in schools.

Your letter to the FCC dated July 7, 2014 titled Education Superhighway, states:

> *"Today, we are writing to you to urge swift bi-partisan action at your July 11, 2014 meeting to adopt the E-Rate modernization proposal set forth by Chairman Wheeler."*
> *"By responsibly investing $2 billion of unused funds and providing predictable ongoing support for Wi-Fi, the plan will make dramatic progress in bringing high-speed connectivity to our classrooms."*

No one denies that bringing high-speed connectivity to our classrooms is important. But it can be a wired connection and does not have to be WiFi. It does not reflect well on the ethics of your corporations to encourage the FCC to provide $2 billion dollars for new wireless classroom infrastructure and devices for school children, knowing that wireless emissions have been classified as a Possible Human Carcinogen by the World Health Organization's International Agency for Research on Cancer (2011). To promote wireless technologies in schools is to deliberately and knowingly disregard current health warnings from international science and public health experts.

Saturating schools with wireless technology will likely create unnecessary liability for municipalities and result in a loss of public trust and confidence in the corporations that push their wireless products with a blind eye toward health concerns.

Epidemiological studies show links between radiofrequency radiation (RFR) exposure and cancers, neurological disorders, hormonal changes, symptoms of electrical hypersensitivity (EHS) and more. Laboratory studies show that RFR exposure increases risk of cancer, abnormal sperm, learning and memory deficits, and heart irregularities. Fetal exposures in both animal and human studies result in altered brain development in the young offspring, with disruption in learning, memory and behavior. The brain development of a fetus can be impaired by in-utero exposure to a pregnant woman. The evidence for these statements is based on hundreds of published, peer-reviewed scientific studies that report adverse effects at levels much lower than current FCC public safety limits. WiFi is schools, in contrast to wired internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Corporations cannot avoid responsibility simply by asserting compliance with existing legal, but outdated and inadequate FCC public safety limits.

Today, corporations that deal with educational technology should be looking forward and helping school administrators and municipal leaders to access safe, wired solutions. Your corporations can reasonably foresee and offer alternatives to potentially hazardous exposures to wireless radiation by choosing to support wired educational technologies.

Thank you for your attention to this letter.

Cindy Sage, MA, Tel: (805) 969-0557 Email: sage@silcom.com
David O. Carpenter, MD, Tel: 518-525-2660 Email: dcarpenter@albany.edu
Co-Editors, BioInitiative 2012 Report
For the BioInitiative Working Group

Copies: CEOs signing Education Superhighway letter to the FCC
Federal Communications Commission
The White House, President Obama
US Secretary of Education Secretary Arne Duncan

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May 13, 2013

Open Letter to the Superintendents
of the School Districts of the United States

The American Academy of Environmental Medicine (AAEM) strongly supports the use of wired Internet connections.

The AAEM comprises Medical Doctors, Osteopaths, and PhD researchers focusing on the effects of environmental agents on human health. For forty years the Academy has trained Physicians to treat the most difficult patients who are often overlooked by our medical system, because the cause of their illness, rather than being caused by an infection or traditionally understood cause, is related to more basic underlying causes such as chemical, toxic metal, food or radiation exposures.

In May 2011 the World Health Organization elevated exposure to wireless radiation, including WiFi, into the Class 2b list of Carcinogens.

There is consistent emerging science that shows people, especially children who are more vulnerable due to developing brains, and thinner skulls, are affected by the increasing exposure to wireless radiation. In September 2010, the Journal of the American Society for Reproductive Medicine-Fertility and Sterility, reported that only four hours of exposure to a standard laptop using WiFi caused DNA damage to human sperm.

In December 2012 the American Academy of Pediatrics- representing 60,000 pediatricians, wrote to Congress requesting it update the safety levels of microwave radiation exposure especially for children and pregnant women.

In a school setting, children are exposed to WiFi for an unprecedented period of time, for their entire childhood. Some of these signals will be much more powerful than is received at home, due to the need for the signals to go through walls, and serve multiple computers simultaneously. The school signals are dozens of times more powerful than the café and restaurant systems.

To install this system in your school district risks a widespread public health hazard that the medical system is not yet prepared to address. Statistics show that you can expect to see an immediate reaction in 3% and delayed effects in 30%, including teachers.

It is better to exercise caution and substitute with a safe alternate such as a wired connection, which is not classified as a possible Carcinogen. While more research is being conducted children must be protected. Wired technology is not only safer, it also stronger and more secure.

While the debate ensues about the dangers of WiFi, cell phone towers and cell phones, it is the doctors who must deal with the after affects. Until we can determine why some get sick and others do not, and some are debilitated for indeterminate amounts of time, we implore you to not take the risk, with the health of so many children who have entrusted you to keep them safe while at school.

Respectfully,

The Executive Committee of the American Academy of Environmental Medicine

Message to Schools and Colleges about Wireless Devices and Health

If wireless devices, such as Wi-Fi, are used in your schools and colleges, then the health of your students, your faculty, and your staff can be at risk. This is a difficult problem but an addressable one if you act.

Background: Wireless devices transmit information using radiofrequency/microwave radiation. The international biomedical research community has been studying the biological impact of such radiation for decades, but more intensely in recent years. Thousands of peer-reviewed studies published in biomedical research journals have contributed to our understanding of this impact. So many serious biological effects have been found that immediate responsive action is warranted. Further, these biological effects are occurring at levels of radiation far lower than earlier understood. Simply stated, a worldwide health crisis is emerging and is becoming a hallmark of the 21st Century. The international biomedical research community is trying to warn us; but we, in the USA, are not yet listening. I hope this message will help to change that.

As a scientist, I urge you to look into the **health impact of the radiofrequency/microwave radiation** produced by wireless devices. Examples of wireless devices of concern in our environment are Wi-Fi in all of its forms; cell phones and cell towers (especially those located on school grounds); cordless phones; wireless computers, whether desktop, laptop, or tablet versions; wireless baby monitors; wireless smart electricity meters; emerging wireless smart appliances; and microwave ovens (because they always leak radiation).

This crisis is the consequence of many factors. Here are some of them:

- All living things are bioelectrical in nature. That is why electrocardiograms and electroencephalograms work. They, of course, measure the tiny electrical signals that operate the heart and the brain. The critical tasks performed by these tiny electrical signals, and so many other electrical signals in all living things, can be disrupted by radiofrequency/microwave radiation.

- The levels of manmade radiofrequency/microwave radiation in our environment are increasing exponentially and already exceed, by many orders of magnitude, the levels at which all life on Earth evolved. Simply stated, we are drowning in a rising sea of manmade radiofrequency/microwave radiation.

- The invisible nature of radiofrequency/microwave radiation leaves the public and the decision-makers unaware of the rising levels of radiation around them.

- The genuine usefulness of wireless devices promotes denial of the risks.

- The intense advertising, the economic power, and the political power of profitable wireless industries enable them to dominate the public dialogue and to hold sway over government regulators and legislators.

- Current Federal standards for limiting the exposure of the public to radiofrequency/microwave radiation are outdated and overly permissive. Those standards are based on thermal heating alone. In effect, the Government claims that if you are not cooked too much by the radiation, then you are fine. Those Federal standards ignore the many biological effects that occur at much lower levels of radiation, leaving the public unprotected.

- Federal and state governments are advocating unlimited expansion of wireless technology, and are even co-funding such expansion and mandating the acceptance of wireless technology by the public. Such

actions reflect a widespread lack of understanding of, or willful blindness to, the underlying science and its consequences for public health.

- Some of the more serious consequences of exposure to radiofrequency/microwave radiation (such as DNA damage, cancer, and infertility) are especially nefarious because they give no early warning signs.

- Other consequences of exposure do give early warning signs (such as sleep disruption, headaches, fatigue, ringing in the ears, memory loss, dizziness, heart arrhythmia, and many others); but those signs are too often dismissed because they can have other causes as well, complicating identification of the true cause.

- The absence of routine training of physicians in the biological effects of radiofrequency/microwave radiation makes it difficult for physicians to identify the causes and to provide responsive guidance.

- Even aware individuals cannot control their exposure in any environment shared with others, because the radiation around them, much like second-hand smoke, is forced on them by unaware individuals. Only governments can fully solve this problem, but they are currently part of the problem. For now the public will have to protect itself, and that will require public education and action.

Fortunately, many of the services that wireless devices offer can be realized with much safer wired devices. The wired devices achieve connectivity with fiber-optic, coaxial, or Ethernet cables. The wired devices are faster, more reliable, and more cyber secure. They are, however, less mobile, often less convenient, and somewhat more expensive to install. But those drawbacks pale in comparison to the benefits of good health.

Simply stated, schools and colleges can protect their students, staff, and faculty from the health risks posed by wireless devices, including Wi-Fi, by converting to safe wired connectivity. If your institution lacks the resources to convert now, do consider shutting down your wireless devices anyway and converting as soon as you can. You can advance learning without leaving a trail of illness behind you, some of which can be lifelong.

As a suggested starting place for exploring the concerns about the radiation from wireless devices, I have appended an “Annotated List of References” and an “Annotated List of Videos”. Please view, especially, video (1) called “Wi-Fi in Schools, the Facts”, made in Australia, on page 6.

Regards,

Ronald M. Powell, Ph.D.
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My background

I am a retired U.S. Government scientist (Ph.D., Applied Physics, Harvard University, 1975). During my Government career, I worked for the Executive Office of the President, the National Science Foundation, and the National Institute of Standards and Technology. For those organizations, respectively, I addressed Federal research and development program evaluation, energy policy research, and measurement development in support of the electronics and electrical-equipment industries and the biomedical research community. I currently interact with other scientists and with physicians around the world on the impact of the environment – including the radiofrequency/microwave environment – on human health.

ANNOTATED LIST OF REFERENCES

The international biomedical research community has conducted thousands of studies seeking to identify the biological effects of exposure to both low frequency and radiofrequency electromagnetic fields, extending into the microwave region. So many serious biological effects have been found from such fields, at levels earlier thought to be low enough to be safe, that immediate action is needed to alert and protect the public.

The most massive review of this biomedical literature is the 1479-page BioInitiative 2012 Report which considered about ***1800*** biomedical research publications, most issued in the previous five years. The BioInitiative 2012 Report was prepared by an international body of 29 experts, heavy in Ph.D.s and M.D.s, from 10 countries, including the USA which contributed the most experts (10). The review concludes that "The continued rollout of wireless technologies and devices puts global public health at risk from unrestricted wireless commerce unless new, and far lower*[,]* exposure limits and strong precautionary warnings for their use are implemented."

> BioInitiative Working Group, Cindy Sage, M.A. and David O. Carpenter, M.D., Editors, BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation, December 31, 2012
> http://www.bioinitiative.org

A group of six doctors in Oregon, led by Paul Dart, M.D., released, in June 2013, a 74-page review of ***279*** biomedical research publications. This review makes the health case against "cell phones, base stations, Wi-Fi, Smart Meters and other RF *[radiofrequency]* or ELF *[extremely low frequency]* -emitting devices". The review notes that "The current levels of exposure need to be reduced rather than increased further. The FCC *[Federal Communications Commission]* must especially protect vulnerable groups in the population including children and teenagers, pregnant women, men of reproductive age, individuals with compromised immune systems, seniors, and workers." This review is posted on the website of the FCC at the link entitled "Health Effects of RF - Research Review (87)".

> Biological and Health Effects of Microwave Radio Frequency Transmissions, A Review of the Research Literature, A Report to the Staff and Directors of the Eugene Water and Electric Board, June 4, 2013
> http://apps.fcc.gov/ecfs/comment/view?id=6017465430

Michael Bevington, in 2013, published a book that summarizes the findings of ***1828*** international biomedical research publications. The book describes the symptoms caused by exposure to electromagnetic radiation, the many diseases associated with such exposure, and the relative risk levels associated with specific sources of electromagnetic radiation. The citations of papers include the PMID index numbers for easy location on the PubMed.gov website of the National Institutes of Health. This website provides the largest index to the biomedical research literature in the world.

> Electromagnetic Sensitivity and Electromagnetic Hypersensitivity: A Summary by Michael Bevington
> NEW EDITION: March 2013
> http://www.es-uk.info

About 200 scientists from 39 countries around the world submitted an international appeal to the United Nations and to the World Health Organization in May 2015. These scientists seek improved protection of the public from harm from the radiation produced by many wireless sources, including "cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors" among others.

Together, these scientists have published over 2000 peer-reviewed research papers on this subject.

https://www.emfscientist.org/index.php/emf-scientist-appeal

The International Agency for Research on Cancer, of the World Health Organization, has already classified radiofrequency electromagnetic fields as a Class 2B carcinogen ("possible carcinogen"), based primarily on the increased risk of brain cancer. That decision was made in 2011. Since then, the research supporting a higher classification of risk ("probable carcinogen", or even "known carcinogen") has continued to build.

http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

The American Academy of Environmental Medicine (AAEM), which trains physicians in preparation for Board Certification in Environmental Medicine, states: "The AAEM strongly supports the use of wired Internet connections, and encourages avoidance of radiofrequency such as from WiFi, cellular and mobile phones and towers, and 'smart meters'." AAEM further states that "The peer reviewed, scientific literature demonstrates the correlation between RF *[radiofrequency]* exposure and neurological, cardiac, and pulmonary disease as well as reproductive and developmental disorders, immune dysfunction, cancer and other health conditions. The evidence is irrefutable." The AAEM concludes: "To install WiFi in schools plus public spaces risks a widespread public health hazard that the medical system is not yet prepared to address."

AAEM, Wireless Radiofrequency Radiation in Schools, November 14, 2013
http://www.aaemonline.org/pdf/WiredSchools.pdf

The American Academy of Pediatrics (AAP), whose 60,000 doctors care for our children, supports the development of more restrictive standards for radiofrequency radiation exposure that would better protect the public, particularly the children. The AAP, in a letter to the Federal Communications Commission (FCC) and the Food and Drug Administration (FDA), dated August 29, 2013, states that "Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes."

http://apps.fcc.gov/ecfs/document/view?id=7520941318

The U.S. Government bears a major responsibility for the exponential growth in the levels of radiation from wireless devices in the environment. In 1996, the U.S. Congress passed, and the President signed, the Telecommunications Act of 1996. Under pressure from the cell phone industries, this law included this provision: "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities *[cell towers]* on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the *[Federal Communications]* Commission's regulations concerning such emissions." Because the Federal Communications Commission's regulations on radiation exposure are so permissive, this provision prevents state and local governments from protecting their people from radiation from cell towers, based on health concerns.

Telecommunications Act of 1996
https://transition.fcc.gov/Reports/tcom1996.pdf

The Federal Communications Commission (FCC) has acted in partnership with the wireless industries by permitting wireless radiation levels far higher than the biomedical research literature indicates are necessary to protect human health. The success of the wireless industries in capturing the FCC, the committees in the U.S. Congress that oversee the FCC, and the Executive Branch is detailed in a new monograph from the Center for Ethics at Harvard University. As an example of that capture, the President recently appointed, as head of the FCC, the former head of the CTIA – The Wireless Association, which is the major lobbying organization for the wireless industry. This, of course, is the infamous "revolving door".

> Norm Alster, Captured Agency: How the Federal Communications Commission is Dominated by the Industries It Presumably Regulates (2015)
> http://ethics.harvard.edu/news/new-e-books-edmond-j-safra-research-lab

Further, the U.S. Government's "American Recovery and Investment Act of 2009" provided funding that was used to motivate the installation of wireless smart meters (also called the "Advanced Metering Infrastructure" or "AMI") by offering cost sharing, in the form of grants, to the utilities that would adopt such meters.

> https://www.smartgrid.gov/recovery_act/overview/smart_grid_investment_grant_program.html

Many states then extended the impact of the above Act by *mandating* the acceptance of wireless smart meters by the public. These meters contain microwave transmitters/receivers and are placed either on, or inside, every home and many businesses. A California court-ordered document indicates that each smart meter broadcasts bursts of radiation, on average about 10,000 times per day and up to a maximum of about 190,000 times per day. Such bursts flood neighborhoods with radiation, day and night, throughout the year.

> http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3pm.pdf

Increasingly, the public is becoming aware of the threat that wireless radiation poses to health. The initial opposition focuses primarily on *mandated* sources of exposure, especially when the individuals exposed include the unborn and young children as they are among the most vulnerable. Thus, the strongest initial opposition is surfacing for cell towers, especially on school grounds; for Wi-Fi in schools and colleges; and for wireless smart meters placed on, or inside, homes and businesses. Most states now have opposition groups, and some states have even 10 or 20 such groups. These groups are pursuing relief through state regulatory bodies, through state legislatures, and through the courts. Below is a sampling of the hundreds of U.S. websites that reflect the nature and scope of the opposition to the unbridled expansion of wireless technology. Such websites seek to educate the public and decision-makers, and thus to promote responsive action, based on the underlying science.

> The BabySafe Project
> http://www.babysafeproject.org/the-science/
>
> National Association for Children and Safe Technology
> http://www.nacst.org/
>
> Stop Smart Meter's listing of groups in the USA and other countries opposed to wireless smart meters
> http://stopsmartmeters.org/frequently-asked-questions/contacts-database/
>
> Smart Grid Awareness, a Website by SkyVision Solutions, Consumer Protection Advocate
> http://smartgridawareness.org

ANNOTATED LIST OF VIDEOS

There are hundreds of videos on the Internet that address the impact of wireless radiation on health. Here are just a few that provide an especially good introduction to this topic. An Internet search will surface many more.

(1) An introduction to the health risks posed by Wi-Fi in schools

Wi-Fi in Schools, the Facts (September 9, 2013) (18 minutes)
Produced by Wi-Fi in Schools Australia.
https://www.youtube.com/watch?v=QQryZbxlqXI&feature=youtu.be

(2) Wide ranging overview of the impact of electromagnetic radiation on human health, particularly at microwave frequencies, with a special emphasis on children and the school environment

Electromagnetic Radiation Health for Children 2014 (70 minutes)
Presented by Dr. Erica Mallery-Blythe, a UK physician.
https://www.youtube.com/watch?v=sNFdZVeXw7M

(3) Documentary on the wireless industry's efforts to suppress public awareness of the health effects of wireless radiation

Microwaves, Science & Lies (2014) (90 minutes)
Produced by Jean Heches and Nancy de Meritens of France.
https://vimeo.com/ondemand/17755/89417454

(4) Samples of video testimony by individuals harmed by the radiation from wireless devices

Cell Phones Cause Cancer (October 17, 2012) (9 minutes)
Presented by Jimmy Gonzalez, Esq.
https://www.youtube.com/watch?v=DIlOVJd0lA8

Woman suffers acute radiation exposure from a bank of smart meters (January 21, 2015) (3 minutes).
Produced by Maryland Smart Meter Awareness.
https://www.youtube.com/watch?v=F9QZuWPw6Y0&feature=youtu.be

Man experiences adverse health effects from exposure to a smart meter (March 7, 2013) (3 minutes).
Presented by Garic Schoen of Gaithersburg, MD.
Produced by Maryland Smart Meter Awareness.
http://marylandsmartmeterawareness.org/smart-meter-news/maryland-ms-resident-testimony-to-economic-matters-committee-re-hb1038-on-march-14-2013/

Individuals with high sensitivity to the radiation from wireless devices search for increasingly rare safe electromagnetic environments.
Searching for a Golden Cage (May 8, 2014) (13 minutes)
Produced by Nadav Neuhaus.
http://time.com/golden-cage/

IDEA

IRISH DOCTORS' ENVIRONMENTAL ASSOCIATION
CUMANN COMHSHAOIL DHOCTÚIRÍ NA HEIREANN

7th January, 2013

Dear Principal,

The Irish Doctors Environmental Association (IDEA) has very serious concerns in relation to the ubiquitous use of Wi-Fi in Irish schools, and alerts you to the warnings of many leading international scientists and medical doctors who believe Wi-Fi is harmful to health, especially children's health.
http://wifiinschools.org.uk/resources/safeschools2012.pdf
Wi-Fi is an unregulated technology and there is absolutely no evidence that it is safe.

Since May 31st, 2011, radiofrequency electromagnetic fields (as in Wi-Fi) have been classified by the World Health Organisation as 'possibly carcinogenic' to humans. The IDEA unequivocally supports the Council of Europe, The European Environmental Agency and The International Commission for Electromagnetic Safety (ICEMS) in urging the adoption of the Precautionary Principle to protect human health.
Warnings by Scientists and Doctors:
http://www.iemfa.org/index.php/appeals

The Precautionary Principal has already been adopted by a number of Governments and agencies internationally.
Governments & organisations banning and warning against Wi-Fi:
http://www.cellphonetaskforce.org/?page_id128

While we fully support the promotion of technology in education we urge you to use wired technologies for your own safety and that of your pupils and staff. The tragedy of avoidable illness is only superseded by the knowledge that it could have been avoided.

Yours sincerely

Elizabeth Cullen M.B. B.Ch. B.A.O. M.Sc. Ph. D 045-485215

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April 9, 2014

Via email: rec@harlanglaw.dk

Dear members of The Committee on Radiation Protection/Komitéen for Strålebeskyttelse:

My name is Frank Clegg and I am the CEO of Canadians for Safe Technology, C4ST, a volunteer based, national organization which promotes the safe use of wireless technology.

In my previous role as President of Microsoft Canada, I witnessed the incredible benefits that technology can provide. I also witnessed the potential harmful effects if technology is not implemented safely. Though wireless technologies afford schools various advantages, this solution cannot overshadow the evidence which demonstrates cause for concern. I request that you consider the following important facts.

The Canadian Teachers' Federation (CTF) is a national alliance of provincial and territorial teacher organizations that represent nearly 200,000 elementary and secondary school teachers across Canada. In their submission to the public consultation of the Royal Society of Canada, Oct. 28, 2013, they submitted the following recommendations. (Safety Code 6 is Health Canada's guideline regarding the limits of radiation from wireless devices).
Recommendations...
... That Safety Code 6 include a recommendation for prudent use of Wi-Fi whenever possible including the recommendation to limit consistent exposure in schools by turning off wireless access points when not in use. ...
That Safety Code 6 exposure thresholds be based upon both thermal and biological effects of exposure to Wi-Fi.
... That the Expert Panel recommend an education program regarding the relative safety of Wi-Fi exposure and that appropriate resources be developed to educate the public regarding ways to avoid potential exposure risks of Wi-Fi access points and devices.

As reported by CBC News on Aug. 17, 2013, http://www.cbc.ca/news/canada/toronto/story/2013/08/17/toronto-cell-phone-ban.html "The Elementary Teachers' Federation of Ontario has updated its policy position on the student use of personal electronic devices, preferring for them to be turned off and put away unless a teacher says otherwise. That policy, which was amended at the union's annual general meeting, informs ETFO in its discussions with the government and school boards on related issues. A portion of that policy now states that such devices, which include cellphones, should "be stored and turned off during the instructional day unless their use is directly authorized by staff." In a separate resolution, ETFO voted to study the effects of non-ionizing electromagnetic radiation, the potentially harmful radiation emitted by cellphones. A report is due on the matter in February."

In a letter to the Peel Region, April 22, 2013, The American Academy of Environmental Medicine stated "To install this widespread wireless internet access system in Peel District schools risks a widespread public health hazard that the medical system is not yet prepared to address. Statistics show that you can expect to see an immediate reaction in 3% and delayed effects in 30%, including teachers."

In 2012, the BC Confederation of Parent Advisory Councils passed resolution 18 which states: "BCCPAC call on Boards of Education to cease to install Wi-Fi and other wireless networks in schools where other networking technology is feasible." http://www.bccpac.bc.ca/resolutions/wi-fi-classrooms-committee-report

In May 2011, the World Health Organization (WHO) announced that the radiation emitted from wireless devices, including Wi-Fi, is a Class 2B carcinogen, which falls into the same category as lead and DDT.

You may already be aware that some schools and libraries in France and Switzerland have already removed Wi-Fi due to the suspected harmful health effects.

The Council of Europe, which includes 47 countries, adopted resolution 1815 which suggests in member countries "give preference to wired Internet connections, and strictly regulate(s) the use of mobile phones by schoolchildren on school premises."

The European Parliament (EU) resolutions 2008/2211(INI) & 2007/2252(INI,) state: "wireless technology (mobile phones, Wi-Fi / WiMAX, Bluetooth, DECT landline telephones) emits EMFs that may have adverse effects on human health... particularly to young people whose brains are still developing... **the limits on exposure to electromagnetic fields which have been set for the general public are obsolete."** (emphasis in original)

Other countries such as Israel, Russia, Switzerland, Frankfurt, Bavaria, and Salzburg have followed suit making the difficult decision to use hard wired connections as well. Recently, France passed a law recommending hard wired technology in schools.

The Austrian Medical Chamber shares that “WiFi may lead to concentration difficulties and memory problems in certain individuals.” The Austrian Medical Association recommends Wi-Fi free school environments.

The International Society of Doctors for the Environment (ISDE) and Irish Doctors Environmental Association (IDEA) advises to “Avoid Wi-Fi in home or work if possible, particularly in schools or hospitals. Use wired technology whenever possible” sharing that: “Because of the potentially increased risks for the fetus, infants and young children due to their thinner more permeable skulls and developing systems, particularly the immune and neurological systems, based on the precautionary principal and on the mounting evidence for harm at the sub-cellular level, we recommend that EMR exposure should be kept to a minimum.”

The American Academy of Pediatrics (AAP) - 60,000 Pediatricians and Pediatric Surgeons calls for caution as well stating that "The differences in bone density and the amount of fluid in a child’s brain compared to an adult’s brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults... the current exposure limits may not reflect the latest research on RF energy" and lends support to removing Wi-Fi from schools as well.

As stewards of the public trust, I urge you to ensure the safest possible learning environment for the students in your care and to set an example for school districts by removing Wi-Fi and adopting “Best Practices” which limit the use of other wireless technologies.

Sincerely,

Frank Clegg
CEO,
Canadians for Safe Technology (C4ST)
frank@c4st.org

cc: Susanne Hansen, sh.klodskov@gmail.com

UNIVERSITY AT ALBANY
State University of New York
Institute for Health and the Environment
and
Department of Environmental Health Sciences
School of Public Health

28 February 2011

Chairman and Trustees
Kawartha Pine Ridge District School Board
Education Centre
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Dear Sirs/Madams:

This is concerning potential adverse health effects associated with exposure to radiofrequency (RF) radiation, specifically that from wireless routers. I am a public health physician who has been involved in issues related to electromagnetic fields (EMFs) for a number of years. I served as the Executive Secretary for the New York Powerline Project in the 1980s, a program of research which showed that children living in homes with elevated magnetic fields coming from powerlines suffered from an elevated risk of developing leukemia. I have edited two books on effects of EMFs, including RF radiation. I served as the co-editor of the Bioinitiative Report (www.bioinitiative.org), a comprehensive review of the literature on this subject. The public health chapter from this report was subsequently published in a peer reviewed journal, and that is attached. Also I testified before the President's Cancer Panel on this subject in 2009, and a publication coming from that testimony is also attached. Thus this is a subject which I know well, and one on which I take a public health approach that has as a fundamental principle the need to protect against risk of disease even when one does not have all the information that would be desirable.

There is clear and strong evidence that intensive use of cell phones increases the risk of brain cancer, tumors of the auditory nerve and cancer of the parotid gland, the salivary gland in the cheek by the ear. The evidence for this conclusion is detailed in the attached publications. WiFi uses similar radiofrequency radiation (1.8 to 5.0 GHz), although the intensity of exposure in the immediate environment is much lower than what one gets from holding a cell phone close to your head. The difference between a cell phone and a WiFi environment, however, is that while the cell phone is used only intermittently a WiFi environment is continuous. In addition WiFi transmitters are indoors, where people (and in this case, children) may be very close to them. There is evidence from Scandinavian studies of cell phone usage that children who use cell phones are about five times more likely to develop brain cancer than if use starts as an adult. Thus it is especially important to protect children.

To my knowledge there has not been any health investigation of individuals living or working in WiFi environments as compared to others who are not. However, because the radiation is the same as those for cell phones, there is every reason to assume that the health effects would be the same, varying only in relation to the total dose of radiation. Wired facilities do not generate any RF radiation. While there is not specific proof that WiFi increases risk of cancer, there is certainly no evidence that it is safe. I urge you to not put WiFi in any school. Children should not be put at increased risk of developing cancer.

Yours sincerely,

David O Carpenter

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13th December 2015

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1. Regarding: Measurements related problems in the MCPS Wi-Fi Report

We have analysed the measurement report and would like to note the following:

- In the **Comparison-table 2.2.** the MCPS provides only average values, no peak values. In cell phone technologies (like GSM) the difference between average and peak value is 2-fold. **In Wireless local area technologies like Wi-Fi, the difference between average value and peak value is up to 100-fold** (Ferro & Potorti, 2005). Note that in the table 2.2. by the MCPS only average values are presented. Later you provide **in the chapter 7.2.2 Maximum, Instantaneous Power Density**, **which needs attention since these levels occasionally exceeded in your school measurements allowable EMC-levels (EN60601-1 → 3 V/m) for medical instruments** (Robinson *et al*., 2003).

- **Almost all MCPS measurements were done in the near field of the devices under 3 wavelengths.** The wavelength for 2,4 GHz is 12,5 cm and for 5 GHz is 6 cm. That means that the near field will be <37,5 cm for 2,4 GHz and <18 cm for 5 GHz. In order to assess power density exposure in near field one needs to measure both electric and magnetic field components.

- The MCPS has not provided **information about Wi-Fi technology, namely it's beacon signal**. This signal, officially **SSID (Service Set IDentifier), is created by the access point (AP) by sending constantly SSID 10 times in a second , at 10 Hz** (Ferro and Poporti, 2005). **Mobile industry has patented technology to avoid this constant SSID sending for health reasons** (Swisscom, 2004). This SSID sending at 10 Hz is an additional risk-factor and it should be mentioned. Our brain operates in alpha, beta and gamma bands. This Wi-Fi beacon overlaps the alpha band. Low-frequency EMFs (including low-frequency pulses) have an effect on evoked potentials of the brain (Carrubba *et al*., 2008).

- **Because of the risk of this 10 Hz Beacon signal of Wi-Fi, The European Academy for Environmental Medicine has assigned very strict precautionary RF-levels for Wi-Fi** (Belyaev et al., 2015). Please, pay attention to Wi-Fi RF power density peak-levels in the next picture.

RF source Max Peak/Peak Hold	Daytime exposure	Nighttime exposure	Sensitive populations[1)]
Radio broadcast (FM)	10,000 µW/m²	1000 µW/m²	100 µW/m²
TETRA	1000 µW/m²	100 µW/m²	10 µW/m²
DVBT	1000 µW/m²	100 µW/m²	10 µW/m²
GSM (2G) 900/1800 MHz	100 µW/m²	10 µW/m²	1 µW/m²
DECT (cordless phone)	100 µW/m²	10 µW/m²	1 µW/m²
UMTS (3G)	100 µW/m²	10 µW/m²	1 µW/m²
LTE (4G)	100 µW/m²	10 µW/m²	1 µW/m²
GPRS (2.5G) with PTCCH* (8.33 Hz pulsing)	10 µW/m²	1 µW/m²	0.1 µW/m²
DAB+ (10.4 Hz pulsing)	10 µW/m²	1 µW/m²	0.1 µW/m²
Wi-Fi 2.4/5.6 GHz (10 Hz pulsing)	10 µW/m²	1 µW/m²	0.1 µW/m²

Picture. Precautionary levels for RF-radiation. **For Wi-Fi less than 10 μW/m² (peak value), which is 0,001 μW/cm² (peak value).** By the **European Academy for Environmental Medicine** (Belyaev *et al*., 2015, p. 356)

- **We would like to draw attention to** long-term exposure related health risks.

Radiofrequency radiation from Wi-Fi devices causes fertility problems as shown by several in vivo and in vitro studies (see for example Atasoy *et al*., 2013, Avendaño *et al*,. 2012, Dasdag *et al*., 2015a, Shokri *et al*., 2015).

Additionally, **RF-radiation from Wi-Fi access points (AP) causes oxidative stress in cells which leads to several disorders** (see for example Nazıroğlu *et al*., 2012, Aynali *et al*., 2013, Salah *et al*., 2013). The overall detrimental impact of RF radiation induced oxidative stress is summarised in the review of Yakymenko *et al*. (2015).

2. Regarding: The IARC classification of RF-EMF as Group 2B, i.e., 'possibly' carcinogenic to humans and the MCPS Report's inaccurate interpretation

The classification of radiofrequency electromagnetic fields (RF-EMF) as Group 2B, i.e., 'possibly' carcinogenic to humans,was made by 30 scientists from 14 countries at a meeting 2011 for the International Agency for Research on Cancer (IARC), World Health Organization (IARC 2011, Baan et al. 2012). **The working group mainly based their classification on one cohort study** (Schüz et al., 2006) **and five case-control studies** (Muscat et al., 2000, Inskip et al., 2001, Auvinen et al.,2002, The Interphone study group, 2010, Hardell et al., 2011).

They also reviewed more than 40 studies that assessed the carcinogenicity of RF-EMF in rodents, including seven 2-year cancer bioassays and also many studies with endpoints relevant to mechanisms of carcinogenesis, including genotoxicity, effects on immune function, gene and protein expression, cell signaling, oxidative stress, and apoptosis (Baan et al., 2011).

The referred INTERPHONE study (The Interphone study group, 2010), in the MCPS radiation report, was one of the case-control studies. **The Interphone study was a multicentre study of mobile phone use and brain tumours, including malignant tumours in the brain as glioma and benign tumours as acoustic neuroma and meningioma**. The pooled analysis included 2708 glioma cases and 2972 controls (participation rates 64% and 53%, respectively). In the Interphone study a regular user of mobile phones had an average of at least one call per week for a period of ≥6 months. **This very low user group was compared to several other groups of low users compared to nowadays more extensive use of mobile phones.** The highest group of users, ≥1640 hours was divided in three sub groups depending on how many years they had used a mobile phone. For the shortest time span on 1-4 years only 23 of the glioma cases and 8 of the controls had used their mobile phones for more than 1640 hours. If any of these 23 persons with a brain cancer or any of the 8 controls had used their mobile phones for only one year they would have used it at least in average for four and a half hours a day during a year. If they instead had talked in their mobile phones during four years it would be for an average of a little more than an hour a day.
For the group of users between 5 and 9 years, 84 cases and 73 controls, the use per day would be at least between 54 minutes and 30 minutes. **For the long user group of 10 years or more, 93 cases and 73 controls, they talked in their mobile phones for 27 minutes a day or less for more than 10 years of use.**
For the main part of cases their use of mobile phones had been for a lot less than four hours a day. Today when most people use only their mobile phone and landline phones both at home and at work are becoming scarce, an amount of 4 hours or more wireless telephone use / day for salesman, telephone operators and so on is not uncommon.
In the Interphone study there was an statistical significant increased risk for a malignant brain tumour of 1.4 times (odds ratio, OR, 1.4, 95% CI 1.03-1.89) only for the highest user group of a total on more than 1640 hours.
Hardell et al. (2011) in Sweden found that **cases who had used a mobile phone for more than 1 year had an increased risk for glioma of 1.3** (OR 1.3, 95% Cl 1.1-1.6).

The **risk increased with increasing time since first use and with total call time, reaching 3.2 times** (OR 3,2, Cl 2.0-5.1) **for more than 2000 hours of use**. Use of the mobile phone on the same side of the head as the tumour was associated with higher risk.

Since 2011 several other studies have been published which are strengthening the possible association between RF-EMF and cancer. Using the **Bradford Hill viewpoints for evaluating strengths of evidence of the risk for brain tumours associated with use of mobile and cordless phones the classification should be upgraded to group 1 carcinogen, i.e., "the agent is carcinogenic to humans"** (Hardell & Carlberg, 2013).

New case-control studies have verified Hardell's studies (Coureau et al., 2014) and up to 20 years of mobile phone use have found even higher risk for brain tumours (Hardell & Carlberg, 2015).

A newly published study has found a tumor promotion effect on mice from exposure to radiofrequency electromagnetic fields below exposure limits for humans (Lerchl *et al*., 2015). RF-EMFs do not cause direct DNA damage. On the contrary **numerous studies have shown generation of reactive oxygen species (ROS) that can cause oxidative damage of DNA. This is a well-known mechanism in carcinogenesis for many agents.** The broad biological potential of ROS and other free radicals makes radiofrequency radiation a potentially hazardous factor for human health, not only cancer risk but also other health effects (Yakymenko *et al*., 2015).

The IARC classification of RF-EMF as Group 2B, possibly carcinogenic to humans, doesn't only include exposure from mobile phones near the ear. **The classification includes all sources of RF-EMFs.** The exposure from mobile phone base stations, Wi-Fi access points, smart phones, laptops and tablets can be long term, sometimes around the clock both at home and at school. **This constant exposure to lower levels of exposure may be as deleterious to health as higher exposure during short time** (Fragopoulou et al., 2012, Dasdag et al., 2015b). This **risk may be accentuated for children because their probable longer use of wireless devices** (Morgan et al., 2014). **Children are also growing and have more immature cells which can be more sensible to RF-EMF** (Markova et al., 2010)

In conclusion, long term health effects from RF EMFs are still under investigation and a significant amount of troublesome scientific evidence has surfaced. By using wireless technologies at close range, long term health risks cannot be excluded. Therefore, we recommend schools to use wired technologies.

Respectfully submitted

Sincerely,

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24 March 2014

Open letter by British medical doctors: Health and safety of Wi-Fi and mobile phones

We wish to highlight our concern over the safety of exposure to microwave radiation from wireless technology, particularly for vulnerable groups like children, pregnant women, the elderly and those with compromised health.

There is growing concern that chronic (long-term) exposure to radiofrequency/microwave radiation from wireless technologies causes damage, particularly genetic damage, cognitive damage, cancer and decreased fertility. There is now substantial evidence of a link between mobile phone use and brain cancer. This was recognised by the International Agency for Research on Cancer (IARC)'s 30-strong panel of scientists, which in 2011 classed radiofrequency radiation as "possibly carcinogenic".

Additionally, doctors are encountering a significant and growing number of people presenting with **a range of acute (short-term) symptoms from wireless radiation, including headaches, palpitations, rashes, fatigue, sleep disturbance, allergies and memory and concentration problems.**

International medical agencies have recognised the evidence of harm (see appended list) but these rulings may take many years to be reflected in public health policy. This controversy is a common characteristic of scientific understanding when environmental exposures are new.

New technologies and substances often come with scientific conflict, which can continue for several decades before consensus is achieved. Commercial pressures often delay the acceptance of health risks, even when scientific evidence is compelling. In the case of tobacco, asbestos, x-rays and leaded petrol, for example, it took many decades before damage was established and accepted by health agencies and, during those decades, millions of people suffered ill health and death as a result of the delay. Now, despite evidence of harm, wireless technology is being rolled out widely.

We urge health agencies and the public to act immediately to reduce exposure to radiofrequency/ microwave radiation. This is especially important for children, who are physiologically more vulnerable to this exposure, and for whom adults have a safeguarding responsibility. **Children's health should be put ahead of convenience and commercial benefits. Children should not use mobile phones except in an emergency, and WiFi should be replaced with wired alternatives in schools and other settings where children spend considerable time.**

Yours faithfully,

Dr Elizabeth Evans MA (Cantab), MBBS (Lond), DRCOG – Medical Doctor
Dr Andrew Tresidder MRCGP (1989), MBBS (Lond) – Medical Doctor
Dr Erica Mallery Blythe BM - Medical Doctor
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Dr Joan Kinder MA, MBBChir(Cantab), MRCPCH – retired Consultant Paediatrician
Dr Sarah Myhill MBBS – General Practitioner (GP)
Dr Dee Marshall MBBS, MFHom – Medical Doctor
Dr Charles Forsyth MBBS, FFHom – Medical Doctor
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Appendix – International Rulings

1. In 2011 the **World Health Organization's scientific panel, the International Agency for Research on Cancer (IARC),** reviewed all the evidence on carcinogenesis (cancer-causing) and categorised electromagnetic radiation from mobile phones and Wi-Fi as **Possibly Carcinogenic (Class 2B).**

See http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

2. **The Council of Europe has called for member states to take measures to reduce exposure to electromagnetic fields and give preference to wired internet connections for children, particularly in schools and classrooms.**

The Parliamentary Assembly stated that "the Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco."

See http://assembly.coe.int/mainf.asp?link=/documents/adoptedtext/ta11/eres1815.htm

3. **The BioInitiative Report**, updated in 2012 by 29 scientists, states that **biological effects are clearly established and occur at very low levels of exposure to electromagnetic fields and radiofrequency radiation** from just minutes of exposure to mobile phone masts (cell towers), WI-FI, and wireless utility 'smart' meters.

See http://www.bioinitiative.org/conclusions

4. **The American Academy of Environmental Medicine** stated in a 2012 Position Paper that "**Multiple studies correlate RF exposure with diseases such as cancer, neurological disease, reproductive disorders, immune dysfunction, and electromagnetic hypersensitivity."**

See http://aaemonline.org/emf_rf_position.html

6. **International Society of Doctors for the environment (ISDE) and Irish Doctors' Environmental Association (IDEA)** state that "**there is sufficient scientific evidence to warrant more stringent controls** on the level and distribution of electromagnetic radiation [EMR]. The joint statement and recommendations are part of a call by medical and scientific experts for safe technologies in schools."

See http://www.env-health.org/news/members-news/article/isde-idea-statement-on

5. The Safe Schools Report 2012 lists statements by **other doctors and medical associations** raising concerns over children's exposure to electromagnetic fields from Wi-Fi and other wireless technology.

See http://wifiinschools.org.uk/resources/safeschools2012.pdf

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July 10, 2009.

Open Letter to Parents, Teachers, & School Boards Regarding Wi-Fi Networks in Schools and Cell Phone Antennas near School Property

I am a scientist who does research on the health effects of electromagnetic radiation and I am becoming increasingly concerned that a growing number of schools are installing WiFi networks and are making their school grounds available for cell phone antennas.

You will be told by both the federal government (Federal Communication Commission in the US; Health Canada and Industry Canada in Canada) as well as by the Wi-Fi provider that this technology is **safe** provided that exposures to radio frequency radiation remain below federal guidelines.

This information is **outdated** and **incorrect** based on the growing number of scientific publications that are reporting adverse health and biological effects below our "short-term, thermal-based" guidelines (see www.bioiniative.org) and the growing number of scientific and medical organizations that are asking for stricter guidelines to be enforced.

For these reasons it is irresponsible to introduce Wi-Fi microwave radiation into a school environment where young children and school employees spend hours each day.

FACT:

1. **GUIDELINES: Guidelines for microwave radiation (which is what is used in Wi-Fi) range 5 orders of magnitude in countries around the world.** The lowest guidelines are in Salzburg Austria and now in Liechtenstein. The guideline in these countries is 0.1 microW/cm^2. See short video (http://videos.next-up.org/SfTv/Liechtenstein/AdoptsTheStandardOf06VmBioInitiative/09112008.html). In Switzerland the guideline is 1 and in both Canada and the US it is 1000 microW/cm^2!

   Why do Canada and the US have guidelines that are so much higher than other countries? Our guidelines are based on a short-term (6-minute in Canada and 30-minute in US) heating effect. It is assumed that if this radiation does not heat your tissue it is "safe". This is NOT correct. Effects are documented at intensities well below those that are able to heat body tissue. See attached report: *Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network* (2007). These biological effects include increased permeability of the blood brain barrier, increased calcium flux, increase in cancer and DNA breaks, induced stress proteins, and nerve damage. Exposure to this energy is associated with altered white blood cells in school children; childhood leukemia; impaired motor function, reaction time, and memory; headaches, dizziness, fatigue, weakness, and insomnia.

2. **ELECTRO-HYPER-SENSITIVITY:** A growing population is adversely affected by these electromagnetic frequencies. The illness is referred to as "electro-hyper-sensitivity" (EHS) and is recognized as a disability in Sweden. The World Health Organization defines EHS as:

   ". . . a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs). . . EHS is a real and sometimes a debilitating problem for the affected persons, while the level of EMF in their neighborhood is no greater than is encountered in normal living environments. Their exposures are generally several orders of magnitude under the limits in internationally accepted standards. "

   Health Canada acknowledges in their Safety Code 6 guideline that some people are more sensitive to this form of

energy but they have yet to address this by revising their guidelines.

Symptoms of EHS include sleep disturbance, fatigue, pain, nausea, skin disorders, problems with eyes and ears (tinnitus), dizziness, etc. It is estimated that 3% of the population are severely affected and another 35% have moderate symptoms. Prolonged exposure may be related to sensitivity and for this reason it is imperative that children's exposure to microwave radiation (Wi-Fi and mobile phones) be minimized as much as possible.

3. **CHILDREN'S SENSITIVITY:** Children are more sensitive to environmental contaminants and that includes microwave radiation. The Stewart Report (2000) recommended that children not use cell phones except for emergencies. The cell phone exposes your head to microwave radiation. A wireless computer (Wi-Fi) exposes your entire upper body and if you have the computer on your lap it exposes your reproductive organs as well. Certainly this is not desirable, especially for younger children and teenagers. For this reason we need to discourage the use of wireless technology by children, especially in elementary schools. That does not mean that students cannot go on the Internet. It simply means that access to the Internet needs to be through wires rather than through the air (wireless, Wi-Fi).

4. **REMOVAL OF WI-FI:** Most people do not want to live near either cell phone antennas or Wi-Fi antennas because of health concerns. Yet when Wi-Fi (wireless routers) are used inside buildings it is similar to the antenna being inside the building rather than outside and is potentially much worse with respect to exposure since you are closer to the source of emission.

   Libraries in France are removing Wi-Fi because of concern from both the scientific community and their employees and patrons.

   The Vancouver School Board (VSB) passed a resolution in January 2005 that prohibits construction of cellular antennas within 1000 feet (305 m) from school property.

   Palm Beach, Florida, Los Angeles, California, and New Zealand have all prohibited cell phone base stations and antennas near schools due to safety concerns. The decision not to place cell antennas near schools is based on the likelihood that children are more susceptible to this form of radiation. **Clearly if we do not want antennas "near" schools", we certainly do not want antennas "inside" schools!** The safest route is to have wired internet access rather than wireless. While this is the more costly alternative in the short-term it is the least costly alternative in the long run if we factor in the cost of ill health of both teachers and students.

5. **ADVISORIES:** Advisories to limit cell phone use have been issued by the various countries and organizations including the UK (2000), Germany (2007), France, Russia, India, Belgium (2008) as well as the Toronto Board of Health and the Pittsburgh Cancer Institute (July 2008). While these advisories relate to cell phone use, they apply to Wi-Fi exposure as well since both use microwave radiation. If anything, Wi-Fi computers expose more of the body to this radiation than do cell phones.

6. **PRECAUTIONARY PRINCIPLE**: Even those who do not "accept" the science showing adverse biological effects of microwave exposure should recognize the need to be careful with the health of children. For this reason we have the Precautionary Principle, which states:

   In order to protect the environment, the precautionary approach shall be widely applied by States according to their capability. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.

   In this case "States" refers to the School Board and those who make decisions about the health of children.

The two most important environments in a child's life are the home (especially the bedroom) and the school. For this reason it is imperative that these environments remain as safe as possible. **If we are to err, please let us err on the side of caution.**

Respectfully submitted,
Dr. Magda Havas,
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Trent University
July 10, 2009

Shallow Minds:
How the Internet and Wi–Fi in Schools Can Affect Learning

By Cindy Lee Russell, MD
VP-Community Health, Santa Clara County Medical Association

Most of us cannot live without our computers, text messaging, e-mail, and immediate access to the vast cloud of information, especially kids and teenagers who have grown up in the age of the Internet. In fact, more schools are integrating computers at younger ages, even in kindergarten. Forty-nine states are phasing out cursive handwriting altogether. What effects does it have, however, on learning, brain development, cognition, and brain health? Studies have shown some interesting ways that technology is rewiring and shaping our brain, which may not be "all good."

A growing body of scientific evidence suggests that the Internet, with its distractions and interruptions, is turning us into scattered, superficial thinkers. What does that portend for our kids?

Multitasking and Internet Addiction

Nicholas Carr explains, in his book "The Shallows," that we are changing the way we process information. "Dozens of studies by psychologists, neurobiologists, educators, and Web designers point to the same conclusion: When we go online, we enter an environment that promotes cursory reading, hurried and distracted thinking, and superficial learning….The Net delivers precisely the kind of sensory and cognitive stimuli-repetitive, intensive, interactive, addictive, that have been shown to result in strong and rapid alterations in brain circuits and functions."

Researchers from Stanford, in 2009, gave a battery of cognitive tests to a group of heavy and light media Internet multitaskers. They found that the heavy multitaskers were much more easily distracted by "irrelevant environmental stimuli" and had less control over their working memory. In addition, they were much less able to focus on a particular task. Professor Clifford Nass, who led the research, stated intensive multitaskers are "suckers for irrelevancy. Everything distracts them." (5)

"Teaching is a human experience. Technology is a distraction when we need literacy, numeracy, and critical thinking." Paul Thomas, author and associate professor of education at Furman University

Law School Professors Ban Laptops in Classrooms

Several years ago, professors who were irritated with students surfing the Web and hiding behind laptop screens began banning the use of the Internet or laptops in the classroom. Laptops have been banned in classes at Harvard Law School, Yale, George Washington University, University of Virginia, and South Texas College of Law, to mention a few. (4)(15) A 2006 study by Carrie Fried backed up the policies, demonstrating that students who used laptops in

class spent considerable time multitasking. They more importantly found that the level of laptop use was negatively related to several measures of student learning. (3)

A 2012 survey by Elon University, the Pew Internet, and American Life Project asked over 1,000 leaders in the U.S. their thoughts about cognition in our millennial generation. They were asked to consider how the Internet and its environment are changing, for better or worse. Overall, the survey found that multitasking is the new norm and that hyper-connectivity may be leading to a lack of patience and concentration. The "always on" ethos may be encouraging a culture of expectation and instant gratification.

Brain Maturation, Learning, Memory, and Intelligence

The maturation of intelligence requires quiet, deep thought, and time. Established research findings in cognitive science leads to the conclusion that laptop use, especially with Wi-Fi access, could interfere with learning.

The hippocampus, which lies under the cortex, is intimately involved in long-term memory storage. Initial experiences are stored and stabilized in the hippocampus and then later transferred to the cortex. Removal of the hippocampus does not affect long-term memories, but prevents new memories from forming.

Learning depends on the ability to transfer information from our working memory to long-term memory and weave this into other acquired knowledge. There is a bottleneck in the passage of working memory to long-term memory. We have a limited ability as humans to capture and process information. The Internet provides too many choices and too much information at once. Excess distracting information creates "overload," preventing long-term memorization and important information is lost. No one disagrees that we need to protect our memories. As author Nicholas Carr highlights, personal memory is not just for the individual to function, but it shapes and sustains our collective cultural memory.

Brain Drain:

Adverse Neurologic and Health Effects of Wireless Microwave Communications

A growing body of peer reviewed research is showing neurologic damage to fetal brain and other systems from Wi-Fi and other microwave wireless sources. In a prior article, "Why-Fi: Is Wireless Communication Hazardous to Your Health?" in the Sept/Oct 2010 SCCMA *Bulletin*, the full range of effects of EMF from our cell phones and wireless devices was discussed. New basic science research in the last three years is confirming these findings. Initially, the Bioinitiative report of 2007 reviewed the biological effects of low level EMF. It found that there was clear evidence of adverse effects to living systems at current environmental exposures and at doses well below the threshold of the International Commission of Non-Ionizing Radiation Protection (ICNIRP) safety guidelines. Current microwave safety limits are based solely on the heating of tissue and do not take into account research showing negative biological effects on DNA, cancer, protein synthesis, skin tissue changes, sperm motility and viability, cognitive functioning, and disruption of the blood brain barrier.

Current Research on Cognition and Wireless Communication

Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice. *Scientific Reports*. March 2012.

Aldad et al noted that neurobehavioral disorders are increasingly prevalent in children with 3%-7% of school-aged children diagnosed with attention deficit hyperactivity disorder (ADHD). The etiology is unclear, however, an association between prenatal cellular telephone use and hyperactivity in children has been postulated by others. To test this, he exposed pregnant mice to cell phone radiation throughout gestation (days 1-17), with a sham cell phone control group. He found that the exposed group had dose responsive impaired neurologic transmission in the prefrontal cortex and that the mice exposed in utero were hyperactive and had impaired memory. He concluded "that these behavioral changes were due to altered neuronal developmental programming."(3)

Microwave Radiation Induced Oxidative Stress, Cognitive Impairment, and Inflammation in Brain of Fischer Rats. Megha. 2012.

Megha evaluated the intensity of oxidative stress, cognitive impairment, and brain inflammation in rats exposed to typical cell phone microwave radiation. They were subjected to 900 and 1,800 MHz EMF for two hours a day, for 30 days. They state, "Significant impairment in cognitive function and induction of oxidative stress in brain tissues of microwave exposed rats were observed, in comparison with sham exposed groups… Results of the present study indicated that increased oxidative stress due to microwave exposure may contribute to cognitive impairment and inflammation in brain."

Effect of Low Level Microwave Radiation Exposure on Cognitive Function and Oxidative Stress in Rats. Deshmukh. 2013.

The author highlights the exponential increase in wireless communication devices we are exposed to. He evaluated the effects of cell phone radiation on oxidation in tissues, in addition to cognition in rats. They subjected rats to 900 MHz EMF for two hours per day, five days a week, for 30 days, with an unexposed control group. "Results showed significant impairment in cognitive function and increase in oxidative stress, as evidenced by the increase in levels of MDA (a marker of lipid peroxidation) and protein carbonyl (a marker of protein oxidation) and unaltered GSH content in blood. Thus, the study demonstrated that low level MW radiation had significant effect on cognitive function and was also capable of leading to oxidative stress."

The Internet Can Damage Teenage Brains

A large radiologic study from China, published July 2011, looked at structural brain changes in Internet-addicted teenagers. It is estimated that 24 million teenagers are addicted to the Internet in China. The researchers found a consistent atrophy of grey matter in parts of the brain and shrinkage of the surface of the brain in those addicted to the Internet. The effects were worse the longer the addiction. In addition, the study revealed changes in white matter of the brain, which

function to transmit messages in the brain to the grey matter. They concluded these structural abnormalities were most likely associated with functional impairments in cognitive control.

"It strikes me as a terrible shame that our society requires photos of brains shrinking in order to take seriously the common-sense assumption that long hours in front of screens is not good for our children's health. Dr Aric Sigman, Fellow of the Royal Society of Medicine

WHO Classifies EMF as a Carcinogen

In 2011, The WHO/International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as "possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer1, associated with wireless phone use."

France Bans Wi-Fi in Schools, But Replaces With Ethernet

The French National Assembly, March 2013, passed an amendment to ban Wi-Fi in their schools until it's proven "safe for human consumption." They instead agreed to install far safer, wired Ethernet cable connections.

The Council of Europe has called for a ban on Wi-Fi use in schools and also recommends a wired alternative.

In Austria, the Austrian Medical Society has also issued a policy statement asking for a ban of Wi-Fi in schools.

The U.K. has a useful frequently-updated website on Wi-Fi in schools, which provides much scientific research. http://www.wifiinschools.org.uk/ Still the controversy persists.

The Cost of a Virtual World

There are a host of concerns with classroom technology, and the virtual world it creates, that have not been explored in the rush to "modernize" education and prevent our kids from becoming "computer illiterate," despite the fact that computers are designed for ease of use. These issues range from distraction in the classroom, impairment of cognitive development and long-term memory, deficiency in learning social skills, Internet addiction, cyber bullying, access to inappropriate content, eye fatigue, and security risks to online learning networks. In addition, the sheer cost of computers and continuous upgrades is likely to break many school budgets. We have not mentioned the issue of toxic e-waste, another growing public health problem.

Common Sense

We will not get rid of the Internet or computers. We should not ignore, however, the enlarging body of science that points to real threats to public health and, especially, our children's safety and well-being. The best approach is precautionary. Reduce the risk by reducing the microwave emissions. It is our obligation as physicians and parents to protect our children. They are the

future and our legacy.

1. Remove wireless devices (white boards and routers) in schools in favor of wired connections and fiberoptic.
2. If there is Wi-Fi, then give teachers the authority to turn it off when not in use or if they feel it is not necessary.
3. Ban cell towers near or on schools.
4. Limit screen time on computers.
5. Limit or ban cell phone use in the class.
6. Limit or ban cell phone use at home.
7. Do not allow laptops to be placed on laps.
8. Undertake independent scientific studies on Wi-Fi and computer use that look at acute and long-term health effects.
9. Train teachers how to recognize symptoms of EMF reactions.
10. Conduct meetings with parents and teachers to address this issue in each school.

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Minimize health risks from electronic devices

Published in the September 2016 NJEA Review
by Adrienne Markowitz and Eileen Senn

Desktops, laptops, tablets, eBook readers, printers, projectors, smart boards, smart TVs, cellphones, cordless phones and wireless networks (WiFi) have become ubiquitous in schools. At their best, they are powerful tools for education. At their worst, they threaten the physical and mental health of teachers, paraeducators, secretaries, librarians and other school staff members and students who spend numerous hours using the devices.

Physical health risks from electronic devices include pain and tingling from repetitive strain injuries to the hands and wrists; pain in the neck, shoulders and back; dry, burning, itchy eyes, blurred vision and headaches; altered sleep patterns and next-day fatigue from exposure to blue screen light; distracted driving; and various health problems from exposure to radiation.

Mental health risks arise from stress due to raised expectations for multitasking, productivity and proficiency with devices; dealing with malfunctioning devices; student and colleague distraction from and addiction to devices; and intrusion of devices into nonwork time.

WiFi devices emit radiation

Radio frequency (RF) electromagnetic frequency (EMF) radiation is sent and/or received by the antennae of phones, routers and other wireless devices. RF radiation is capable of causing cancer, reproductive, neurological and ocular effects. The amount of radiation exposure received depends on the amount of time exposed and distance from the source. Radiation levels fall off exponentially with distance from antennae. If you double the distance, the radiation is four times less. If you triple the distance, it is nine times less, and so on. Children and developing fetuses are particularly at risk because their bodies are still growing. People with implanted medical devices are at risk for device interference.

Hazards and solutions

The most straightforward ways to minimize health risks are to use electronic devices in moderation and to maximize your distance from them. There are also specific solutions to specific hazards listed below.

Local associations should work with their UniServ field representative to negotiate solutions that are in the control of district administrators such as providing training and ergonomic equipment and hard-wiring devices. Individuals should take steps within their control, such as:

For repetitive strain injuries

- Use voice control/speech recognition.
- Use ergonomic alternatives to traditional mice and keyboards.
- Use as many fingers as possible when typing and both thumbs when texting.

For neck, shoulder and back pain

- Ensure an ergonomic workstation.
- When using a hand-held device, support it and the forearms.
- Avoid bending the head down or jutting it forward.
- Take frequent, short breaks from the device.
- Ensure good posture and change positions frequently.
- Stand and do stretching exercises.

For eye pain, blurred vision and headaches

- Use sufficient, but not excessive, lighting.
- Use assistive technology built into Apple, Android and Windows devices.
- Enlarge and darken the cursor and pointer.
- Enlarge the font; magnify the text.
- Use text-to-speech instead of reading.
- Use special computer glasses.
- Relax the eyes on a minibreak.

For altered sleep patterns and next-day fatigue

- Stop using devices at least one hour before bedtime.

For distracted driving

- Use hands-free devices, preferably speakerphones.
- Pull over and park.
- Let someone else drive.

For radiation exposure

- Keep devices away from the body and bedroom.
- Carry phones in briefcases, etc., not on the body.
- Put devices on desks, not laps.
- Hard wire all devices that connect to the internet.
- Hard wire all fixed devices such as printers, projectors and boards.
- Use hard-wired phones instead of cell or cordless phones.
- Text rather than call.
- Keep conversations short or talk in person.
- Put devices in airplane mode, which suspends EMF transmission by the device, thereby disabling Bluetooth, GPS, phone calls, and WiFi.
- Use speaker phone or ear buds instead of holding the phone next your head.
- Take off Bluetooth devices when not using them.

For stress

- Training in device use, assistive technology.
- Easy access to user manuals.
- Easily available technical support.

Cell phones and cancer

The National Toxicology Program (NTP) is conducting the largest set of laboratory rodent studies to date on cellphone RF radiation. The studies cost $25 million and are designed to mimic human exposure. They are based on the cellphone

frequencies and modulations currently in use in the United States. The NTP studies are designed to look at effects in all parts of the body.

On May 27, 2016, NTP released a report with partial results of the studies. They found increased occurrence of rare brain tumors called gliomas and increases in nerve tumors called schwannoma of the heart in male rats. The released results are partial because more rat studies and all of the mouse studies will be forthcoming by 2017. The cells that became cancerous in the rats were the same types of cells as those that have been reported to develop into tumors in human cellphone users.

The EMF produced by cellphones was classified as possibly carcinogenic to humans by the World Health Organization in 2011. They found that long-term use of a cell phone might lead to two different types of tumors, gliomas and acoustic neuroma, a tumor of the auditory nerve.

For more information

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COUNCIL OF EUROPE
CONSEIL DE L'EUROPE

Resolution 1815 (2011)[1]
Final version

The potential dangers of electromagnetic fields and their effect on the environment

Parliamentary Assembly

1. The Parliamentary Assembly has repeatedly stressed the importance of states' commitment to preserving the environment and environmental health, as set out in many charters, conventions, declarations and protocols since the United Nations Conference on the Human Environment and the Stockholm Declaration (Stockholm, 1972). The Assembly refers to its past work in this field, namely Recommendation 1863 (2009) on environment and health: better prevention of environment-related health hazards, Recommendation 1947 (2010) on noise and light pollution, and more generally, Recommendation 1885 (2009) on drafting an additional protocol to the European Convention on Human Rights concerning the right to a healthy environment and Recommendation 1430 (1999) on access to information, public participation in environmental decision-making and access to justice – implementation of the Århus Convention.

2. The potential health effects of the very low frequency of electromagnetic fields surrounding power lines and electrical devices are the subject of ongoing research and a significant amount of public debate. According to the World Health Organization, electromagnetic fields of all frequencies represent one of the most common and fastest growing environmental influences, about which anxiety and speculation are spreading. All populations are now exposed in varying degrees to electromagnetic fields, the levels of which will continue to increase as technology advances.

3. Mobile telephony has become commonplace around the world. This wireless technology relies upon an extensive network of fixed antennae, or base stations, relaying information with radio-frequency signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology. Other wireless networks that allow high-speed Internet access and services, such as wireless local area networks, are also increasingly common in homes, offices and many public areas (airports, schools, residential and urban areas). As the number of base stations and local wireless networks increases, so does the radio-frequency exposure of the population.

4. While electrical and electromagnetic fields in certain frequency bands have wholly beneficial effects which are applied in medicine, other non-ionising frequencies, whether from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals as well as the human body, even when exposed to levels that are below the official threshold values.

5. As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the precautionary principle should be applied when scientific evaluation does not allow the risk to be determined with sufficient certainty. Given the context of growing exposure of the population, in particular that of vulnerable groups such as young people and children, there could be extremely high human and economic costs if early warnings are neglected.

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1. Text adopted by the Standing Committee, acting on behalf of the Assembly, on 27 May 2011 (see Doc. 12608, report of the Committee on the Environment, Agriculture and Local and Regional Affairs, rapporteur: Mr Huss).

6. The Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco.

7. Moreover, the Assembly notes that the problem of electromagnetic fields or waves and their potential consequences for the environment and health has clear parallels with other current issues, such as the licensing of medication, chemicals, pesticides, heavy metals or genetically modified organisms. It therefore highlights that the issue of independence and credibility of scientific expertise is crucial to accomplish a transparent and balanced assessment of potential negative impacts on the environment and human health.

8. In light of the above considerations, the Assembly recommends that the member states of the Council of Europe:

8.1. in general terms:

8.1.1. take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours;

8.1.2. reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation;

8.1.3. put in place information and awareness-raising campaigns on the risks of potentially harmful long-term biological effects on the environment and on human health, especially targeting children, teenagers and young people of reproductive age;

8.1.4. pay particular attention to “electrosensitive” people who suffer from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network;

8.1.5. in order to reduce costs, save energy, and protect the environment and human health, step up research on new types of antenna, mobile phone and DECT-type device, and encourage research to develop telecommunication based on other technologies which are just as efficient but whose effects are less negative on the environment and health;

8.2. concerning the private use of mobile phones, DECT wireless phones, WiFi, WLAN and WIMAX for computers and other wireless devices such as baby monitors:

8.2.1. set preventive thresholds for levels of long-term exposure to microwaves in all indoor areas, in accordance with the precautionary principle, not exceeding 0.6 volts per metre, and in the medium term to reduce it to 0.2 volts per metre;

8.2.2. undertake appropriate risk-assessment procedures for all new types of device prior to licensing;

8.2.3. introduce clear labelling indicating the presence of microwaves or electromagnetic fields, the transmitting power or the specific absorption rate (SAR) of the device and any health risks connected with its use;

8.2.4. raise awareness on potential health risks of DECT wireless telephones, baby monitors and other domestic appliances which emit continuous pulse waves, if all electrical equipment is left permanently on standby, and recommend the use of wired, fixed telephones at home or, failing that, models which do not permanently emit pulse waves;

8.3. concerning the protection of children:

8.3.1. develop within different ministries (education, environment and health) targeted information campaigns aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves;

8.3.2. for children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises;

8.4. concerning the planning of electric power lines and relay antenna base stations:

8.4.1. introduce town planning measures to keep high-voltage power lines and other electric installations at a safe distance from dwellings;

8.4.2. apply strict safety standards for the health impact of electrical systems in new dwellings;

8.4.3. reduce threshold values for relay antennae in accordance with the ALARA principle and install systems for comprehensive and continuous monitoring of all antennae;

8.4.4. determine the sites of any new GSM, UMTS, WiFi or WIMAX antennae not solely according to the operators' interests but in consultation with local and regional government authorities, local residents and associations of concerned citizens;

8.5. concerning risk assessment and precautions:

8.5.1. make risk assessment more prevention oriented;

8.5.2. improve risk-assessment standards and quality by creating a standard risk scale, making the indication of the risk level mandatory, commissioning several risk hypotheses to be studied and considering compatibility with real-life conditions;

8.5.3. pay heed to and protect "early warning" scientists;

8.5.4. formulate a human-rights-oriented definition of the precautionary and ALARA principles;

8.5.5. increase public funding of independent research, in particular through grants from industry and taxation of products that are the subject of public research studies to evaluate health risks;

8.5.6. create independent commissions for the allocation of public funds;

8.5.7. make the transparency of lobby groups mandatory;

8.5.8. promote pluralist and contradictory debates between all stakeholders, including civil society (Århus Convention).

Dr. Devra Davis PhD., President of Environmental Health Trust (Petitioner) Comments, Jul. 11, 2017

In the Matters of:

Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment	)	**WT Docket No. 17-79**
Revising the Historic Preservation Review Process for Wireless Facility Deployments	)	**WT Docket No. 15-180**
Accelerating Wireline Broadband Deployment by Removing Barriers to Infrastructure Investment	)	**WC Docket No. 17-84**
Reassessment of Federal Communications Commission Radiofrequency Exposure Limits and Policies	)	**WC Docket No. 13-84**
Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields		**WC Docket No. 03-137**

To: Office of the Secretary
Federal Communications Commission
Washington, DC 20554

Dear FCC Commissioners,

Contrary to industry assertions of safety and contrary to industry comments to the FCC calling for the need to remove barriers to wireless infrastructure roll out , there is sufficient research showing adverse environmental and human health effects of radiation from wireless technology at levels far below the current FCC RF limits to justify the FCC placing a moratorium on the rollout of new wireless infrastructure. Most recently renowned Swedish researchers published an analysis which found that when the current body of evidence was analyzed in according with public health viewpoints, the conclusion was that "RF radiation should be regarded as a human carcinogen causing glioma."[1]

In these reply comments we provide the evidence documenting adverse effects from wireless radiation and we also document the stated risk that wireless companies are aware of as shown by their own filings.

In light of these and other developments it is imperative that 5G not be introduced widely into commerce at this time. Before introducing a new form of wireless technology into the environment, it is necessary to:

- model exposures to infants, children, and pregnant women;
- conduct experimental tests on exposures impact on wildlife; and
- evaluate impacts on human systems through in vitro and in vivo toxicology.

[1] Carlberg, Micheal and Lennart Hardell. "Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation." BioMed Research International, vol. 2017, 2017.

The assumption that 5G technology must be safe because it does not generate heat has been shown through the recent studies to be incorrect. Environmental Health Trust scientists and advisers are willing and able to help you develop appropriate protocols to evaluate environmental and health impacts the 5G technology. It is imperative that such an evaluation proceed prior to the widespread introduction of 5G or additional wireless infrastructure rollout.

We ask that:

1. The FCC preserve the copper line phone system.
2. The FCC place a moratorium on 5G and new antenna installations.
3. The FCC issue cautionary warnings to users of wireless technology.
4. The FCC request Congress to fund the EPA to set biologically-based population-protective RF safety limits.

On June 28, 2017 Environmental Health Trust sent the following letter to California State officials.

The Honorable Cecilia Aguiar-Curry
Chair of the Local Government Committee
1020 N Street, Room 157
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities — OPPOSE

Dear Chair Aguiar-Curry:

As a nonprofit research and policy organization dedicated to identifying and reducing environmental health hazards, Environmental Health Trust (EHT) writes to advise you of serious scientific grounds to reject SB 649 as advanced by Senator Hueso. I have personally served as an expert advisor to the California Department of Health as well as the San Francisco and Berkeley City governments on matters relevant to this bill. EHT has been honored to work with California government and scientists for over a decade. At the invitation of the Israel Institute for Advanced Study of the Hebrew University of Jerusalem, EHT recently organized and chaired an Expert Forum on Wireless Radiation and Health, bringing together scientists and engineers from more than ten high tech nations. Reflecting these efforts, EHT provides independent scientific research and advice on avoidable environmental health hazards to local, state and national governments.

SB 649 will pave the way for widespread introduction of 5G microwave wireless radiation frequency (RF) that has never been tested for its impact of public health or the environment. Other RF microwave radiation such as that used by cellphones and other wireless devices has been classified as a 'possible carcinogen' by the International Agency for Research on Cancer in 2011 and more recently dubbed a 'probable carcinogen,' by expert researchers looking at newer information in 2015.[2, 3, 4]

[2] World Health Organization. "IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans," WHO, Press Release, no. 208, 2011.
[3] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. "Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields." *IARC Monographs On The Evaluation of Carcinogenic Risks to Humans*, vol. 102, pt. 2, 2013.

In addition, this bill could result in the loss of hundreds of millions of dollars in local revenue, as the San Francisco Chronicle noted today.

By ignoring growing scientific evidence of harm, the bill effectively will ensure the widespread exposures of millions of Californians to an agent that growing numbers of scientists and nations consider a serious health threat. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects[5], as Dr. Cindy Russell, Vice President of Community Health for the Santa Clara Medical Association noted.[6] As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

EHT has a longstanding history of research and policy advice to state, local and national governments regarding strategies to reduce disease and promote health by avoiding environmental health hazards. Our organization opposes the broad scale installation of untested wireless antennas and associated electrical equipment close to humans and through critical wildlife habitat and corridors. Both federal and local zoning controls are needed to assure that cellular equipment are installed to avoid significant and serious safety threats of electrical shock, fire, and radio frequency (RF) microwave radiation exposures, as well as chronic impacts on public health and the environment.

Consistent with public health concepts of preventing harm by reducing exposure to suspected carcinogens, EHT opposes the usurpation and preemption of local authority that will allow federal and state authorities to place what state reports of the bill indicate can be thirty thousand new radiating 5G cell antennas on city and county utility, light poles, and other right of ways in close proximity to city and county workers, children, residents and visitors. In some cases towers will need to be sited every 100 feet with antennas at a height of 30 feet or less. Local authority and duty should not be overridden by preemptive federal or state policies such as SB 649 which disregards scientific evidence on this matter as outlined below.

Regarding potential health risks from RF a number of corporations advise their shareholders that they face serious risks from RF. For instance, Crown Castle's 2016 10-K ANNUAL REPORT, states that,

> *"If radio frequency emissions from wireless handsets or equipment on our wireless infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues. The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us...If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and*

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[4] Morgan, L. Lloyd, et al. "Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A)." *International Journal of Oncology,* vol. 46, no. 5, 2015, 1865-71.
[5] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.
[6] Russell, Cindy. "A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?" Santa Clara Bulletin, Jan./Feb. 2017.

adversely affected. We currently do not maintain any significant insurance with respect to these matters."

Most wireless companies from AT&T to Nokia to T Mobile to Verizon Wireless have issued similar warnings to their shareholders.

Regarding public health impacts, recently released research findings from the premiere test program of the National Institute of Environmental Health Sciences (NIEHS) add to the body of scientific evidence indicating that RF microwave radiation can be harmful. The 10 year $25 million NIEHS National Toxicology Program's Studies of the Toxicology and Carcinogenicity Cell Phone Radiation reports that RF produced increases rates of highly malignant very rare tumors: gliomas of the brain and schwannomas of the heart.[7] These experimental findings are consistent with human studies showing increased rates of gliomas and acoustic neuromas (schwann cells) among humans exposed to cell phone radiation. In addition to increased cancers, the NTP study also reported that prenatally exposed animals produced offspring with lower birth weight and evidence of direct genetic damage.

Since the 2011 WHO/IARC classification, the peer reviewed research connecting microwave exposure to cancer has significantly strengthened. In 2015, a study replicated a 2010 experiment that found that weak cell phone signals significantly promote the growth of tumors in mice, and that toxic chemical exposures combine with RF to more than double the tumor response.[8,9] The Ramazzini Institute is engaged in similar research with RF that is 1000 less than the NTP exposures—set to mimic radiation exposure levels caused by network equipment (e.g., cell tower antenna emissions).

Consistent with the NTP findings, the Ramazzini Institute team report significantly lower litter weights, as presented at the January 2017 Conference on Wireless and Health at Israel Institute for Advanced Study, Hebrew University of Jerusalem.[10] Findings of effects at such low levels is indication of the capability of low level electromagnetic radiation exposure to result in biological effects.

Other studies finding serious increased risk of glioma in regular cell phone users are of special relevance. In 2014, a French national study linked higher cell phone exposure to increased glioma in cell phone users.[11] A newly published research report in the *American Journal of Epidemiology* finds that Canadians who have used cell phones for 558 hours or more have more than a doubled risk of brain cancer.[12]

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[7] Wyde, Michael, et al. "Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure)." *bioRxiv,* no. 055699, 2016.

[8] Lerchl, Alexander, et al. "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans." *Biochemical and Biophysical Research Communications,* vol. 459, no. 4, 2015, pp. 585-90.

[9] Tillmann, Thomas, et al. "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model." *International Journal of Radiation Biology,* vol. 86, no. 7, 2010, pp. 529-41.

[10] Belpoggi, Fiorella. "Recent findings on wireless radiation and health from the Ramazzini Institute could reinforce the NTP results." *Conference on Wireless and Health*, 2017.

[11] Coureau, Gaëlle, et al. "Mobile phone use and brain tumours in the CERENAT case-control study." *Occupational Environmental Medicine,* vol. 71, no. 7, 2014, pp. 514-22.

[12] Momoli, F., et al. "Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors." *American Journal of Epidemiology*, 2017.

Previous published re-analysis of the multi country Interphone study data has found stronger positive associations to glioma risk among long term users and heavy users and a statistically significant association between where tumors were located and how much radiation an individual received from their phone.[13,14]

More recently, research carried out by physicists in Israel and others have shown that the higher millimeter wave frequencies to be used in 5G applications uniquely interacts with sweat ducts of the human skin which can then function as antennas to amplify signals. This work extends studies first produced in 1986.[15] The potential long-term impact of such stimulation on precancerous skin growths should be evaluated carefully, including potential super-growth of bacteria.[16] A lecture by Paul Ben-Ishai, PhD, and published research on this issue can be found on the 2017 Conference website.[17, 18, 19]

Cancer is not the only health concern presented by wireless devices and infrastructure. Impacts on reproduction and brain development have also been repeatedly reported in the peer reviewed literature in addition to a myriad of other adverse effects.[20, 21, 22, 23]

In light of these developments showing growing evidence of the biological impact of RF, it is imperative that new infrastructure and 5G not be introduced widely into commerce at this time. The State of California needs to critically consider the potential impact of massive new and possibly carcinogenic wireless exposures to their population. Before introducing additional untested wireless technology into the environment, it is necessary to:

- model exposures to infants, children and pregnant women;
- conduct experimental tests on exposures' impacts on wildlife; and
- evaluate impacts on human systems through in vitro and in vivo toxicology

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[13] Turner, Michelle C., et al. "Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries." *Annals of Epidemiology,* vol. 26, 12, 2016, pp. 827-32.
[14] Grell, Kathrine, et al. "The intracranial distribution of gliomas in relation to exposure from mobile phones: analyses from the INTERPHONE study." *American Journal of Epidemiology*, vol. 184, no. 11, 2016, pp. 818-28.
[15] Gandhi OP, Riazi A. "Absorption of millimeter waves by human beings and its biological implications." *IEEE Transactions on Microwave Theory and Techniques*, vol. 34, no. 2, 1986, pp. 228-235.
[16] Soghomonyan D, K. Trchounian and A. Trchounian. "Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?" Applied Microbiology and Biotechnology, vol. 100, no. 11, 2016, pp. 4761-71.
[17] Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.
[18] Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts." *Physical Review E*, vol. 89, no. 042715, 2014.
[19] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.
[20] Adams, Jessica A., et al. "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International,* 70, 2014, pp. 106-112.
[21] Deshmukh, P.S., et al. "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation." *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.
[22] Aldad, T.S., et al. "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice." *Scientific Reports,* vol. 2, no. 312, 2012.
[23] Sonmez, O.F., et al. "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field." *Brain Research,* vol. 1356, 2010, pp. 95-101.

In 2015, the International EMF Scientist Appeal, now signed by over 225 scientists from 41 nations, was submitted to the Secretary-General of the United Nations, the Director-General of the World Health Organization and U.N. Member Nations urging the development of more protective guidelines for EMF (including RF-EMF), encouraging precautionary measures, and calling for education of the public about health risks, particularly risks to children and fetal development.[24] Most recently, the EMF Scientists have submitted Comments to the FCC asking the FCC to critically consider the potential impact of the 5th generation wireless infrastructure on the health and safety of the U.S. population before proceeding to deploy this infrastructure.

California firefighters have lobbied to protect themselves and successfully received exemption on health grounds from the installation of these cell towers. Similarly cities and counties should be given the needed local controls to protect their citizens from the health and safety risks of these installations. As currently envisioned, transmitters can be placed in close proximity to bedrooms and schools without consideration of the health of their occupants. Research is critically needed to evaluate the public health and environmental impacts of proposed wireless facilities before deployment.

Worldwide, governments are acting to minimize exposures to children as they are most vulnerable. For example, the Supreme Court of India upheld the High Court of the State of Rajasthan's decision to remove all cell towers from the vicinity of schools, hospitals and playgrounds because of radiation "hazardous to life." In Chile, the 2012 "Antennae Law" prohibits cell antennae/towers in "sensitive areas".[25] Please learn more about international policy actions such as these in our online briefing.[26]

The assumption that all wireless technology is safe has been shown through recent studies to be incorrect. EHT strongly opposes the widespread installation of 5G antennas and towers and believes that the state should move forward on its commitment to support the installation of fiber optic cables buried in the ground to every business, home, school, and hospital in California. We urge the state not to ignore this evidence of harm from RF. Please vote "no" vote on SB 649 and uphold the rights of local government to protect public health and the environment.

Sincerely,

Devra Davis, PhD, MPH
Fellow, American College of Epidemiology
Visiting Prof. Hebrew Univ. Hadassah Medical Center & Ondokuz Mayis Univ. Medical School
Associate Editor, *Frontiers in Radiation and Health*
President, Environmental Health Trust

[24] Blank, M., et al. "International Appeal: Scientists call for protection from non-ionizing electromagnetic field exposure." *European Journal of Oncology,* vol. 20, no. 3/4, 2015, pp. 180-2.
[25] "New communications antenna law in Chile." *Communications Law: Newsletter of the International Bar Association Legal Practice Division*, vol. 20, no. 1, 2013, pp. 14-16.
[26] "International Policy Briefing: Cautionary Policy on Radiofrequency Radiation Actions by Governments, Health Authorities and Schools Worldwide." Environmental Health Trust, 2017.

Addendum to FCC Reply Comments

1.French Government Release of Cell Phone Radiation Measurements Shows Cell Phones Breech FCC limits When Used in Body Contact Positions
2. International Policy Actions on Wireless Radiation
3. Medical Organization Recommendations on Electromagnetic Fields
4. Telecom and Insurance Companies Warn of Liability and Risk 2017 10K filings, Insurance Reports, White Papers and Legal Cases.
6. Myth Fact on the National Toxicology Program Study
7. Myth Fact on Cell Phones and Health PDF
8. List of US Government Reports on Cell Phone and Wireless Radiation
9. Millimeter and Submillimeter Frequencies Have Bio Effects And Their Interaction With Human Skin Poses A Health Risk to the Public

French Government Release of Cell Phone Radiation Measurements Shows Cell Phones Breech FCC limits When Used in Body Contact Positions

What information did the government of France release?

France released radiation measurements for hundreds of cell phones tested independently by the government of France. When cell phones were tested in positions mimicking an individual holding the phone directly against the body, the radiation levels were so high that most tested phones exceeded European limits, showing radiation levels up to three times higher than the limits!

The vast majority of cell phones tested in body contact positions had radiation measurements that far exceeded European allowable limits. In 2015, testing showed that 64 out of 72 cell phone models tested in direct body contact positions had radiation levels *higher* than allowable radiation limits. Since 2012, 208 of the 273 phone models tested in direct body contact positions had radiation levels *higher* than allowable radiation limits. However, when these same phones were tested with a separation distance of 15 mm to 25mm, they were within regulatory limits. In other words, the cell phones only passed radiation tests when they were laboratory tested with a separation distance between the phone and test dummy.

Despite violating the safety limit for radiation exposure to users, all of these phones still pass tests as "compliant" because outdated regulations do not require testing in body contact positions.

The cell phone data released by France is in the form of a spreadsheet with the make, model, and radiation measurements of almost 400 cell phones tested at 0 distance, 5 mm distance, and the distance used by the industry. Read Press Release.

Why wasn't this information released earlier?

France has been testing cell phones for radiation levels since 2012 but did not publicly release the findings. In 2016, an analysis of their test results was presented in a scientific report of the national French Agency for Food, Environmental and Occupational Health & Safety (ANSES) called "Radiofrequency Exposure and the Health of Children." The 2016 report stated, "In 2015, 89 percent of tested cell phones had a SAR greater than the maximum limit value of 2 W/kg and 25 percent had a SAR greater than 4 W/kg." However, the make and model of the cell phones were not in the report. (Read english translation here.)

Dr. Marc Arazi, a French physician, made an inquiry to see the actual data. He was first denied the information. He then filed for the information in court. After several court challenges, the court ordered the data to be released. France's National Frequencies Agency (ANFR) posted the information on their website in June 2017. Arazi maintains a blog about the issue.

Note: The 2016 ANSES report stated that current cell phone radiation testing methods need to be re-evaluated and that compliance with the regulatory limits needs to be ensured in *all conditions of use*, such as when the phone is in contact with the body. The report concluded that children are more vulnerable to radio frequency wireless exposures and recommended children's exposures to wireless radiation be immediately reduced.

Why is this information important for people who use cell phones?
This data is documented proof that cell phone laboratory test methods in place since 1999 are inadequate. This data provides solid evidence that cell phones are capable of exposing people to radiation at levels that exceed government standards when people use their phones in common ways.

The majority of cell phone owners carry and use their devices in direct contact with their bodies. This includes carrying phones in a bra, tucked next to skin in stretchy pants, and placed in shirt and pants pockets. Teenagers often sleep with phones on their chests or beneath their pillow. Many pregnant women rest phones on their abdomens. All of these common positions result in the phone being in direct contact with the body. However radiation compliance tests are not conducted with the phones in direct contact with the body. The closer a cell phone is to the body, the higher the user's radiation dose is. Most of the general public is unaware that the phone is *always* emitting radiation, when they are not talking or using the cell phone, during all the time the phone is waiting to receive the next call, message, or other notification. France's data clearly shows that the way people use phones in real life could result in radiation exposures that exceed government radiation limits. For some phones the radiation exceeds *by over 3 times*.

Why is this referred to as as a "health scandal" and termed "PhoneGate"?
This is considered a scandal because the test seems to be rigged. Phones are passing compliance tests but violate radiation limits because the test strategy does not measure use against the body in the way we actually use cell phones.

The issue has been termed "PhoneGate" because of the parallel to "Diesel Gate." In "Diesel Gate," Volkswagen cars passed diesel emission exams when tested in laboratory conditions, however, when the cars were driven on real roads, they emitted far more fumes. In the same way, every one of these cell phones tested by France 'passed' laboratory radiation tests and were marked compliant. Yet when France tested phones in body contact positions, the radiation levels were triple the compliance test limits.

Why don't cell phone companies test phones in body contact positions?
Before coming onto the market cell phones do not need to be be tested in direct body contact positions for radiation emissions. In fact, manufacturers can set distances of 15 or 25 mm when they perform SAR radiation testing for their phones and they are still within the law.

CTIA, which is the wireless industry's lobby group, has long argued that "there is no reliable evidence proving that current testing protocols fail to ensure compliance with RF standards." This is stated in the CTIA submission to the US Federal Communications Commission regarding the FCC Proceeding on Human Exposures to Radiofrequency Radiation. CTIA also stated, "a zero-measuring requirement would not accurately mimic real usage or increase safety." The French data release provides solid reliable evidence that refutes those CTIA statements.

Is this the first time such testing at zero distance has been done?
Levels which exceed the regulatory maximum limits at zero distance have been shown many times. For example, a 2017 investigation by the Canadian Broadcasting Corporation found radiation levels higher than government standards after they tested popular cell phones in a US FCC certified laboratory. Israeli news featured an investigation in which phones were tested by the Holon Institute of Technology in Israel and many were found to exceed radiation limits, especially after phones were repaired in a shop.

In fact, years ago and repeatedly, researchers and scientists documented this testing problem and have been calling for immediate action to update cell phone compliance testing to reflect the way people actually use cell phones in direct contact with the body. A 2002 study reported that SAR will be up to seven times higher when the back of the cell phone (where the antenna is located) is placed in a shirt pocket next to the skin. The study concludes, "This implies that a telephone tested for SAR compliance against the model of the head may be severely out of compliance if it were placed in the shirt pocket."

Has France released all of the data?
No. There is believed to be significant information still missing from the information posted by ANFR. Dr. Arazi sent a letter to the Director-General of ANFR, Gilles Brégant, asking for this information, including:

- The SAR measurements for extremities. The 2016 ANSES report stated that 25% of the 95 mobile phones tested in 2015 by ANFR in contact or near contact with the skin were above the regulatory threshold of 4 W/kg. Yet this data is not on the spreadsheet.
- The measurements of the whole body SAR.
- The complete technical reports for each test.
- The SAR data for body contact positions for several phones, including the Apple iPhone 7 and Sony Xperia XA, are omitted from the ANFR spreadsheet. Where are the SAR measurements for these phones? Why is that data missing?

On June 19, 2017, Dr. Marc Arazi wrote two French Ministers, informing them of this issue and asking them to take action. He tells them about the missing data and states, "a further delay in the transmission and publication of these missing data would undoubtedly be an inexcusable fault". Read his translated letter here.

So far, Dr. Arazi has not received a response to his questions.

What are the government cell phone radiation regulatory limits?

Before a cell phone model is permitted to go on the market for sale, its manufacturer performs Specific Absorption Rate (SAR) tests to evaluate the radiation levels. SAR values are expressed in terms of watts per kilogram (W/kg) and are intended to measure the amount of cell phone radiofrequency radiation absorbed by the body when using a wireless device. The SAR limits were developed decades ago.

Europe has different cell phone radiation compliance limits than the United States and Canada.

In Europe the SAR limits are as follows. For the head and trunk, the SAR limit is 2.0 watts per kilogram averaged over 10 grams of human tissue. For extremities such as the wrists, ankles, hands, and feet, the SAR limit is 4.0 W/kg averaged over 10 grams of tissue.

In the United States and Canada the SAR limits are as follows. The FCC and Health Canada limit for public exposure from cellular telephones is a SAR level of 1.6 watts per kilogram averaged over 1 gram of tissue. For extremities such as the wrists, ankles, hands, ears, and feet, the allowable SAR limit is much higher and is 4.0 W/kg averaged over 10 grams of tissue.

Why aren't countries changing policy?

Policy takes decades to catch up with science. In Europe, a new June 2016 regulation forces manufacturers to measure SAR radiation for extremities (hands, feet, wrists and ankles) at 0 mm. However, for the torso (trunk, legs and arms), manufacturers still can radiation test with a distance between the body part and the phone.

How do the French measurements compare with United States/Canada radiation limits?
If you compare the French body contact measurements with US/Canada regulatory limits, the numbers are much much worse. Almost ALL of the cell phones France tested would exceed US/Canada safety radiation limits by an even greater amount.

The US SAR limit is 1.6 W/kg, which is stricter than the European limit of 2.0 W/kg. However, the European SAR limit averages over 10 grams of tissue and US/Canada averages over 1 gram of tissue. This averaging by either a 1 gram or 10 gram volume is very important. Averaging over a larger volume—such as the 10 gram volume—allows *much higher* peak radiation values, such as are at the tissue locations closest to the cell phone.

What does SAR mean?
The exposure standard for wireless mobile phones employs a unit of measurement known as the Specific Absorption Rate or SAR. SAR is a measure of the rate of radiofrequency energy absorption into the body from the cell phone. The SAR limit was developed decades ago.

How are phones SAR tested?
SAR testing uses a plastic dummy model based on a large 220 pound adult male body—larger than 90% of the population. The plastic shell of the test dummy is filled with a liquid. Each cell phone is tested while operating at its highest power level. The phone is precisely positioned at the head and body with a

spacer or plastic ear, and a robotic probe measures the electric field at specific locations within the dummy head and torso.

The US government does not perform independent cell phone compliance testing. In the United States, each manufacturer submits their own SAR testing results to the FCC. The situation is the same in Europe and worldwide. Manufacturers do the testing, not governments.

Why is the ear considered an extremity?
The ear, now referred to as a pinna, was reclassified by the FCC in 2013 as an extremity, meaning that more radiation absorption is allowed into this tissue. This reclassification is considered a concession to the cell phone industry and has been criticized because it allows much higher cell phone radiation emissions into tissue directly next to the head.

Does the government allow manufacturers to test with these separation distances?
Yes. In Europe, manufacturers can test with up to a 15 mm distance between the phone and torso per European regulations. In the United States, regulations allow even more distance and some phones are tested at a distance of ¾ of an inch.

Current regulations do not force companies to test cell phones or wireless devices at positions that are 0 mm to the body, despite billions of people using cell phones in this way.

Do these separation distances really matter?
Yes. Every millimeter you distance the cell phone away from your body can substantially reduce your exposure. As the French data shows, phones can meet regulations when tested at a 15 mm distance and be three times the maximum limit when tested at body contact distance.

For example, the Polaroid PRO 881A had a SAR of 1.5 W/kg when compliance tested at 15 mm distance but had a SAR of 7.42 W/kg when tested with 0 mm separation distance. Similarly, the Apple iPhone 5 had a SAR of .825 W/kg when compliance tested at 10 mm distance but had a SAR of 5.321 W/kg when tested with 0 mm separation distance.

Do manufacturers inform consumers of these distances?
In the United States, manufacturers can set the test separation distances. They have the distances in the fine print of their manuals, usually buried within the legal fine print.

Please see these examples of manufacturers' fine print instructions:

For body-worn operation, this phone has been tested and meets FCC RF exposure guidelines when used with an accessory that contains no metal and that positions the mobile device a minimum of 1.0 cm from the body. -Samsung Galaxy Note 3

"Use hands-free operation if it is available and keep the BlackBerry device at least 0.98 in. (25 mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry device is turned on and connected to the wireless network." -Blackberry Bold Manual

"To reduce exposure to RF energy, use a hands-free option, such as the built -in speakerphone, the supplied headphones, or other similar accessories. Carry iPhone at least 10mm away from your body to ensure exposure levels remain at or below the as -tested levels. Cases with metal parts may change the RF performance of the device, including its compliance with RF exposure guidelines, in a manner that has not been tested or certified." -Apple iPhone 4

"This device meets RF exposure guidelines when used either in the normal use position against the ear or when positioned at least 1.5 cm away from the body. When a carry case, belt clip or holder is used for body worn operation, it shouldn't contain metal and should position the product at least 1.5 cm away from your body... Ensure the above separation distance instructions are followed until the transmission is completed." -LG G3

Will glasses, braces, ear piercings, metal phone cases, or metal jewelry affect how your body absorbs radiation?
Yes. Metal can reflect and refocus cellular radiation, resulting in much higher absorption rates. The FCC, states, "Electrically conductive objects in or on the body may interact with sources of RF energy in ways that are not easily predicted. Examples of conductive objects in the body include implanted metallic objects. Examples of conductive objects on the body include eyeglasses, jewelry, or metallic accessories."

Published research shows that eyeglasses with metal frames and metal jewelry can affect the SAR levels. For example, a study found the SAR measured in the eye closest to the phone increased up to almost 30% when metal glasses were a part of the calculation. Similarly, publications have reported that the peak SAR can be up to 25% higher when a 900 MHz phone is pressed up to an ear pierced with a metallic object such as an earring. Another study looked at the SARs into the leg and reproductive organs when a cell phone was placed in a pocket alongside a keychain with a metal ring and found that the presence of a metallic ring significantly increases the averaged 10g SAR inside the testicle by more than 20% at 1.8 GHz. Metallic implants inside the body have been found to increase the SAR levels in several studies.

Manufacturers warn consumers about metal cases in their fine print warnings. For example the Apple iPhone 5 states, "Cases with metal parts may change the RF performance of the device, including its compliance with RF exposure guidelines, in a manner that has not been tested or certified." However, they do not warn about eyeglasses or placing a cell phone in a pocket next to a keyring, which is something people typically do.

So far, governments have neglected to consider metal in their regulatory compliance testing, despite the fact that metal (body-worn or internal) will interact with the cell phone radiation absorption into the user's body. The SAR test dummy does not have any metal (e.g., dental fillings, dental braces, earrings, piercings, orthopedic implants, wire-supported bras, or eyeglass frames) that could increase the radiation absorption beyond the laboratory measurements. Yet people use cell phones near metal. This is yet another important reason why current SAR testing is inadequate.

Why isn't the public informed about this?

The cell phone industry has repeatedly sued local governments that attempt to inform citizens about these distances. In California, the City of Berkeley was sued by the main Wireless Industry Association, called the CTIA, when Berkeley passed an ordinance mandating consumers be informed of these manufacturers' instructions by retail stores. The CTIA argued that the Berkeley "Right To Know Ordinance" violated free speech rights. Previously, in 2012, the CTIA had successfully halted a similar ordinance in San Francisco, but in 2017 they lost their case against Berkeley in court when the judges ruled that the Cell Phone Ordinance was "in the public interest."

Despite France having the most progressive policy among over a dozen countries that inform the public to reduce cell phone radiation exposure, France's national Agency for Food, Environmental and Occupational Health & Safety (ANSES) 2016 Report conceded that the public is largely unaware of instructions to put a distance between one's cell phone and body or head. ANSES stated that it was "unlikely that people, especially children, are aware of the conditions of use close to the body, as defined by manufacturers."

Similarly, the Canadian Broadcasting Corporation (CBC) independent survey of more than 11,000 Canadians found that more than 80 percent were unaware of manufacturers' recommended separation distance and 67 percent admitted they carry their phones against their bodies. In parallel, an Australian study found that 25 per cent of women have carried their smartphone tucked into their bra.

Manufacturer's' instructions to keep a distance are noted within the fine print deep inside cell phone manuals. Most people erroneously assume that cell phones are safe any way they use them.

Why do scientists state that SAR is an inadequate metric?
There are three major problems with the SAR laboratory compliance tests: (1) the models, (2) the method, and (3) the limits.

Inadequate Model: SAR Test Dummies Do Not Represent Human Cell Phone Users
SAR is not an adequate metric for understanding a person's exposure as the test method is not representative of the actual people (from babies to adults) who use cell phones. The SAR test dummy is based upon a large adult male (6'2" tall and 220 pounds) called the Specific Anthropomorphic Mannequin, or *SAM*. 97% of the population is smaller than the SAM model, meaning that only 3% of cell phone users are represented. Research confirms that radiation absorption into a child's head can be over two times greater, and absorption into the skull's bone marrow can be ten times greater than adults.

The SAM head and body phantom is filled with a homogenous liquid. This liquid is not representative of the human body, which has dozens of different tissues—from eyes to muscles to bones—each of which has different electrical properties. Radiation moves in a more uniform fashion through SAM's homogeneous liquid but does not move the same way though human tissues, which vary in thickness. Scientists are concerned, due to research that has shown in human brains cell phone radiation ricochets through the tissues and can form hotspots. Furthermore, the SAR laboratory compliance tests do not integrate various internal (e.g., piercings, metal implants) and external environmental factors (e.g., eyeglasses, metal walls) that could further impact the radiation absorption in a human body.

Inadequate Method:
SAR Test Positions Do Not Reflect Actual Use Patterns
Manufacturers are not required to test cell phones in positions of direct contact to the body. A person who obtains a cell phone more than likely will use the cellphone in various positions where the phone is touching the user's body. Common body contact positions, such as placing the phone in a pocket, are not tested before a cell phone is allowed on the market.

SAR Test Calculations Mask Actual Exposures With Averaging
During laboratory tests, the temperature probe takes measurements in a grid pattern inside the SAM model and *averages* the numbers. Averaging substantially lowers the reported temperature. For example, the SAR is highest in tissues near the phone's antennae and lower further away. Peak SARs can be quite high but are not documented by the manufacturer. Instead the numbers are averaged together. SARs are averaged over a 1 gram volume or a 10 gram volume, again substantially impacting the final SAR number. When a value is averaged over the 10 gram volume, the final reported SAR is lowered even further. Thus, SAR averaging calculations mask peak radiation exposures to human tissue.

Inadequate Limits: SAR Limits Do Not Protect the Public from Adverse Effects
Most importantly, the SAR limits of 2.0 W/kg and 1.6 W/kg are too lenient and *allow* radiation exposures that have been shown to have adverse effects in hundreds of peer reviewed published studies.

The SAR test is only relevant to heating effects of cell phone and wireless radiation. SAR limits do not consider the large amount of scientific evidence that indicates heating is *not the only harm* from cell phone radiation. Seemingly "low" cell phone radiation levels (far below SAR limits) that do not induce measurable changes in heat can have adverse impacts on biological systems. Cancer, reproductive damage, neurodegenerative diseases, enhanced production of damaging free radicals and reactive oxygen species, membrane weakening, and damage to heat shock proteins are all non-thermal effects that have been found to occur following cell phone radiation exposures at levels far below SAR regulatory limits. SAR limits do not adequately protect public health.

For all of the reasons noted above, over 200 scientists have taken part in the EMF Scientist Appeal and have called for the urgent development of EMF guidelines that are more protective. In the United States, the American Academy of Pediatrics (the nation's largest group of over 64,000 pediatricians and pediatric specialists) has urged the FCC to update US outdated cell phone testing methods and stated, "The current metric of RF exposure available to consumers, the Specific Absorption Rate, is not an accurate predictor of actual exposure."

Could the SAR tests be wrong ?
Yes. the reality is that SAR testing could be very, very wrong—whether tests are conducted by the government of France or by the cell phone manufacturers. In fact, on September 9, 2016, Swankin & Turner sent a letter on behalf of the National Institute for Science, Law & Public Policy and the Environmental Health Trust to the US Federal Communications Commission about this problem. They wrote about the fact that FCC test methods have a known margin of error (uncertainty factor) which is plus or minus 30%. This means that "over as many as 75% of cell phones in use today could be over the FCC limit."

Examples of how various popular phone brands, and wireless transmitting devices such as tablets, may easily exceed the FCC's limit, with high SARs were included with the letter. The letter remains unanswered by the FCC.

A 30% plus or minus factor is a lot when it comes to our bodies' exposure to radiation. Read the Inquiry letter to the FCC.

What is the solution to this problem?

1. Cell phones and wireless devices should be tested in commonly used positions—especially positions that mimic direct contact to the body. Devices should meet regulatory limits when tested in all possible positions.
2. Laboratory conditions must consider the interactions with metal from internal and external sources (braces, fillings, metal implants, piercings, etc.) and other environmental conditions that occur during real use of cell phones.
3. The cell phone and wireless device certification process must be fully re-evaluated and updated to incorporate different modes of use, different head/body sizes (child and adult), and different tissue properties.
4. To ensure the public is protected, a systematic research review by accountable, independent groups is needed to develop safety standards that protect the public from thermal *and non-thermal effects*. Anatomically-based models of children and pregnant women must be employed in revising safety limits, and children's developmental stages must be considered.
5. The public needs to be fully informed about the radiation that wireless devices emit and how to reduce emissions and exposures.

The above are simply *a few* of the ways that our cell phone certification process must be updated.

Myth: Even though the SAR measurements are high, "it does not matter" because the phone does not go to high power in everyday use.
Fact: The SAR method tests phones at their highest power levels—a worst-case scenario. However, there *are many common circumstances* under which a phone will go to higher power.

Phones go to higher power due to use of applications.

- If more apps are running, the phone is going to higher power to run all of them. Apps are often updating and running even when you are not using them. Widgets are also constantly syncing with the cell tower. More apps running simultaneously = higher exposures.
- Heavier downloads increase power. For example, uploading and downloading music, live streaming, or movie files will result in more radiation than texting.

The harder a phone must work to get a connection, the higher the power.

- When you are inside a car, bus, train, or elevator, the phone goes to a higher power to force its radiation *through the metal walls* to connect to a network base station.
- While you are moving from location to location, such as in vehicles (e.g., cars, trains, buses, aircraft) or cycling, walking, jogging, running, etc., the phone goes to a higher power each time

you're in the fringes of a network base station's coverage area as the phone must check in with the next closest base station in order to remain connected to the network. These higher power connections will happen continuously during travel as the phone is communicating (checking in) with each network tower/antenna you pass by.

- Metal also reflects this type of radiation, therefore the radiation exposure can be far more intense if you are *inside* a room or vehicle with metal exterior or metal furnishings *and moving*. Radiation ricochets around in these spaces and generally this intensifies exposure.
- Phones use more power when trying to connect in low-signal areas. So if you are further from a cell tower because you are in a rural area, or if you are in a large building and not near windows, or if you are in a basement, the cell phone will go to higher power to make a network connection.
- Note: If you are using Wi-Fi on a laptop or tablet or other device and the signal is low, the same concept applies. The wireless device will go to a higher power to connect if the signal is weak.

It would be incorrect to dismiss the French data by claiming phones do not generally go to higher power. Phones do go to higher power in real use situations. Many parents give their children cell phones or tablets for streaming movies while traveling in a car; the phones usually rest in the children's laps for long periods of time during such use. This is one important example of a time when the phone could go to higher power.

Is this a radiation concern only for cell phones? What about other wireless devices?
All wireless devices have this problem—including laptops, tablets, wearables, Wi-Fi routers, baby monitors, printers, keyboards, mouse, gaming consoles, smart utility meters, and many other "wireless" or "smart" devices and sensors. Manufacturers are not required to test these devices at 0 mm distance from the body. Instead, many of these devices are tested at 20 cm (approximately 8 inches) from the body in the compliance testing protocols.

The Samsung laptop manual states, "Keep safe distance from pregnant women's stomach or from lower stomach of teenagers. Body worn operation: Important safety information regarding radiofrequency radiation (RF) exposure. To ensure compliance with RF exposure guidelines the Notebook PC must be used with a minimum of 20.8 cm antenna separation from the body." Yet most people place laptops directly on their lap.

The Apple watch states, "When placing Apple Watch near your face, keep at least 10 mm of separation to ensure exposure levels remain at or below the as-tested levels," despite the fact that people may sleep with their watches on their wrists and have their heads nestled against the watches.

When these devices are tested in positions mimicking direct body contact or positions closer than 8 inches distance to the body—such as a laptop on the lap, or a printer placed to the side of a desk so that the person is close to the printer—then radiation limits can be exceeded. Yet the public is largely unaware and people commonly use wireless devices closer to their bodies than these distances.

Read about the fine print warnings for many wireless devices at webpage on fine print warnings here.

Link to the French ANFR Website with full details on cell phones/make/model
ANFR Cell Phone SAR Measurements (PDF)
Link to EHT Press Release on Cell Phone Data Release
Link to List of Published News Articles on Phonegate.
Link to Dr. Marc Arazi's Blog
Link to France's National Agency for Food, Environmental and Occupational Health & Safety Report on Radiofrequency and Children (In French)
English Translation of ANSES Report Section on Cell Phone Studies

2. International Policy Actions on Wireless Radiation
Countries worldwide are implementing protective policy in regards to wireless radiation.
Click here for EHT's PDF International Policy Actions on Wireless Radiation

ENVIRONMENTAL HEALTH TRUST

INTERNATIONAL POLICY BRIEFING
Cautionary Policy on Radiofrequency Radiation
Actions by Governments, Health Authorities and Schools Worldwide
Please go to source documents by clicking on the blue underlined hyperlink.
(Please email info@ehtrust.org for comments/updates as we do our best to ensure accuracy but the policy landscape is always changing. This is a living document.)

France

French Agency for Food, Environmental and Occupational Health & Safety (ANSES) 2016 Report "Radiofrequency Exposure and the Health of Children" recommends regulatory changes to ensure "sufficiently large safety margins" to protect the health of young children stating:

"ALL wireless devices, including tablets, cordless phones, remote controlled toys, wireless toys, baby monitors and surveillance bracelets, should be subjected to the same regulatory obligations as cell phones."
Recommendations of the Agency: ANSES recommends to "reconsider the regulatory exposure limits" to ensure "sufficiently large safety margins" to protect the health of young children:

- All wireless devices, including tablets, cordless phones, remote controlled toys, wireless toys, baby monitors and surveillance bracelets, should be subjected to the same regulatory obligations as cell phones.
- Compliance with regulatory exposure limits should be insured for the ways that devices are customarily used, such as positioned in contact with the body.

- Exposure limits for radiofrequency electromagnetic fields should be tightened to ensure sufficiently large safety margins to protect the health and safety of the general population, particularly the health and safety of children.
- Reliance on the specific absorption rate (SAR) to set human exposure limits should be re-evaluated and replaced through the development of an indicator to assess real exposures for mobile phone users that applies to various conditions: signal type, good or bad reception, mode of use (call, data loading, etc.), location device is used on the body.
- ANSES reiterated its recommendation, as previously stated, to reduce exposure to children: minimize use and prefer a hands-free kit.

The new report has made headlines across the country.

- ANSES Article: "Radio Frequencies, Mobile Telephony and Wireless Technologies"
- Press Release on Report (translate into English)
- Full 2016 Report (French)
- EHT Press Release on Report

2016 National Decree No. 2016-1074 on the protection of workers against the risks arising from electromagnetic fields

- It is forbidden to place workers under age 18 in posts where EMF is apt to exceed limit values
- each employer has to evaluate EMF risks.
- When exposure exceeding limit values is detected or when an undesirable or unexpected health effect from exposure to EMF is reported, the worker will benefit from a medical visit.
- The employer must provide information and training to his employees regarding the characteristics of EMF emissions, the direct and indirect biophysical effects that could result from exposure to EMF, etc.
- The employer must adapt as much as possible the post in order to limit exposure to EMF.
- Specific precautions will be taken regarding pregnant women.
- Next Inpact News Article: "As early as 2017, employers will have to protect their employees against electromagnetic waves"
- Inter France News Article: "Companies will have to protect employees from electromagnetic waves"
- Decree No. 2016-1074

2015 National Legislation - "Law on sobriety, transparency, information and consultation for exposure to electromagnetic waves." Original Report

- **WiFi Banned in Nursery Schools:** WIFI and Wireless devices will be banned in "the spaces dedicated to home, to rest and activities of children under 3 years".
- **WiFi on "OFF" as Default to Minimize Exposures in Schools**: In elementary schools,WIFI routers should be turned off when not in use.
- **Schools Will be Informed:** The school board should be informed when new tech equipment is being installed.
- **Cell Tower Emission Compliance Will Be Verified:** A decree will define the limits of emission of equipments for electronic communications or transmission to which the public is exposed. These values can be verified by accredited organizations and results will be made accessible to the public through a National Radiofrequency Agency.
- **Citizens Will Have Access to Environmental/Cell Tower Radiation Measurements** Near homes: Every resident may get access to the results of measurements for their living space.

- **Cell Antennae Maps For the Country**: A description and map of the places with atypical (higher than the limits) places will be conducted at regular intervals with follow up of the actions being taken to limit the exposure. A map of all antennas will be produced for each town.
- **Continued Evaluation of Health Effects:** The National Radiofrequence Agency will be in charge of surveillance and vigilance, evaluating potential risks and setting up scientific research, including information on health effects.
- **SAR Radiation Labeling Mandated:** The SAR of cell phones must be clearly indicated on the package.
- Information on Reducing Exposures Mandatory: Information on ways to reduce exposure will be detailed in the contents of the cell phone package. .
- **WIFI Hotspots will be Labeled:** Places where WIFI is provided should be clearly marked with a pictogram.
- Advertisements Must Recommend Devices That Reduce Radiation Exposure to the Brain: Advertising for cell phones should clearly indicate the recommendation of hand free kits for protection of the head of the user and it will be included in the package. Advertising for cell phone not accompanied by such a kit is forbidden. Companies in violation will be fined 75,000 Euros.
- **Children Must Be Provided Protections:** At the request of the buyer, equipment reducing cell phone radiation exposures to the head for children less than 14 years should be provided.
- **The Public Will Be Informed:** Within a year, a policy of information on awareness and information on a responsible and reasonable use of cell phones and other apparatus emitting radiofrequencies will be set up.
- **Electrohyper-sensitivity Report To Be Submitted:** Within a year, a report on electrohyper-sensitivity must be given to the Parliament *according to the law.*
- Le Monde.fr News Article: "A law to frame exposure to the airwaves"

French Agency for Food, Environmental and Occupational Health & Safety (ANSES) 2013 recommendations for limiting exposure to radio frequencies

- Original opinion and report on the Update of the "Radiofrequencies and health" expert appraisal
- Recommends hands free phones, SAR labeling, and "limiting the population's exposure to radiofrequencies… especially for children and intensive users, and controlling the overall exposure that results from relay antennas."
- ANSES news article: "ANSES issues recommendations for limiting exposure to radiofrequencies"

French National Website Informs the Public About How To Reduce Exposure

The Website hosts infographics on 8 Ways To Reduce Exposure which include

1. Protect children and youth the most. It is recommended that parents advise their children or teenagers to use their phone only for essential calls. The use of the SMS and the use of the earpiece should also be encouraged by the parents. In addition to these specific tips, other good gestures should also be adopted.

2. Telephone with a headset: By phoning with a headset (wired or bluetooth, wireless), the phone is moved away from the head. It is an effective way of reducing exposure to head waves.

(EHT Note: Bluetooth still exposes the brain to RF so we do not recommend this.)

3. Prefer SMS (Texting): By using SMS to communicate, one reduces the emission of waves of his telephone. Indeed, to send an SMS, the phone "connects" to the nearest relay antenna only the time to send the message. During a conversation, the phone connects to the nearest relay antenna and renews the connection regularly, especially

on the go. The level of emission of waves is therefore more important. Also when sending an SMS, the notebook is away from the head.

4. Keep the phone away from electronic implants: If you wear an electronic implant (pacemaker, insulin pump, neurostimulator ...), keep your mobile phone away from the equipped area. It can disrupt the functioning of your medical device.

5. Do not call in areas of poor reception: The less the network coverage is good, the more your phone emits waves to keep the conversation going. It is therefore recommended not to call in areas where reception is not good: underground car parks, elevators, confined spaces ... Check the number of bars on your phone, it indicates the quality of coverage of the network.

It is also generally prohibited to call in hospitals and airplanes because of the presence of radio-frequency devices. Your phone may cause interference and interfere with the operation of electronic devices.

6. Move the phone away just after dialing: To limit exposure to waves at the head, you can get into the habit of not approaching the phone in your ear within seconds of dialing. Indeed, it is during these first seconds that the transmission of waves is strongest to find the nearest relay antenna. The level of wave emission then stabilizes.

7. Avoid calling while traveling at high speeds (car, train, bus). When moving at high speed, the phone must successively connect to different relay antennas to maintain the conversation. With each search for a relay antenna, the telephone transmits at full power, the level of emission of waves is therefore regularly higher. It is therefore recommended to avoid calling by train, for example. Telephoning while driving is also prohibited and liable to a fine. The danger comes more from the distraction created by the conversation than from the immobilization of a hand.

8. Read the information in your cell phone manual: You can find out about the level of exposure to the waves of your mobile phone: this is the DAS, whose display becomes mandatory at the points of sale in April 2011. The DAS (Specific Absorption Rate (SAR)) phones Mobile device quantifies the user's maximum exposure level to electromagnetic waves, for use at the ear. The French regulations require that the DAS does not exceed 2 W / kg. The devices described as "anti-waves" have not proved their effectiveness.

Go to French Government Website which hosts these 8 Ways To Reduce Exposure

French National Agency on Frequencies Maintains Information On Cell Tower Radiation:

The Agence Nationale des Fréquences holds public information on the measurements from base stations. Their website has information on their measurements of electromagnetic fields around base stations and other radio frequency emitters.

Over 150 Cities in France have refused Smartmeters

Additional Official Recommendations to Reduce Exposure

French Ministry of Solidarity and Health website on electromagnetic waves. Prior to the 2013 and 2016 recommendations, in 2012 a Brochure Téléphones mobiles, santé et sécurité (Official Recommendations to reduce exposure: Mobile phones, health and safety) was created to inform public

about how to reduce exposure to cell phone radiation. In 2010 Recommendations were issued on the government website here.

2010 French Law on National Commitment to the Environment Cell Phone Statute

- For all mobile telephones offered for sale in the national territory, the specific absorption rate shall be clearly indicated in French. Mention should also be made of the recommendation to use the accessory to limit the exposure of the head to radio transmissions during communications
- Article 183: Cell phone advertising aimed at children younger than 14 is banned. In nursery schools, elementary schools and colleges, the use of a mobile telephone during a teaching activity and in the places provided by the rules of procedure, by a pupil is prohibited. Cell phones made for children under 6 are banned "to limit exposure to children".
- EWG Blog Post: "French law informs, protects cell phone users"
- Law No. 2010-788, Article 184 2010 Decree No. 2010-1207 relating to the display of the specific absorption rate of radio terminal equipment

The City of Lyon France's Cell Phone Campaign "Poster: No Cell Phone Before 12 Years old"

Removal of Wifi From French Cities and Buildings

- The Dacsupap Blog Press Release: "BNF Renounces WiFi"
- The French National Library along with other libraries in Paris, and a number of universities have removed all Wi-Fi networks.
- "Removing Wifi from Schools" - Herouville-Saint-Clair has removed all Wi-Fi equipment installed in municipalities.

Belgium

2014: Ghent Belgium bans wi-fi from pre-schools and day care. Read the Flanders Today article: "Ghent bans wi-fi from pre-schools and day care"

2013 Federal Public Health Regulations Bans Cell Phones and Advertising Cell Phones for Young Children

- Original Legislation:"New rules for selling mobile phones: Practical guide for sellers and distributors"
- Phones designed for children under 7 years old are prohibited from sale.
- Total Advertising Ban on cell phones aimed at children.
- Mandatory Radiation SAR levels must be available for consumers at point of sale.
- Warning label on phones: "Think about your health – use your mobile phone moderately, make your calls wearing an earpiece and choose a set with a lower SAR value."
- Recommendations include use of hands-free methods to keep the phone away from the body such as text messaging and not making calls when the signal is weak, such as in elevator/vehicle.
- Flanders Today News article: "Belgium bans sale of mobile phones designed for children"
- 2014 Presentation on the "Implementation of the Council Recommendations in Belgium" by the Ministry of Public Health of Belgium.
- Belgium Governments's frequently asked questions about the new law.
- Press Release by Dr. Moskowitz: "Belgium Adopts New Regulations To Promote Cell Phone Radiation Safety"
- Lower RF Limits are Precautionary in accordance with advice of the Belgium Health Council.

2009 Resolution of the Belgian Parliament - "Introduction of new rules for mobile phone sales"

Belgian Health Food and Safety Brochure on Wireless Devices: This document discusses everything from DECT home phones to baby monitors to Bluetooth to SAR.

> "Considering that baby monitors can differ so greatly, it is advisable to carefully follow the instruction manual, to place the baby set at a sufficient distance from the crib (at least 1 m) and to use the 'voice activation' setting, among other things."

The Belgian Foundation Against Cancer warns that intensive use of a mobile phone can increase the risk of contracting cancer. They suggest that children younger than 12 should not use a mobile phone, and that using a mobile phone as an alarm clock is not desirable because the phone is in close proximity to the head the entire night. The Cancer Foundation also strongly advises people not to use a mobile phone in the car or a train. Read details in the **Mobile Phones Section 7: UK & International regulations** by Alasdair and Jean Philips.

WHO International EMF Project Report on national activities in Belgium for 2010-2016

- Details the research and legislation activities of Belgium

The Government of the Brussels Capital Region Has Maps of Cellular Antennae: A map of all the locations of antennas is accessible online with the technical data of each installation.

Flanders Belgium Department of the Environment Website Section on "**Radiation: transmitting antennas, WiFi, mobile …"**

- Radiation is unhealthy or not?
- FAQ on transmitting antennas and health

Belgian Federal Public Service: Health, Food Chain Safety and Environment Recommends Reducing Exposure

- "Wireless Devices" - Document describing regulation for wireless telecommunication equipment, wireless home telephones, baby monitors, wireless on the Internet, bluetooth, and comparison of SAR values
- Specific tips for Wi-Fi installations: "In order to limit the exposure, the following simple measures can be taken: Only switch on your wireless network connection when it is needed. This concerns the wifi adapter in your laptop in particular. Otherwise, your laptop tries to continually connect to the network, and that leads to unnecessary exposure and decreases the life expectancy of the batteries. Place the access point away from places where you spend lots of time."
- Tips for prudents use - "So far, it has not been proven that the radiation from mobile phones is harmful to their users. But on the foundation of current scientific knowledge, health risks relating to long-term, frequent mobile phone use cannot be ruled out. Experts – including those on the Superior Health Council – advise everyone to limit their exposure to mobile phone radiation."
- Mobile phones and children - "The use of the mobile phone by children is a special point of attention. Children may be more sensitive to radio waves. Children absorb twice as much radiation in the brain than adults do, and 10 times more in the bone marrow of the skull. In addition, due to the popularity of the mobile phone, the cumulative exposure of the current generation of children will be much higher by the time they reach their adulthood than that of the current adults."
- Electromagnetic hypersensitivity: This webpage contains information about complaints, the state of affairs of the scientific research and advice about what can be done in this situation.

- Wireless on the Internet "Only switch on your wireless network connection when it is needed. This concerns the wifi adapter in your laptop in particular. Otherwise, your laptop tries to continually connect to the network, and that leads to unnecessary exposure and decreases the life expectancy of the batteries. Place the access point away from places where you spend lots of time. "
- Brochure electromagnetic fields in Dutch, French and German

Spain

Several autonomous parliaments and numerous municipalities have adopted resolutions that urge the application of the precautionary principle in the field of electromagnetic pollution, e.g. by eliminating/ limiting wireless networks for children, conducting health education and public awareness campaigns, avoiding the implementation of smart meters, and claiming support measures for people affected by central sensitization syndromes.

Institutional statements of some regional parliaments of the Autonomous Communities (Basque Country and Navarre) adhering to Council of Europe Parliamentary Assembly Resolution 1815 (PACE) of 2011 to apply the precautionary principle in relation to EMF exposure.

More and more Spanish schools requests a cable internet connection, and the case of the School Solokoetxe in Bilbao has been significantly discussed in the Basque Parliament itself in 2015 with scientific advisors provided by the parents' association.

The Basque Parliament

In October 2011, the Basque Parliament in a Non-Law Motion adheres to PACE Resolution 1815 to "act accordingly ... in favor of health protection" in the field of electromagnetic waves, in particular the conducting of information and awareness campaigns "against the immoderate use of mobile phones among children".

In April 2013, a Resolution of the Ombudsman of the Basque Country recommends that the Basque Department of Education implement measures to reduce the levels of radiofrequency emission in schools.

The Parliament of Navarra

In September 2014 the Parliament of Navarre voted to adhere to PACE Resolution 1815 *The potential dangers of electromagnetic fields and their effect on the environment*,with a resolution urging the Spanish Government and the Navarre Autonomous Community Government to implement the recommendations to apply the precautionary principle in relation to EMF exposure. News Article: "The Parliament of Navarre urges to remove the WIFI in schools by precaution"

Since 2012, various institutional declarations have been approved by municipalities and other local entities requesting the implementation of the recommendations of PACE Resolution 1815:

Barakaldo, Errentería, Espartinas, Hospitalet, Jerez de la Frontera, San Sebastián, Vitoria, Villa de Plentzia, Cornellá de Llobregat, Torrox, Mula, Villa de Buenavista del Norte, Poio, Arganda del Rey, Cenizate, Hospitalet, Juntas generales de Guipúzcoa, Villava,

Hospitalet City Council deactivated Wi-Fi:

In April 2014, the Hospitalet City Council deactivated the Wi-Fi network of municipal nursery schools, reducing levels in these centers below the limits required by PACE Resolution 1815. In December 2014, the head of the Hospitalet department of education asked the Department of Education of the Catalonia Autonomous Community to follow the precautionary principle to reduce EMF exposure in Catalan educational establishments.

The Vitoria-Gasteiz City Council at its plenary session in September 2015 unanimously approved a precautionary approach with wireless: Citizens will be informed of the location of wireless transmitters are in civic centers and municipal buildings. It is recommended that children's spaces such as playgrounds and family libraries, will be free of Wi-Fi or have decreased Wi-Fi and Wi-Fi free zones will be established in playgrounds and building entrances.

- El Mundo News Article: "Victoria 'cures in health' against the wifi"

Institutional motions regarding people affected by environmental pathologies

Since 2012, municipal institutional motions have been approved in support of people affected by central sensitization syndromes and / or in favor of prevention and action measures in environmental pathologies: Vitoria-Gasteiz (May 2012), Pinto (January 2014), Jaén (December 2014), Sant Cugat del Vallès (Setember 2014), Tarragona (November 2015), Barcelona (December 2015), Vilanova i la Geltrú (December 2015), Terrassa (January 2016), Hospitalet de Llobregat (March 2016), Vilassar de Mar (March 2016), Montcada i Reixac (March 2016), Castellbisbal (May 2016), Badia del Vallés (April 2016), Arenys de Munt (June 2016), Durango (February 2017).

The Tarragona City Council (Tarragona is a major city 100 kilometres south of Barcelona) at its plenary session in November 2015 unanimously approved the "Institutional Declaration of support for people with Central Sensitivity Syndromes":

1. Carry out (with a yearly update) a diagnosis and census of those affected by CSS in the City of Tarragona, showing what is the actual situation and the specific needs of these patients and their families.
2. An intervention protocol for the staff of the Area of Services to Citizens of the Tarragona City Government to look after those with CSS- including a list of economic subsidies for food, first necessity elements, reduced water bill, and home help specific to the needs of these patients.
3. Housing protocol for people with CSS, especially those who have MCS and/or EHS, those threatened by eviction or those who are forced to leave their home. This protocol has to include a series of safe social housing (green/white spaces: free of xenobiotics and electromagnetic waves).
4. Create green/white spaces in all municipal buildings (free of xenobiotics and electromagnetic waves).

5. Eliminate, as much as possible, the use of pesticides in the whole of the municipality. In the case when this is not possible, establish a communication protocol to contact those affected and the press regarding the places and dates of the interventions with preventive advice.
6. Training for social workers and educators about CSS, its social, health and economic reality. Elaboration of information and education to increase the knowledge about these illnesses amongst the general population and of the city workers in particular, with the objective of diminishing the stigma that is now present regarding these illnesses.
7. Protocol for adapting working conditions of the municipal workers who have CSS with specific measures of support when having a flare up. These would be the measures: work schedule flexibility, encourage work from home through internet (teleworking), reserved parking spaces and include in the collective agreement not deduct the salary of the first 20 days of sick leave.
8. Read the full article in Catalan, Spanish and English detailing the actions here.
9. Blog Post: "GOOD NEWS: FIRST RESCUE PLAN FOR PEOPLE WITH CSS"

In May 2012, the Galician Association of Biologists asks the government of the Autonomous Community of Galicia to apply the precautionary principle to exposure to electromagnetic fields, specifically to protect children: Information on health EMF risks, the ban of the use of mobile phones and Wi-Fi devices in the schools and mobile phone antennas near the schools.

In May 2016, the Guipuzcoan Association of Pharmacists of (COFG) and the Guipuzcoan Association of Fibromyalgia and Chronic Fatigue Syndrome Bizi Bide signed a collaboration agreement of 284 pharmacies in Guipúzcoa to disseminate information and to raise awareness on Central Sensitization Syndromes (Fibromyalgia, Chronic Fatigue Syndrome, Multiple Chemical Sensitivity and Electrohypersensitivity).

Smartmeters

- During 2016 and 2017 motions were approved at municipal or provincial level, in Catalonia and Andalusia, against the installation of "Smart meters" (1 and 2): Sta. Perpetua de Mogada (June 2016), Diputació de Barcelona (June 2016), Barcelona (July 2016), Masnou (September 2016), Hostalet de Pierola (September 2016), Sta. Coloma de Grallanet (setember 2016), Vallirana (September 2016), Sant Feliu de Guíxols (setember 2016), Celrà (October 2016), Hostalric (October 2016), Sant Adrià de Besòs (October 2016), Cerdanyola del Vallès (October 2016), Diputació de Girona (November 2016), Torrelles de Llobregat (November 2016), San Cugat del Vallés (November 2016), Hospitalet de Llobregat (November 2016), Cornellà de Llobregat (November 2016), La LLagosta (November 2016), Pallejà (November 2016), Polinyà (November 2016), Monistrol (December 2016), Rupià (December 2016), Balaguer (December 2016), Cervellço (December 2016), Vendrell (December 2016), Esplugues de Llobregat (January 2017), Molins de Rei (January 2017), Cunit (January 2017), Sant Cebrià de Vallata (January 2017), Caldes de Malavella (January 2017), Prat de Llobregat (February 2017), Fuente Vaqueros (Granada, February 2017), Sant Boi de Llobregat (February 2017), Sant Andreu de la Barca (February 2017), Sant Quirze del Vallès (February 2017), Mollet del Vallés (March 2017), Abrera (March de 2017), Diputación de Granada (March 2017)

Since 2011, several court judgments have been approved recognizing the disability to different people affected by electrosensitivity.

- In May 2011, a judgment of the Madrid Labour Court nº 19 to declare permanent incapacity (100% of his base salary) of a worker Complutense University of Madrid who suffered from chronic fatigue and environmental and electromagnetic hypersensitivity (the EHS is mentioned for the first time in Spain as cause of disability).
- In July 2016, a judgment Nº 588/2016 of the High Court of Madrid has recognized for the first time a situation of total permanent disability for the exercise of the profession of a telecommunications engineer as result of "electrosensitivity syndrome (EHS)". For the first time in Spain, the EHS condition is considered as the main cause of disability involved. "This is the first we have achieved total disability due exclusively to this syndrome," says attorney Jaume Cortés, the Col·lectiu Ronda. Lavanguardia News Article: "A 'teleco' with electrosensitivity achieves the inability to work between wifis: The TSJ of Madrid recognizes the right to a benefit denied by the INSS"
- In February 2017, the Social Court, number 4, of Castellón has issued a ruling that recognizes, for the first time, a permanent disability in the degree of great disability to a patient who suffers as a clinical picture residual multiple chemical sensitivity and electrosensitivity.
- During the last decades, Regional and municipal regulations were approved to reduce the legal exposure in their territories. Unfortunately, now, the last General Telecommunications Law (2014) eliminated the regional and municipal competences in that area.

Canada

Health Canada offers Practical Advice on reducing exposure to wireless radiation

1. Limit the length of cell phone calls
2. Replace cell phone calls with text, use "hands-free" devices
3. Encourage children under the age of 18 to limit their cell phone usage.

2015 Canadian Parliament Standing Committee on Health of the House of Commons Report: "Radio Frequency Electromagnetic Radiation and the Health of Canadians"

- Original Report
- They made 12 recommendations including an awareness campaign on reducing exposures, improved information collecting and policy measures regarding the marketing of radiation emitting devices to children under the age of 14, "in order to ensure they are aware of the health risks and how they can be avoided."

2015 National Bill C-648 was Introduced into the House Of Commons

- An Act Respecting the Prevention of Potential Health Risks From Radiofrequency Electromagnetic Radiation" would require manufacturers of all wireless devices to place specific health warning labels clearly on packaging, or face daily penalties /fines and/or imprisonment. Although the Bill did *not pass,* it made headlines.Press Conference for
- Bill C-648 Video.
- Canadians For Safe Technology Press Section Website

Canadian Pediatric Association issued a Position Statement Recommending no Screen-based Activities for Children under Two

- Original Position Statement: Healthy active living: Physical activity guidelines for children and adolescents
- For healthy growth and development: screen time (eg, TV, computer, electronic games) is not recommended for children under 2 years old. For children 2-4 years, screen time should be limited to <1 h/day; less is better.

European Parliament

2011 The Parliamentary Assembly of the Council of Europe - Resolution 1815:

- **Resolution 1815:** *"The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment."*
- A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours." The Resolution calls for member states to:
- Implement "information campaigns about the risk of biological effects on the environment and human health, especially targeting children and young people of reproductive age. "
- "Reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."
- "For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises."

2009 European Parliament Resolution: Health concerns associated with electromagnetic fields

- Original Resolution
- Urges the Commission to review the scientific basis and adequacy of the EMF limits as laid down in Recommendation 1999/519/EC and calls for the review to be undertaken by the Scientific Committee on Emerging and Newly Identified Health Risks
- Calls for particular consideration of biological effects when assessing the potential health impact of electromagnetic radiation, especially given that some studies have found the most harmful effects at lowest levels
- Calls for active research to address potential health problems by developing solutions that negate or reduce the pulsating and amplitude modulation of the frequencies used for transmission

Australia

The Australian Radiation Protection and Nuclear Safety Agency 2015 Fact Sheet: "How to Reduce exposure from mobile phones and other wireless devices."

- Reduce the risk from WiFi devices by "keeping them at a distance, for example placing the wireless router away from where people spend time", and "reducing the amount of time you use them".
- ARPANSA recommends that parents encourage their children to limit their exposure stating that "It is recommended that, due to the lack of sufficient data relating to children and their long term

use of mobile phones, parents encourage their children to limit their exposure by reducing call time, by making calls where reception is good, by using hands-free devices or speaker options, or by texting."

Queensland Department of Education, Training and Employment - 2015 **"Guide to Safe Technology"**

- It's not only physical hazards you need to consider when thinking about health and safety issues at work or home — you should also think about how you use technology. When using a computer, you need to think about: ergonomics and posture, radiation, vision impacts and harmful lack of exercise (DVT).
- "Wireless devices — smart/mobile phones, tablets, slates, monitors etc — all emit low levels of electromagnetic radiation and should be used correctly. When using electronic devices, the department recommends you follow WiFi/3G/4G best practice:
- Follow the manufacturer's usage guideline operate from a table or bench — not on your lap
- Use 'hands-free' devices to keep smart/mobile phones away from your head and body during phone calls limit the number and length of calls
- Position the device antenna away from your body
- Do not sit within 0.5 m of a wireless router use smart/mobile phone in areas of good reception to reduce exposure."
- Safe use of technology by WFi in Schools Australia - Video

New Zealand

2016 - Rotokawa School Takes Steps to Minimize RF Exposure: After concerns were raised about e-learning by a small group of parents from the school, the principal has put some positive procedures in place as follows:

- Children will use ipads in flight mode
- Children using laptops and Chromebooks will work on the desk top
- Parents may request that their child use an Ethernet cord to access the internet
- Children are taught about the health precautions as part of their cyber citizenship
- Digital learning in the one to one Year 5 & 6 environment is kept to less than 2 hours per school day.
- The principal has also stated there are no plans to increase the existing Wi-Fi coverage at this stage.

Italy

2017: The Italian Court of Ivrea ruling recognizes causal link between cellphone use and brain tumor.

- Italian court is the first in the world to recognize this causal link in an April 11, 2017 ruling which awarded a Telecom employee, Roberto Romeo, lifetime damages of 500 euros a month after he developed a brain tumor from fifteen years of cellphone use.
- Original Ruling
- Press Release EHT
- The Guardian News Article: "Italian court rules mobile phone use caused brain tumour"
- NY Daily News Article: "Italian Court Finds Link Between Cell Phone Use and Tumor"
- Courthouse News Service Article: "Italian Court Finds Link Between Cell Phone Use and Tumor"

2016: Mayor of Borgofranco d'Ivrea ordered Wi-Fi to be turned off in schools. "Mayor Livio Tola told the town's high school and elementary school to return to using cables to connect to the internet after reading that the electromagnetic waves given off by wireless routers were especially harmful to young children."

- The Local News Article: "Italian town shuts down wifi over health fears."
- Torino News Article: "Ivrea, The Mayor Removes WiFi as it Could Be Dangerous".

2015: State Parliament of South Tyrol voted to reconfirm the precautionary principle: The State Government was mandated:

- To replace existing wireless networks whenever possible with networks that emit less radiation at schools, preschools, hospitals, nursing homes, and other public facilities.
- Establish a working group whose mandate it is to assess these new technologies and their exposure levels. With regard to wireless communication technologies, mobile Internet access, and public health, the working group shall clarify which technologies emit less radiation and provide sustainable technology options and
- To start an education and awareness campaign that informs about possible health risks, especially regarding the unborn, infants, children, and adolescents and that develops guidelines for a safer use of cell phones, smartphones, and Wi-Fi.
- Previous Hearing at the Parliament of South Tyrol, 29 April 2015 - "hearing on the effects of mobile radio"
- Discussion at the Plenary Session: "Mobile Communications, Refugees"
- Kompetenzinitiative News Article: "Parliament of South Tyrol Reconfirms Precautionary Principle"
- Official Resolution - "WLAN, mobile radio, radiation exposure: does the precautionary principle apply"

2012 Italian Supreme Court Ruling: Man's brain tumor was caused by his cell phone use.

- The National Institute for Workmen's Compensation must compensate a worker with head tumor due to cell use.
- Reuters News Article - "Italy court ruling links mobile phone use to tumor"
- RT News Article - "Cancer cells: Italian court rules 'mobile phones can cause brain tumors'"
- Daily Mail News Article - Mobile phones CAN cause brain tumours, court rules in landmark case.

Lecce, Italy, "Istituto Comprensivo Alighieri- Diaz" School banned wifi: Their two resolutions decided:

- To ban wifi in school and install a wired system for the use of internet and reject the request of the local government (Municipality) to install an antenna on the school roof for the wireless signal providing for the "Wireless city" program.
- The resolution also asks the Municipality to install the antenna at a reasonable distance from school.

The Piemonte Region Council adopted a resolution to limit EMF exposure by limiting the use of wifi in schools and be considerate to the problem of EHS people.

- Original Resolution - "Adoption of the Precautionary Principle exposition Installations in Wireless Environments in School"

The Italian Society for Preventive and Social Pediatrics has officially called to prohibit cell phones for children under 10 years old.

- Giuseppe Di Mauro, president of the Italian Society of social and preventive pediatrics [Società italiana di pediatria preventiva e sociale (www.sipps.it)] "We do not know all the consequences associated with cell phone use, but excessive use could can lead to concentration and memory loss, increase in aggressiveness and sleep disturbances." and he cites electromagnetic fields stating"The damage to health are increasingly evident"
- Il Tirreno Tuscany News Article - "Pediatricians: Phone Alarm for Kids"

2016 - Turin Mayor Chiara Appendino laid out plans "to cut back on Wi-Fi in state schools and government buildings over concerns that radiation might damage people's health".

- The Local News Report "Turin could slash Wi-Fi over 'radiation' concerns"

Finland

2015 - Radiation and Nuclear Safety Authority (STUK) recommend reduced exposure to children

- "Exposure can be reduced by simple means" webpage recommends:
- Use a hands free device, don't use phones reception is poor, the phone should be kept on a table or similar location instead of in the user's pocket.
- "STUK recommends that unnecessary exposure to radiation from mobile phones be avoided. In particular, children's unnecessary exposure should be avoided as their life-long exposure will be longer than that of those who begin using mobile phone as adults and as only scant research exists on health effects to children."
- "Mobile phones are a major source of radio frequency radiation" webpage states:
- "The level of exposure to radiation from a mobile phone held next to user's ear can approach the exposure limits. *Never before have humans been exposed to equally strong sources of radiation in their living environments.* Identifying any health impacts is highly important because practically everybody uses a mobile phone today."

2009 - Radiation and Nuclear Safety Authority (STUK) initially issued recommendations to reduce exposure with more explicit cautionary language.

- Information posted on the STUK website in 2009, now removed. - "Radiation and Nuclear Safety Authority: Children's mobile phone use should be limited"
- 2009 Policy position paper by STUK detailing why "It would be good to restrict children's use of mobile phones." - "Statement of Finnish Radiation and Nuclear Safety Authority (STUK) concerning mobile phones and health on 7th January 2009"
- 2009 Yle Uutiset News article - "Authority Recommends Restricting Childrens' Use of Mobiles"

Finland Schools

- 2012 Kivioja primary school in Ylivieska Finland bans phones and minimizes Wireless.
- 2017: Wi-fi OFF Switches Installed in the Fiskars primary school. Read press release.

Israel

2017: Ministry of Education banned personal use of cell phones for teaching and educational staff during teaching hours. Read english translated memorandum. Read original Memo in Hebrew

2016: Ministry of Education banned cell phones during the school day.

- Original Summary of the Directive
- A computer or tablet are approved for Pedagogical activities and smartphones are not approved until examination of the issue by the Ministry with published Instructions.

- CH10 News Report - "NEW CEO memorandum - No use of cellphones for learning in class"

2016: The Mayor of Haifa calls for the removal of Wi-fi from all schools. Haifa Mayor Yona Yahav, said that "When there is a doubt, when it comes to our children, there is no doubt".

- "The roots of the decision go back to a 2013 petition by parents in four schools who claim that such networks are harmful. The case eventually made its way to the High Court, which has postponed a final decision on the matter...The movement has spread from Haifa to other cities as well, and petitions have been signed by parents in dozens of cities demanding the removal of the networks. Haifa is the first city to take action on the matter.Haifa Mayor Yona Yahav said that the city would replace the wireless network with a wired connection that will provide safer options to students."
- The school system has developed in house ability to ethernet connect computers in schools, however *in practice,* a few schools are choosing to continue to use wireless despite the ability to be fully hardwired but access is limited.
- **Video of Lecture by Reuven Kurman, BSc, MBA,** Chief Information Officer, Education Department of Haifa, Israel*"What Can be Done" - Reducing Exposure to Children in Schools and at City Level*PDF of January 2017 IIAS Presentation
- Haifa & Haifa News Report - "The Wi-Fi in kindergartens and schools in Haifa severed.".
- Hamodia News Report - "Haifa to Shut School Wireless Networks."

2015 Israel National Activity Report details actions being taken to reduce ELF and RF EMF.

- Cellular operators must inform consumers about radiation safety instructions.
- According to a settlement agreement accepted by the Tel Aviv-Yafo District Court in February 2014, cellular operators have to inform buyers of new mobile phone about the radiation safety instructions, including the minimum distances from the head and the body. Hand-free kits must be provided with every new mobile phone and each cellular operator has to provide information on the safe use of mobile phones on its website.

The Ministry of Health - "Environmental Health in Israel 2014" details EMF Policy, Science and Need For More Protections. Original Publication

- "Precautions should be strictly enforced with regard to children, who are more sensitive to developing cancer." and that "wireless communication networks in schools be reduced." The Health Ministry recommends "sensible use of cellular and wireless technology, including: considering alternatives like landline telephones, use of a speaker while talking on a cellphone, and refraining from installing the base of wireless phones in a bedroom, work room, or children's room." The Report states that "Findings in Israel clearly indicated a link between cellphone use for more than 10 years and the development of tumors in the salivary glands, particularly among people who held the telephone on the same side where the tumor developed and individuals in the highest category of exposure (heavy use in rural areas)."
- Linda S. Birnbaum, Director, USA National Institute of Environmental Health Sciences and National Toxicology Program wrote in the Israeli Report final chapter that, " *If some of the studies turn out to be harbingers of things to come, we may have major health consequences from the nearly ubiquitous presence of wireless equipment."*

2013 Ministry of Environmental Protection Publication on recommendations for ELF-EMF: The recommendations of the Ministry of Environment and the Ministry of Health maximum permissible level of exposure to ELF in places of prolonged chronic exposure such as schools and residences is 4 mG. This is signed by Prof. Stelian Galberg and states that this protection should apply to those under 15 years old.

Israeli Ministry of Health Recommends Reducing Exposure to Cell Phone Radiation

- "These expert committees determined that there are indeed gaps in the knowledge concerning the implications of exposure to this radiation, and therefore they called for further studies on the subjects and recommended to adopt the **"precautionary principle"**. This principle adopts simple and relatively cheap means to reduce exposure to the minimum radiation levels possible with existing technology."
- "In particular, it is recommended to follow precautionary rules in the children population who are typically more sensitive to cancer development due to exposure to cancerous agents...the Ministry of Health advises parents to reduce children's exposure to mobile phones as much as possible, consider the age they start using them, reduce the amount of time mobile phones are used, and in any event, make sure they use earphones (not wireless) or a speaker when using the mobile phone."
- TNUDA - "Recommendations for prudents use of cellphones in Israel" Include:
- Using the speakerphone/headset during conversation.
- Keep the phone away from the body.
- Reduce the amount and duration of calls made on a cell phone.
- Areas of low reception equals higher radiation (low cell tower reception, elevator, car, train) Reduce call time in these low reception areas.
- While driving, it is best to talk as little as possible on the mobile phone, and follow the law which bans handheld phones. Inside vehicles, it is advisable to install an antenna outside the vehicle and not inside it, and to prefer wire connections between the phone and the speaker- rather than bluetooth.

2013 - Israeli Ministry Of Education has issued guidelines limiting WiFi radiation in schools.

- Wireless networks banned in preschool and kindergartens.
- 1st. & 2nd. grade internet is limited to max. 3 hr. per week of internet.
- 3rd grade maximum 8 hours a week.
- A hard wired direct cable connection is required if the teacher has a computer in the class.
- Recommendations for reducing magnetic fields to below 4 mG for children under 15 in schools representing the government's position that international guidelines are NOT protective of children.

Note: Despite the precautionary recommendations of the Health Ministry and the statements in Education Ministry regulations for the preference of wired (not wireless) networks- the reality is that wireless is still being deployed in schools. ICNIRP limits are presented as the limit for comparison at the same time that it is stated that non-thermal effects and effects from long term exposure are possible. The *actual practice* in Israel is different than t*he official stance* and this has prompted strong outcry from doctors, parents and citizens for the government to be accountable to children's health.

- A 2016 News Report shows the complex picture whereby no agency is assuming responsibility for ensuring protections. Although smartphones are banned as an educational classroom tool, the Education Ministry is still promoting the use of digital tools that are used for Smartphones, such as Kahoot.

2002 Israel Consumer Protection Regulations (information on non-ionizing radiation from a mobile phone)

- Compulsory cell phone labeling, radiation information provided to consumers. A mobile phone

may not be sold unless they comply with the following:

- A clearly visible sticker on cell phone packaging that says, “"This mobile phone emits non-ionizing radiation; details and information about the radiation levels of this mobile phone model and the maximum permissible level of radiation are included in the attached leaflet."
- The packaging must include an information leaflet in Hebrew, Arabic and Russian with SAR information.
- The information must be clearly displayed to the public at points of sale of mobile phones, service provision centers, websites of manufacturers, suppliers and service providers of mobile phones.
- Israel Environment and Health Fund - “Non-Ionizing Radiation”
- TNUDA - Compulsory Marking/Provision of Information on Non-Ionizing Radiation
- Israel Ministry of Environmental Protection - “Radiation from Cellphones” Webpage

Notable Israeli News Stories/Videos

- 2016: TV CH 2 Documentary – “HOW WE ARE KILLING OURSELVES – WIRELESS RADIATION”
- 2016 TV Report on Israeli government on WiFi Health Concerns: For english subtitles click CC.
- "Health Ministry: Limit Kids' Use of Cell Phones" - 2009 News article on cell phone guidelines in Israel

Notable History

- “Stop Wi-Fi in schools, deputy health minister implores” - In 2012 Israel's deputy Minister of Health Rabi Litzman stated that he supports a ban on Wi-Fi in schools. Currently the Health Minister is relying on scientific recommendations of Dr. Sadetsky.
- "2012 Israeli National Activity Report" - States that a joint ministerial committee of the Education & Health & Environmental Protection Ministries gave advice to the Education Minister for ethernet connections in schools- not wireless. The Environmental Protection Ministry asked to limit the use of cell phones in buses and to prohibit the use of cell phones in elevators.
- “The Israeli Supreme Court Ordered the Israeli Government to Investigate the Number of Children Currently Suffering From EHS.” - In 2013 a court case moved through the the Israeli Supreme Court on Wi-Fi radiation in classrooms. The 2015 Israeli Supreme court decision was that that the court sees no reason to intervene with the (Israeli) Education Ministry deployments of wireless network at schools.

Israeli Government Links

Ministry of Environmental Protection Webpage on Non-ionizing Radiation, Interactive Map of Cell Tower Locations
Israeli National Information Center for Non-Ionizing Radiation TNUDA
Ministry of Health Webpage on Cell Phone Radiation

Switzerland

The Switzerland Federal Office for the Environment Webpage Informs Public on EMF

- “Mobile as an electrosmog source”
- “How strong is mobile radiation?” - Webpage that contains a PDF of tips for mobile phone use from the Federal Office of Public Health and which states “caution should be exercised primarily when using devices held close to the body, such as laptops, PDAs and Internet telephones..” and gives recommendations on how to reduce exposure including turning the Wi-Fi off when not in

use, installing the access point one metre away from places where you work, sit or rest for long periods of time and keeping laptops off laps.

- Publications on Electrosmog in the environment - Precautionary protection provided by the installation limit values is limited to locations where people regularly spend lengthy periods of time. Here, long-term exposure shall be kept as low as possible. Places of sensitive use include apart- ments, schools, hospitals, offices and playgrounds, but do not include balconies and roof terraces, stairways, garages, storage and archive rooms, temporary workplaces, churches, concert halls and theatres, camp sites, sports and leisure-time facilities, passenger areas in railways, observation decks.
- 2015 Environmental Report - Chapter 17 on Electrosmog states "Effects can also be detected for weak radiation intensity. For example, weak high-frequency radiation can alter electric brain activity and influence brain metabolism and blood flow. Whether these effects have an impact on health is still unclear" and recommends the precautionary principle to reduce risk "Because major gaps still exist in our knowledge about the health impacts of long-term exposure to weak non-ionising radiation, the adopted protective strategy should be pursued consistently."
- 2012 Radiation of radio transmitters and Health - "*In view of the fact that there are gaps in the available data, the absence of proof of health risks does not automatically also mean proof of their absence. From the scientific point of view, a cautious approach in dealing with non-ionising radiation is still called for. There remains a need for extensive research into the potential long-term effects"*

Swiss expert group on electromagnetic fields and non-ionising radiation (BERENIS)

- In Switzerland, the Federal Office for the Environment (FOEN) is the responsible government body for monitoring and assessing research on health effects of non-ionising radiation (NIR) from stationary sources in the environment. The FOEN has nominated *BERENIS - Swiss expert group on electromagnetic fields and non-ionising radiation-* a consultative group of Swiss experts from various disciplines with scientific expertise regarding electromagnetic fields. The BERENIS experts regularly screen the scientific literature, and assess the publications which they consider relevant for the protection of humans from potentially adverse effects. Regular BERENIS Newsletter and Scientific Updates

2008 - The Governing Council of Thurgau Canton Recommends Hard-Wired Schools

- "Parliamentary Inquiry on Wireless LAN at Elementary, Junior and Secondary High Schools"
- "The Governing Council recommends for schools to forgo the use of wireless networks when the structural makeup of a given school building allows for a wired network."
- 2007 "Decision of the Bavarian Parliament - Protecting Children at School from Radiation Exposures Final Report"

Swiss Physicians Association of Doctors for Environmental Protection

- 2012 Swiss Physicians Letter stating, "the risk of cancer for this type of [wireless] radiation is similar to that of the insecticide DDT, rightfully banned... From the medical point of view, it is urgent to apply the precautionary principle for mobile telephony, WiFi, power lines, etc."
- 2014: Preliminary draft for a federal law on the protection against dangers: Non-ionizing radiation (NIS) is growing steadily. Especially the everyday stress in the area of low-frequency and high-frequency.
- 2016: Press Release on the NTP Study and Policy Implications: "There are increasingly clear indications that mobile radio is a health hazard. From a medical point of view it is clear: the scientific results so far show it is clear that prudent avoidance of unnecessary exposures is necessary."
- Report on Smartphones- (OEKOSKOP 1/16)

- AefU-News about Electrosmog

Germany

The Federal Office for Radiation Protection (FORP) Website provides precautionary advice and tips for reducing radiation exposure to smartphones, tablets and wireless devices stating, "*Since long term effects could not be sufficiently examined up to now the Federal Office for Radiation Protection (BfS) recommends to keep exposures to these fields as low as reasonably achievable."*

- "Electromagnetic Fields" FORP Website **"**
- *"There are uncertainties in the risk assessment that the German mobile communications research programme has not been able to remove completely. These include in particular: possible health risks of the long-term exposure of adults to high frequency electromagnetic fields when making mobile telephone calls (intensive mobile use over more than 10 years) & the question of whether the use of mobile phones by children could have an effect on health. For these reasons, the BfS continues to consider that precautionary measures are necessary: exposure to electromagnetic fields should be as low as possible."*
- "Smartphones and tablets – tips to reduce radiation exposure" Website - which recommends: *"It is particularly important to minimise children's exposure to radiation. They are still developing and could therefore react more sensitively in terms of health."*
- "Bundesamt warns schools against WLAN networks" - The FORP recommends landline phone instead of mobile phone base stations and that schools should not connect wirelessly to the internet.
- FORP Public Education Poster "Less radiation when Telephoning"

The German Federal Ministry for Radiation Protection: Read the German Parliament 2007 document which states,"supplementary precautionary measures such as wired cable alternatives are to be preferred to the WLAN system."

Bavaria - The State Ministry of Education and Cultural Affairs

- 2007 Decision of the Bavarian Parliament - Protecting Children at School from Radiation Exposures Final Report
- "For precautionary reasons the Federal Office for Radiation Protection recommends for schools that if a wireless network is used to place its components in suitable locations and to prefer the use of wired network solutions whenever possible." In 2007 Parliament recommendation to all schools to *not* install wireless LAN networks.

Frankfurt's Schools Banish Wireless Networks

- The Local Education Authority did not wish to conduct a "large scale human experiment," said Michael Damian, spokesperson of the Head of the School Department Jutta Ebeling. "In Frankfurt's schools there will be no wireless networks in the short or mid term.
- Omega News Article - "WLAN is to be banished from the school sphere"

2013: Four German Federal Agencies issued a guidebook recommending reducing cell phones and Wi-Fi to young children

- "Parenting Guide: Environmental and Child Health" by the Federal Office for Radiation Protection (BfS), the Federal Institute for Risk Assessment (BfR), the Robert Koch Institute (RKI) and the Federal Environmental Agency (UBA). It contains practical information including reducing electromagnetic radiation from baby monitors and telephones: Baby monitors should be as far as possible away from the crib. Phones should be banished from the nursery. They are not suitable toys for infants and toddlers. Use of cabled landline phones is preferable. Wi-Fi routers are are not suitable in children's bedrooms, and should be switched off when not in use, especially at night.
- Umwelt Bundesamt News Article - "Nothing for children's sorts: Thick air in school and home: Federal authorities publish comprehensive advice on children's health"

Austria

Salzberg Public Health Department Advises Against Wi-Fi in Schools

- Original Letter
- "The official advice of the Public Health Department of the Salzburg Region is not to use WLAN and DECT in Schools or Kindergartens." - Gerd Oberfeld, MD.
- The public health department of Salzburg (Landessanitätsdirektion) also recommends to evaluate mobile phone base station exposures based on the EUROPAEM EMF Guideline 2016
- Lists Electrosmog studies highlighting the EUROPAEM EMF guideline 2016 as representing the current state of medical science that it is used by the Landessanitätsdirektion Salzburg for the health assessment of EMF.

The Vienna Medical Association issued cell phone safety guidelines

- Guidelines state that cell phones should be used for as short of a time as possible and that children under 16 should not use cell phones at all. They also state that "wireless LAN leads to high microwave exposure".
- Ten Cell Phone Guidelines:

1. Make calls as short and little as possible - use a landline or write SMS. Children and teenagers under 16 years old should carry cell phones *only for emergencies!*
2. Distance is your friend- Keep the phone away from body during connection of Phone. Pay attention to the manufacturer's safer distance recommendation in the manual, keep a distance during the call set-up from the head and body. Take advantage of the built-in speakerphone or a headset!
3. When using headsets or integrated hands-free, do not position mobile phones directly on the body - special caution applies here for pregnant women. For men, mobile phones are a risk to fertility if Mobile is stowed in Trouser pockets. Persons with electronic implants (pacemakers, insulin pumps et cetera) must pay attention to distance. Unless otherwise possible, use coat pocket, backpack or purse.
4. Not in vehicles (car, bus, train) calls - without an external antenna, the radiation in the vehicle is higher. In addition, you will be distracted and you bother in public transport the other passengers!
5. During the car when driving should be an absolute ban on SMS and internetworking - the distraction leads to self-endangerment and endangering other road users!
6. Make calls at home and at work via the fixed corded (not wireless) network - Internet access via LAN cable (eg via ADSL, VDSL, fiber optic) no Radiation, is fast and secure data transfer. Constant radiation emitters like DECT cordless telephones, WLAN access points, data sticks and LTE Home base stations (Box, Cube etc.) should be avoided!
7. Go offline more often or use Airplane mode - Remember that for functions such as listening to

music, camera, alarm clock, calculator or offline games an internet connection is not always required!

8. Fewer apps means less radiation - Minimize the number of apps and disable the most unnecessary background services on your smartphone. Disabling "Mobile services" / "data network mode" turns the smartphone again into a cell phone. You can still be reached, but avoid a lot of unnecessary radiation by background traffic!
9. Avoid Mobile phone calls in places with poor reception (basement, elevator etc) as it increases transmission power. Use in poor reception Area a headset or the speakerphone!
10. For buyers of mobile phones, Look out for a very low SAR value and an external antenna connection!

- Press Release - "EMF guideline propagates precautionary principle for electromagnetic fields"
- Translated Poster with Tips

Austria's Highest Health Council of the Ministry of Health Advices to Reduce Exposure to Cell Phone Radiation: Brochure states that since the long term research is still not completed, it is advisable to take simple precautions to reduce exposure.

- Original Brochure
- WHO Report on Austria's EMF activities and research studies

Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses (EMF syndrome)

- Original Guidelines
- The Austrian Medical Association has developed a guideline for differential diagnosis and treatment of health problems associated with outdoor and indoor electrosmog.

India

2012 - The Ministry of Communications and Information Technology issued new EMF guidelines with new Exposure Limits *lowered to 1/10 of the ICNIRP level, and* SAR labeling on phones.

"Keeping the precautionary EMF safe exposure limits for the Radio Frequency Field (Base Station Emissions) as 1/10th of the safe limits prescribed by ICNIRP for all areas in India, eliminates the need for fixing lower limits for specific areas like schools, hospitals, residential premises, children playgrounds; a segregation of which is impractical in densely populated localities." http://www.dot.gov.in/journey-emf

- Official Guidelines
- India Government Precautionary Guidelines for mobile users:
    1. Keep distance – Hold the cell phone away from body to the extent possible.
    2. Use a headset (wired or Bluetooth) to keep the handset away from your head.
    3. Do not press the phone handset against your head. Radio Frequency (RF) energy is inversely proportional to the square of the distance from the source -- being very close increases energy absorption much more.
    4. Limit the length of mobile calls.
    5. Use text as compared to voice wherever possible.

6. Put the cell phone on speaker mode.
7. If the radio signal is weak, a mobile phone will increase its transmission power. Find a strong signal and avoid movement – Use your phone where reception is good. 8. Metal & water are good conductors of radio waves so avoid using a mobile phone while wearing metal-framed glasses or having wet hair.
9. Let the call connect before putting the handset on your ear or start speaking and listening – A mobile phone first makes the communication at higher power and then reduces power to an adequate level. More power is radiated during call connecting time.
10. If you have a choice, use a landline (wired) phone, not a mobile phone.
11. When your phone is ON, don't carry it in chest/breast or pants pocket. When a mobile phone is ON, it automatically transmits at high power every one or two minutes to check (poll) the network.
12. Reduce mobile phone use by children as a younger person will likely have a longer lifetime exposure to radiation from cell phones.
13. People having active medical implants should preferably keep the cell phone at least 15 cm away from the implant.

The Ministry of Communications and Information Technology has an EMF webpage.

2013: Supreme Court of India upheld the High Court of the State of Rajasthan decision to remove all cell towers from the vicinity of schools, hospitals and playgrounds because of radiation "hazardous to life."

- Two hundred and four mobile towers installed on the school premises of Rajasthan have been removed in compliance.
- Zilla Parishad orders removal of all cellphone towers near schools citing exposure to "harmful radiation".
- Economic Times News Article - "Rajasthan HC orders relocation of mobile towers from schools, hospitals"
- Hindustan Times News Article - "Brihanmumbai Municipal Corporation (BMC) bans mobile towers at parks, playgrounds"

Indian Council of Medical Research Continues research on EMFs:

"Short Report on the Indian Studies" - Document prepared by Dr. Sharma, Sr. Deputy Director of the Indian Council of Medical Research on Indian Research Studies.

Department of Telecom, Government of India

- "Ensuring Safety from Radiations : Mobile Towers and Handsets" - Graphic including precautionary guidelines for mobile phones In English In Hindi

2011 Ministry of Environment and Forest Study on the Impact of Communication Towers

- "Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees"
- "*The review of existing literature shows that the Electro Magnetic Radiations (EMRs) are interfering with the biological systems in more ways than one. There had already been some warning bells sounded in the case of bees and birds, which probably heralds the seriousness of this issue and indicates the vulnerability of other species as well."*

Celebrity Advocates Raising Awareness

- Juhi Chawla - who has won multiple awards for her work has taken on the issue of EMF's and recieved the Indira Gandhi Award for her efforts in raising awareness: Global Awards 2016,

Indira Gandhi Memorial Awards, Full Speech at Gandhi Awards, 2011 Lecture, Do's and don'ts for using cellphone safely by Juhi Chawla

Video Lecture: A Review of epidemiology and toxicology: Dr. R.S Sharma, Dr. Devra Davis and special guest Dr. George Carlo at George Washington University – The Milken Institute School of Public Health

In a 2015 lecture at George Washington University, Dr. R.S. Sharma, Indian government Senior Deputy Director General & Scientist of the Indian Council of Medical Research, reviewed the research showing genetic damage and health effects from wireless exposures which are informing India's new telecommunications policy. He describes how the government is supporting efforts to reduce exposures.

Slides from Dr Sharma's presentation can be found here.

News Stories

Government sets up laboratory at TEC for testing radiation level of mobile phone

Russia

Russian National Committee on Non-Ionizing Radiation Protection Issued Resolutions to Protect Individuals from Wireless Radiation

- 2011 Original Resolution - "ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECT ON CHILDREN AND TEENAGERS"
- Official Recommendations: The Russian Federation specifically advises that those under the age of 18 should not use a mobile phone at all, recommends low- emission phones; and requires the following: on-device labelling notifying users that it is a source of RF-EMF, user guide information advising that ''it is a source of harmful RF-EMF exposure'' and the inclusion of courses in schools regarding mobile phones use and RF-EMF exposure issues. "Thus, for the first time in the human history, children using mobile telecommunications along with the adult population are included into the health risk group due to the RF EMF exposure….In children, the amount of so-called stem cells is larger than in adults and the stem cells were shown to be the most sensitive to RF EMF exposure….It is reasonable to set limits on mobile telecommunications use by children and adolescents, including ban on all types of advertisement of mobile telecommunications for children."
- 2008 Original Decision - "Children and Mobile Phones: The Health of the Following Generations is in Danger"
- 2012 - Video of Russian National Committee Meeting in which they repeatedly warn about electromagnetic radiation impacts on children and recommended WiFi not be used in schools.
- 2010 - Video of Yuri Grigoriev, President of the Russian National Committee, giving a lecture

European Environment Agency

2013 - EEA Issues *"Late Lessons From Early Warnings: Chapter 12: Mobile phone use and brain tumour risk: early warnings, early actions?"*

- The chapter concludes that " Precautionary actions now to reduce head exposures, as pointed out by the EEA in 2007, and many others since, would limit the size and seriousness of any brain

tumour risk that may exist. Reducing exposures may also help to reduce the other possible harms..."

2011 - Precautions Recommended by David Gee, EEA Senior Advisor on Science, Policy and Emerging Issues

- Original document - "Health risks from mobile phone radiation – why the experts disagree"
- Gee stated in a press release that "We recommend using the precautionary principle to guide policy decisions in cases like this. This means that although our understanding is incomplete, this should not prevent policymakers from taking preventative action.**"**

2009 - EEA Issues Recommendations Based on Current Evidence

- Original Statement
- "The evidence is now strong enough, using the precautionary principle, to justify the following steps: 1. For governments, the mobile phone industry, and the public to take all reasonable measures to reduce exposures to EMF, especially to radio frequencies from mobile phones, and particularly the exposures to children and young adults who seem to be most at risk from head tumours."

2007 - Professor Jacqueline McGlade, the EEA's executive director issued recommendations

- McGlade stated that "Recent research and reviews on the long-term effects of radiations from mobile telecommunications suggest that it would be prudent for health authorities to recommend actions to reduce exposures, especially to vulnerable groups, such as children."
- Independent News Article - "EU watchdog calls for urgent action on Wi-Fi radiation"

Singapore

Singapore's National Environmental Agency Advises Specific Precautions.

- Frequently asked Questions About Radiation Protection
- NEA's advice to the public on cell phone use on their webpage on radiation protection: "While further research is being carried out to study the long-term health effects of RF field, individuals could take precautionary measures to reduce RF exposure to themselves or their children by limiting the length of calls, or using 'hands-free' devices to keep the mobile phones away from the head and body."

Singapore's Nanyang Technological University **Advice to Limit Cell Phone radiation**

The University website page called "Mobile Phone and Health" which states:

Cell phones do have effects on people. Some people feel headache after talking too long and some hypersensitive people fell sick when the cellphone is turned on. These effects are mainly non-thermal effects and we do have a new explanation. We believe that non-thermal effects are due to the waveforms (causing mechanical vibration) that are determined by the frequency of carrier wave and the modulation that is way to put the information riding on the carrier wave. The principle and effect of modulation may be explained using a very close example, music or sound. Different music and sound have different waveforms, assuming the same small volume one may feel comfortable when listening some music or sound but fell uncomfortable or even sick when listening to some other music or (noise) sound (like scratching glass using something). It has been reported that certain waveforms can be used to cure some mental illnesses such as depression, sleepless, etc. This shows that the nerve system of people could be affected by the waveforms.

"Suggestions" include:

- Shorter conversations.

- Avoid speaking for long periods on the cell phone. Try to plan your calls in such a way that you use ordinary phones for long conversations.
- Speak as little as possible inside the car:
- because the reflection from the car cavity may amplifies the radiation. If you have to speak a lot from the car - get a roof antenna.
- To use plug-in earpiece:
- Plug-in earpiece will separate the antenna further away from your head/body.
- Try a CDMA phone if you are hypersensitive to a GSM one:
- If you fell headache or uncomfortable when using a GSM phone, you may be hypersensitive to the modulation of electromagnetic waves. People are less sensitive to CDMA phones.
- Newer CDMA system works differently than GSM system and doesn't emit the sharp-edged lower frequency pulses. The digital RF signal more resembles a noisy analogue signal and is also likely to be less bio-active. This may also be one reason to push industry to replace GSM systems with CDMA systems.
- Read Singapore's Nanyang Technological University Webpage on Cell Phones here

Poland

In April 2016, the Polish government announced they were preparing an Act on protection of the population from the radiation emitted by mobile base stations.

According to the Telecom News article:

> "The Polish Ministry of Digitalisation has announced its preparation of an act on the control of the effects of electromagnetic radiation from radiocommunications devices on human life and health, reports Telko.in. The first consultations are planned for the beginning of May. Discussions on public concerns related to electromagnetic radiation are conducted under the patronage of the President's Office.
>
> After the first round of the discussions, the ministry decided to withdraw the controversial provision on facilitating the placement of radiocommunications devices from the draft amendment of the act to support telecommunications services and network development.
>
> The task of the new consultation group will be discussing the assumptions of the draft act with experts and the public and subsequent preparation of the draft. The group will include representatives of the public sector, the public, telecommunications operators and experts in the field of radio-communications and medicine, namely the Institute of Communications and Collegium Medicum of the University Jagiellonski.
>
> The new acts will enforce supervision of emissions standards, tightening sanctions and increase the influence of the local community on the process of placing new radio communications devices."
>
> Read the April 2016 Telecom Article on Poland's Developing Action

> On December 2016, a conference was organized by the National Institute of Telecommunications on "Medical, Biological, Technical and Legal Aspects of Electromagnetic Field Influence on Environment" (see warsaw-conference-on-emf) and speakers from Poland, Finland and Japan presented the latest research and opinions about EMF technology and health.
>
> Video's of the lectures are available at the Polish Government website here

Slides from Dariusz Leszczynski's lecture "Cell Phone Radiation, Health Hazard and Precaution" are available on his blog.

The first mayor of Kraków to be elected by popular ballot, law professor Jacek Majchrowski initiated forums for citizens to discuss the growing 'smog' of electro-magnetic fields.

United Kingdom

The UK National Health Service recommends reducing exposure since 2002.

- 2002 Steward Report commissioned by the UK Government - "Phones and Mobile Health - AUK Perspective". The report found that exposure to RF radiation below guidelines has not been "proven" to cause adverse health effects but it is not possible to say "that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects" as "there is some scientific evidence which suggests that there may be biological effects and gaps in knowledge justify a precautionary approach to the use of mobile phone technologies until much more detailed and scientifically robust information on any health effects becomes available."
- UK Department of Health - 2005 "Mobile Phones and Health" brochure which reads: *"The expert group has therefore recommended that in line with a precautionary approach, the widespread use of mobile phones by children (under the age of 16) should be discouraged for non-essential calls. In the light of this recommendation the UK Chief Medical Officers strongly advise that where children and young people do use mobile phones, they should be encouraged to: • use mobile phones for essential purposes only • keep all calls short - talking for long periods prolongs exposure and should be discouraged The UK CMOs recommend that if parents want to avoid their children being subject to any possible risk that might be identified in the future, the way to do so is to exercise their choice not to let their children use mobile phones."*
- NHS 2009 slide presentation - "Radio Waves"
- 2015 Webpage "Risks of mobile phone use"' with recommendations that state, *"Children are thought to be at higher risk of health implications from the use of mobile phones. This is because their skulls and cells are still growing and tend to absorb radiation more easily. It is recommended that children use mobile phones only if absolutely necessary.*"
- National Health Service - 2011 "Mobile Phones and Base Stations" which reads, *"Therefore, as a precaution, the UK Chief Medical Officers advise that children and young people under 16 should be encouraged to use mobile phones for essential purposes only, and to keep calls short. If you are concerned, you can take steps to reduce your exposure such as using hands free kits or texting.*"
- 2011 NHS Brochure - "Mobile phones and base stations: Health advice on using mobile phones", which states: "The body and nervous system are still developing into the teenage years. Therefore, as a precaution, the UK Chief Medical Officers advise that children and young people under 16 should be encouraged to use mobile phones for essential purposes only, and to keep calls short."
- Prior to 2015, the NHS also had additional website sections on health effects, including "Mobiles and mums-to-be" web page, which summarized the research showing cell phones had been linked to behavioral issues in children. NHS also had a "Mobile effect on sleep" webpage which detailed research which concluded RF " is associated with adverse effects on sleep quality within certain sleep stages". For the public, the NHS had "recommendations to help lower any potential long-term risks" which included keeping calls short, keeping the phone away from the body on standby mode, only use the phone when the reception is strong and using a phone with an external antenna. These web pages were deleted from the current site.

- In 2011, the National Health Service offered specific recommendations to reduce cell phone radiation exposure to children. Precautions are still recommended, however by 2015 this original advice was no longer present on the site. **The UK National Health service changed the public advice text. Everything noted *above* was reworded. *Now* the website states:**
- 2015 Mobile Phone Safety - Risks Webpage - "If there are any health risks from the use of mobile phones, children might be more vulnerable because their bodies and nervous systems are still developing. Research carried out to date hasn't supported a link between mobile phone use and childhood cancers such as leukaemia. However, if you have any concerns, you can lower your child's exposure to radio waves by only allowing them to use mobile phones for essential purposes and keeping calls short."
- The newly edited section called "Mobile phone safety - FAQs" states: "***Do scientists know everything about mobile phones and health?*** *No, and research is continuing. Mobile phones have only been widely used for about 20 to 30 years, so it's not possible to be so certain about the safety of long-term use. More research on the effects of mobile phones on children is also needed, as they're known to be more sensitive than adults to many environmental agents, such as lead pollution and sunlight. Government advice is to be on the safe side and limit mobile phone use by children."*
- 2015 Webpage "Risks of mobile phone use"' contains recommendations that state,*"Children are thought to be at higher risk of health implications from the use of mobile phones. This is because their skulls and cells are still growing and tend to absorb radiation more easily. It is recommended that children use mobile phones only if absolutely necessary.*"

2016 Regulation No. 588 - "Control of Electromagnetic Fields at Work"

- Original Legislation
- The regulation requires employers to assess the levels of EMFs their employees may be exposed to, ensure compliance, provide information on risks and take action if necessary.
- "*You must ensure you take workers at particular risk, such as expectant mothers and workers with active or passive implanted or body worn medical devices, into account when appropriate, devise and implement an action plan to ensure compliance with the exposure limits."*
- Safety and Health Practitioner News Article - "Explained: CEFAW Regulations, which come into force today"

Cyprus

2017 Directive of the Minister of Culture and Education to Ban Wi-Fi from kindergartens, Remove Wi-Fi from Elementary Classrooms and Halt Deployment.

- Original Translated Directive from the Cyprus Minister of Culture and Education
- Wireless is recommended only to be used if needed in the administrative areas of elementary schools, not by the students. However, if the use of Wi-Fi is required, " necessary measures to protect children should be taken, and wireless access points should remain inactive when not in use for teaching purposes." Furthermore before installation of any wireless program involving teachers or students "the consent of parents should be ensured in advance" the directive reads stating that the director of the school should send a letter to the parents of children who will participate in programs involving wireless technology informing them for the reason and duration of WiFi usage.
- Read Press release on Cyprus Wi-Fi removal from elementary classrooms

Cyprus National Committee on Environment and Child Health

- "Protecting children from radiation emitted by Wi-Fi, mobile phones and wireless" Webpage
- EMF brochure on reducing the risks to children from exposure to the Non Ionizing Radiation (mobile phones, Wi-Fi, tablets, etc.).
- The Cyprus National Committee on Environment and Child Health is supported by the Nation of Cyprus and "has as its basic aim the prevention of illnesses, which also are related with the exposure of children in environmental dangers." The activities of the National Committee are supported by the State of Cyprus.
- The National Committee recommends, "Be Precautionary and reduce exposure to phones, Wi-Fi and other wireless devices," states the Cyprus National Committee on Environment and Child Health (ECH). Dr. Stella Michaelidou, President of the ECH, states that society should respond by taking precautions because "Documentation of other potential and more serious biological side effects are on the tip of an emerging iceberg."
- An In-Cyprus news article quoted Michaelidou as saying that "multiple and frequent exposure to this kind of radiation, which falls below the acceptable levels of thermal effects, pose a health risk to a developing embryo." Children who use their mobile phone more frequently face a higher risk at having a weaker memory, attention deficit disorder, and similar issues.
- In-Cyprus News Article - "Mobile devices could harm kids"

Public Awareness Video

- **PSA Video on Children's Health and Wi-Fi:** Original Video in Greek & English
- **PSA Video on Pregnant Women and Wireless:** Original Video in Greek & English
- Youtube channel of the Committee

Scientific Presentations:

- 2015 Powerpoint Slide Presentation by the President of the Commission, Dr. Stella Kanna Michaelides on EMFs (in Greek)
- Dr Michalis Tornaritis on media use (in Greek)
- Dr. Michaelidou of the National Committee gives presentation to Ioannina University: "Neurological and behavioral effects of Non Ionizing Radiation emitted from mobile devices on children: Steps to be taken ASAP for the protection of children and future generation
- **Stella Canna-Michaelidou, PhD,** President of the National Committee on Environment and Children's Health of Cyprus, *Multi-Media Public Health Tools to Promote Public and Health Professional Understanding of Wireless Radiation* PDF of January 2017 IIAS Presentation

News Reports from Cyprus

- April 2016 - Dr. Michaelidou, President of the Cyprus National Committee, gives presentation: "Environment and Health of the Child", presenting on the issue of Electromagnetic radiation and its effects on children's health.
- Sigma TV News Report - "Children and Wi-fi"
- President of the National Committee "Environment and Child Health" with Professor Loukas Margaritis speaking in a news piece. https://www.youtube.com/watch?v=WumF2qOUKrU
- 2015 In-Cyprus News Report: **Mobile devices could harm kids**
- 9/2015 News Report Cyprus Mail: 'Technology harming our children' MPs say

Argentina

2016 Proposed National Law on Electromagnetic Pollution

- The law proposes a regulatory framework to "radio infrastructure with radiant systems, antennas and all installations capable of generating electromagnetic radiation" in order to "ensure the protection of public health" considering "both thermal effects and biological. " In education and health facilities only wired connections to data networks and Internet access may be used.
- Electrosensibili News Article

Taiwan

2015 - Government Updated their Protection of Children and Youths Welfare and Rights Act to Ban Cell Phones for Young Children.

- Complete ban on children under the age of two from using electronic devices such as iPads, televisions and smartphones.
- Parents can be fined NT$50,000 (about $1600 US Dollars)
- The new law also states that parents must ensure that under-18s only use electronic products for a 'reasonable' length of time.
- Daily Mail News Article - "Taiwan makes it ILLEGAL for parents to let children under two use electronic gadgets... and under-18s must limit use to 'reasonable' lengths"
- Teen Safe News Article - "Fined For NOT Monitoring: Taiwan's New Parenting Penalty"

Namibia

2011/2012 - Namibia's atomic energy review report states that current so called "safety" standards DO NOT protect citizens from long term health effects.

- Atomic Energy Annual Review
- "ICNIRP guidelines do not guarantee adequate protection against the long term effects of exposure, such as increased risk of cancer. " - Republic of Namibia:Atomic Energy Board

Turkey

The Ministry of Health has issued public information brochures that recommend limiting exposure especially for pregnant women and children.

- Ministry of Health Brochure Mobile Phones and Health Effects:
- The Brochure starts by saying the research on cell phone radiation shows low levels of electromagnetic frequencies "may cause cancer". 13 Recommendations to Reduce Exposure *which include:* Pregnant women and children (under 16) are more vulnerable and they should use the phone only when necessary, Prefer speaker or headset, Decrease time on phones, Use low SAR phone, Keep phone away from the body, Keep phones out of baby and children's bedroom,Turn phone off when you sleep or keep it one meter away from bedside, using phones in cars increases your EMF exposure so it is not recommended.

Education on Safer Phone Use Project

- The project is mentioned in the following document: "Annual Report from Turkey: National Activities on Health Effects of Electromagnetic Fields."

- Turkey has begun an educational project funded by Ministry of Internal Affairs, accomplished by Temkoder (Prevention, Measurement of Electromagnetic Pollution and Training Organization), which has resulted in secondary school student training in the safer usage of cellular phones.

Development of regulations prohibiting children's cell phone use. In 2014, the Ministry of Health started working on new regulations to prohibit cellphone usage for children under 14 year-old children.

- 2014 WHO Report - "Annual Report from Turkey: National Activities on Health Effects of Electromagnetic Fields."
- However by 2016 the regulation was weakened and in 2016 Turkey stated that they are developing regulations that only would pertain to children under 7 years old.
- 2016 WHO EMF Report - "Short Report Related to National Activities on Health Effects of Electromagnetic Fields"

The Ministry of Communications and Maritime Affairs monitors Electromagnetic fields around the schools and homes.

- Ministry Website
- The EMF in schools is monitored and the public can get measurements on EMF levels from cell towers and schools at a national site.

Greece

Greek law mandates lower RF exposures near schools, nurseries and hospitals

- The exposure limits in Greece are at 70% of the official European limits. In areas less than 300 m from schools, hospitals and nurseries the exposure limit is lower at 60% of the official European limits. Cell antennae are prohibited from being on top of schools and nurseries.

2012 - The Greek government website materials recommend reducing cell phone radiation to children under 16 and they inform citizens of non-ionizing radiation power levels in their community.

- The National Observatory of Electromagnetic Fields - Interactive web portal linked to a network of 500 fixed measurement stations throughout Greece that continuously monitor the EMF levels from all kinds of antenna stations in the frequency range 100 kHz – 7 GHz.
- ELF and EMF Site Measurements can be looked up for various locations at EEAE.
- The Greek government funds research as detailed on the WHO EMF report.
- The Q and A on RF radiation states the following text about children:

> *"Even though it hasn't been proven conclusively that children are more sensitive/reactive than adults to exposure to radiation, nevertheless, the direct/pointed recommendation of international organizations is that children be discouraged from [literally translated, learn not to trust] using cell phones. The above statement is supported by the following:*
>
> *1. Up to about the age of 16, the nervous system of the human body is in the process of development. Consequently, it's totally possible (although not conclusively proven by relevant scientific research) that up until this age, human being are more sensitive to any number of factors/elements/determinants.*
> *2. Younger people have more years ahead of them than older persons during which the long –term effects of mobile phones can be manifested.*

3. Environmental factors/elements have a greater general impact on the health of children than on the health of adults."

Athens Medical Association

2017 the Athens Medical Association voted to issue 16 recommendations to reduce human exposure to wireless radiation. Read the press release here.

16 RULES FOR SAFER USE OF WIRELESS COMMUNICATION

- Use your cell phone with caution and make brief calls as necessary
- Children under the age of 14 should make limited use of cell phones
- Do not put your cell phone in contact with your head
- Do not use your cell phone inside a car, train, aeroplane, or elevator
- Restrict cell phone use when children or pregnant women are near
- Keep mobile phones away from your body
- When using your cell phone keep a safe distance from others
- Do not carry or keep your cell phone inside your pockets
- At bedtime, disable WiFi on your router and switch off your mobile phone
- Do not play games on-line; and if you will, first switch to airplane mode
- Hands-Free option is always preferable though may not be completely safe
- Wireless connections may increase your exposure to microwave radiation
- Limit WiFi connectivity and use hard-wired connection whenever possible
- When signal strength is weak do not attempt to make a call
- If a corded landline is available make use of this as a preferred option
- Disable WiFi, Bluetooth & Data options from your cell phone and other mobile device(s) when not needed.

Athens Medical Association website page on Electromagnetic Radiation and Health Conference whereby doctors voted to issue these recommendations.

Chile

2012 "Antennae Law" prohibiting cell antennae/towers in "sensitive areas"

- International Bar Association Legal Practice Division Newsletter: "New communications antennae law in Chile"
- 'Regulates the installation of antennas used for the emission and transmission of telecommunications services' This law limits the power of antennas, reduces urban impact of towers through 'infrastructure sharing' opens up a process for citizen participation in the approval or denial process, establishes mitigation measures in areas that are saturated with antennas and prohibits towers near "sensitive areas" institutions serving children, the elderly and medically compromised.
- Sensitive areas are those areas that demand special protection due to the presence of educational institutions, nurseries, kindergartens, hospitals, clinics, nursing homes or other institutions of similar nature.
- Chile's Minister of Transportation and Telecommunications Pedro Pablo Errazuriz stated, "*...in addition to protecting the urban landscape and the goodwill of the neighborhoods, the new law takes care of the most important: the health of people in a precautionary manner as recommended by the World Health Organization, setting strict limits on the powers of the antennas. Chile is setting standards in this regard."*

- Press release
- RCRWireless News Article - "Chilean telecom companies need to comply with new antenna law"

Ireland

Department of the Environment, Community and Local Government Gives Advice to Reduce Exposure

The department has a webpage on Electromagnetic fields which directs people to the advice of the Chief Medical Officer.

- Advice of the Chief Medical Officer of Ireland.
- "Advice from the Chief Medical Officer on mobile phone use: We may not truly understand the health affects of mobile phones for many years. However, research does show that using mobile phones affects brain activity. There is general consensus that children are more vulnerable to radiation from mobile phones than adults. Therefore the sensible thing to do is to adopt a precautionary approach rather than wait to have the risks confirmed.In the light of these findings, the Chief Medical Officer of the Department of Health and Children strongly advises that children and young people who do use mobile phones, should be encouraged to use mobile phones for "essential purposes only" All calls should be kept short as talking for long periods prolongs exposure to radiofrequency electromagnetic fields.All mobile phone users can reduce their exposure to radiofrequency energy by making fewer calls, reducing the length of calls, sending text messages instead of calling, using cell phones only when landline phones are unavailable, using a wired "hands free" device so that the phone need not be held against the head and refraining from keeping an active phone clipped to the belt or in the pocket".

Irish Doctors Environmental Association Recommends Wired Connections

- 2013 Letter
- The Irish Doctors Environmental Association wrote a statement in 2013 concerning health concerns with Wi-Fi in school: "We urge you to use wired technologies for your own safety and that of your pupils and staff."

Denmark

Denmark Board of Health Provides Recommendations to Reduce Exposure

- Denmark Board of Health Recommendations on Reducing Cell Phone Radiation
- "As a precautionary measure, the Board of Health recommends a series of simple steps you should follow to reduce exposure from mobile phones:

  Use the headset or handsfree with earbud, conversation, or use the speakerphone feature
  When possible, use text instead of call
  Limit the duration of calls
  Did not sleep with the phone close to the head
  Limit conversations during low reception and while in transport.
  Do not cover the phone with aluminum foil, special covers, etc.
  Compare phones' SAR value. Lower SAR require less exposure

Denmark Schools that have removed or reduced wireless exposure; Bjedstrup elementary School og Børnehus, (school and kindergarten) Student must hand over cell phones before classes + no wifi in

school premises; Hammer Free Private School - all internet connections are hard wired; Vejlernes private school - no wifi; Kastanjely kindergarten - no wifi

Tanzania

2014 - Director General of Tanzania Atomic Energy Commission (TAEC), Mr Idy Mkilaha publicly endorses precaution.

- "Mr Mkilaha says that when weighing up this convenient tool with the questionable health impact control, caution and measures must be taken to reduce one's exposure from radio frequency (RF) emissions from the cell phone to prevent health hazards."
- "According to TAEC, we should use hands-free devices or wireless headset to increase the distance between the phone and our heads. This is the best approach because it creates distance between us and the radiating phone… We should also keep phone away from us when dialling. Phones use more radiation during connection time, says TAEC."

News Reports

- AllAfrica News Article: "Tanzania: We Should Manage Our Cell Phones Properly Otherwise…"
- AllAfrica News Article: Tanzania: Need to Protect Oneself When Using Cell Phone

Tanzania Commission for Science and Technology Newsletter Details how to reduce cell phone exposure

- Original Newsletter (pg. 11)
- After complaints were raised by residents about health effects the Commission co-authored a published paper that reviews national RF level profiles of the radiation emitted from base stations.
- Review on Measured and Calculated Radio Frequency Radiation Emission From The Base Stations
- The paper states: *"In 2016, Director General of Tanzania Atomic Energy Commission (TAEC), Mr Idy Mkilaha died under investigated circumstances and at this time EHT is unable to find the Reports or official warnings as mentioned in the news reports on the current Atomic Commission webpage."*

Romania

Recommendations Of The Consumers Protection Association Of Romania On Cell Phones And Wireless

- Recommendations to reduce exposure
- The Association for Consumer Protection in Romania launched a national campaign of information and awareness of consumers entitled "SOS electromagnetic pollution."
- *"Do not allow children younger than 12 years how to use a cell phone, except for emergencies. Developing bodies are more susceptible to negative influences from exposure to electromagnetic fields".*

United States

Legislation has been introduced at the state and national level. Some Communities have issued proclamations, resolutions and and started initiatives to inform the public of wireless health issues.

May 12, 2015 Berkeley Adopted the Cell Phone "Right to Know" Ordinance on a Unanimous Vote. Berkeley is the first city in the nation to require cell phone retailers to provide those who purchase a new phone an informational fact sheet which informs buyers to read the user manual to learn the cell phone's minimum separation distance from the body. The text states:

> "The City of Berkeley requires that you be provided the following notice: To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. Refer to the instructions in your phone or user manual for information about how to use your phone safely."

- "Right to Know" Ordinance Dr. Moskowitz blog on the Ordinance
- Berkeley's Right To Know Ordinance: Environmental Health Trust's Page on the Ordinance
- Video of the historic vote featuring Harvard Law professor Lawrence Lessig.
- Video of testimony to Berkeley from November 8, 2011 on the need for cell phone guidelines.
- Video of the September 2016 Federal Appeals Court Hearing oral arguments CTIA vs. Berkeley as the CTIA tries to strike down the Ordinance. -- This the hearing considering whether to overturn the district court's decision that denied the CTIA's request for an injunction to block Berkeley's cellphone ordinance.

NEWS RESOURCES

- March 2017 video of CBC's coverage of the Berkeley Ordinance with an investigation finding cell phones tested against the body violate current safety standards.
- News One: Video on Ordinance

2014 - Wireless Router Labeling in all Suffolk, NY Public buildings: Legislation requires all county buildings to post notices that wireless routers are in use such as, "Notice: Wireless technology in use." The resolution, sponsored by Legis. William Spencer (a physician), warns that every wireless device emits radio frequency radiation or microwave radiation. It notes that studies "that have looked at the effects of low-level RFR radiation on human cells and DNA have been inconclusive."

- "Press Release: Suffolk County Passes Legislation to Warn Visitors of Wireless Radiation Exposure"
- Newsday News Article - "Wireless routers to get warning signs at Suffolk county buildings"

2011 - A Passed Ordinance by the City of San Francisco required cell phone retailers to distribute an educational sheet: Educational sheet created by the San Francisco Department of Environment that explains radiofrequency emissions from cell phones and details how consumers can minimize their exposure. However implementation was blocked after a **three year court battle.** The CTIA sued the city and settled with the City to block implementation of the Ordinance in exchange for a waiver of attorney's' fees.

- Although implementation was halted, the City Cell Phone Radiation Webpage remains online.
- Open Letter to San Francisco Mayor and Board of Supervisors
- Press Release: "San Francisco's Cell Phone Fact Sheet is Factual"
- Video from testimony to the City of San Francisco
- Video of San Francisco Supervisor discussing the Ordinance here.
- Press conference with survivors speaking on cellphone health risks at the San Francisco Commonwealth Club. Cellphone cancer victims tell their personal stories and those of their lost

loved ones.
- San Francisco developed the following public health information resources:
- City Webpage - "Cellphones"
- Answers on How to reduce exposures to cell phone radiation.
- A Poster on Cell Phones and RF Radiation
- A Factsheet for the Public
- Display stickers for Cell Phone packaging.

US PUBLIC SCHOOLS

2017 - Maryland State Children's Environmental Health And Protection Advisory Council Recommendations For Wired Internet In Schools and Minimizing RF Classrooms:

- The Maryland State Children's Environmental Health and Protection Advisory Council (CEHPAC) issued a Report advising the Department of Education to recommend local school districts reduce classroom wireless radiation exposures by providing wired—rather than wireless—internet connections.
- The Children's Environmental Health and Protection Advisory Council recommendations:
- "The Maryland State Department of Education should recommend that local school systems consider using wired devices" "WiFi can be turned off" and instead "a wired local area network (LAN) can provide a reliable and secure form of networking...without any microwave electromagnetic field exposure."
- "New school construction and renovations to include wired cabled connections: "If a new classroom is to be built, or electrical work is to be carried out in an existing classroom, network cables can be added at the same time, providing wired (not wireless) network access with minimal extra cost and time."
- "The Maryland State Department of Education should recommend that local school systems use strategies to minimize exposures: "Have children place devices on desks to serve as barrier between the device and children's bodies; Locate laptops in the classroom in a way that keeps pupil heads as far away from the laptop screens (where the antennas are) as practicable; Consider using screens designed to reduce eyestrain; Consider using a switch to shut down the router when it is not in use."
- "The Maryland Department of Health and Mental Hygiene should provide suggestions to the public on ways to reduce exposure: Sit away from WiFi routers, especially when people are using it to access the internet. Turn off the wireless on your laptop when you are not using it. Turn off WiFi on smartphones and tablets when not surfing the web. Switch tablets to airplane mode to play games or watch videos stored on the device."
- "The General Assembly should consider funding education and research on electromagnetic radiation and health as schools add WiFi to classrooms."
- The Maryland Department of Health and Mental Hygiene should "ask the United States Department of Health and Human Services to formally petition the FCC to revisit the exposure limit to ensure it is protective of children's health and that it relies on current science."
- "The Report should be shared with the United States Department of Health and Human Services, Federal Communications Commission, Maryland State Department of Education and Maryland General Assembly."
- CEHPAC's health experts include Governor appointed pediatricians, Maryland State House/Senate appointees and representatives of the Department of Education and Department of Health.

LINKS

- Wifi Radiation in Schools in Maryland Final Report
- Letters from Physicians CEHPAC's Public Comments

- Testimony to the Maryland State Children's Environmental Health and Protection Advisory
- Baltimore Sun article by Devra Davis on the Report Recommendations
- Baltimore Sun response by Dr. Cindy Russell
- Public News Service article on CEHPAC Recommendations
- Green Gazette Article on CEHPAC Recommendations

2017 - Montgomery County Maryland Chromebook Policy states that laptops should stay on tables and not on laps.

- Montgomery County Maryland ChromeBook Guidelines for students.

2017: Worcester Massachusetts, School Committee voted to approve "precautionary options" to be posted on the Worcester District Website

Read the Document entitled "Radiofrequency Radiation Exposure" now posted on Worcester's School District's website.

"It is the Administration's view that existing government regulating agencies should be setting proper exposure levels and offering best practices, such as the EPA and FCC".

"Based on the guidance from these agencies, the Administration proposes the following:

If you are concerned about radiation or heat from electronic devices, follow these guidelines:

- Consider increasing the distance between electronic devices and your body
- Consider keeping your cellphone, tablet, or laptop in your purse, backpack, or briefcase case instead of keeping it on or close to your body
- If talking on a cellphone, consider using speakerphone or a hands free headset or reduce the number or length of calls
- When not using wireless or Bluetooth, consider shutting off these services on the device or put the device in Airplane mode
- Consider not placing the device directly on your lap. Instead consider placing it on a hard surface such as a desk or bo

Note: This initiative was supported by a local community organization called Worcester Info Team for Health whose Mission Statement was "… to support Worcester decision makers and others in learning about and mitigating the public health risks posed by the rapid roll-out of wireless devices and infrastructure, emphasizing the Precautionary Principle and seeking collaboration on creative solutions."

Watch video testimony with excerpts from Worcester School Committee deliberations and vote here.

News Articles on the Worcester School Committees Actions on Wi-Fi

- "The Education Beat: Cell phones: protecting yourself and your children" Worcester Magazine May 18, 20
- "Worcester school board hesitant but curious about possible WiFi health risk" Telegram.com October 2016
- Monfredo: How Safe are the Electromagnetic Fields Emitted by Wireless Technology? Go Local Worcester, September 3, 2016

2016 - Petaluma Public Schools, California USA: Public school district adopts "Digital Device Practices"

- Digital Device Best Practices PDF
- Parents raised the issue of wireless health risks with the district for years and this new policy was put in place in 2016. However- as this policy still does not protect the students health, parents

continue to advocate for a safe school environment and signed a petition which can be found at http://responsibleipad.com/petition.html
- The Petaluma 2016 iPad Best Practices state: "Keep it on the Desk: The best place for your iPad to sit during use is on a desk, table or other flat surface."
- Videos of Parent Testimony to District
- Child Testimony
- Doctors Letters to District

2016 - Onteora School District in New York State Adopts "Best Practices with Wi-Fi
- **April 20, 2016 Meeting Minutes Page 2.**
- "Turn off the device when not in use and at the end of each day. If device is to stay on, turn Wi-Fi off when not in use. Always place device on a solid surface. Viewing distance should be a minimum of 12 inches from the screen. Staff was asked by the Principals to post this in areas that contain computers and devices. They are reminding staff to follow it."

2015 - Ashland Public Schools, Massachusetts Institutes "Best Practices"
- Ashland was the first US school District to institute "Best Practices" to turn the Wi-Fi off when not in use and keep devices away from the body
- Download powerpoint slides used for teacher/staff training.
- Video of parent who initiated this, Video of school board member discussing the process.
- Magazine article on Ashland's Decision Here, Newspaper Coverage
- TV Program of parent advocate CeCe Doucette and Keith Marciniak discussing the policy changes.

Los Angeles, California Public Schools Recommends Cautionary Exposure Levels
- RADIOFREQUENCY (RF) EVALUATION REPORT Use of Wireless Devices in Educational Settings
- The LA School District Uses a RF-EMF Exposure Threshold 10,000 Less Than the FCC Limits:
- 2009 adopted resolution - LA School board wrote a resolution banning cell towers from schools and recommending against WiFi.
- 2009 Resolution *Condemning Cell towers NEAR Schools* as was this T-Mobile Cell Tower across the street from an elementary school.
  Motion by Supervisors Zev Yaroslavsky and Michael Antonovich
- 2000 LA School Board Resolution Opposing Cell Tower Placement on Schools -- Calls for precautions with wireless. 'Whereas, Recent studies suggest there is evidence that radio-frequency radiation may produce "health effects" at "very low field" intensities'

Note: ***Digital Device "Best Practices"*** that still allow Wi-Fi access points in classrooms *still allow* microwave exposures to the children and such practices are not adequately protective to children. These District actions seem to be *acknowledgment that wireless device expose the body to radiation*. However, such "Best Practices" still allow access points to be powered on and thus are always exposing the students and staff to continuous microwave radiation regardless of the devices being in use or not. In addition, devices are also continuously transmitting during student use of the internet and no procedure is in place to ensure that Best Practices are followed so that the transmissions are turned off when the internet is not needed. Therefore these "Best Practices" *do not* mitigate the risk nor protect students from School District created wireless exposures.

US HEALTH ADVICE TO THE PUBLIC
2017 - California Department of Public Health releases Cell Phone and Health Document.

- The California document recommends people keep the phone away from the brain and body especially for children stating, "EMFs can pass deeper into a child's brain than an adult's. Also, the brain is still developing through the teen years, which may make children and teens more sensitive to EMF exposures."
- California Department of Health Cell Phone and Health 2017 Released Document
- Guidelines were drafted starting in 2009 . Please read the 27 Versions of the cell phone radiation safety fact sheet prepared by the California Department of Public Health (CDPH) initially in 2009 and revised multiple times through January, 2015 released by the California Attorney General's Office to Joel M. Moskowitz, Ph.D. of the School of Public Health University of California, Berkeley who sued the CDPH for the release of these guidelines. Dr. Moskowitz states that California State has never adopted this fact sheet nor released it to the public due to what Dr. Moskowitz refers to as suppression by "political appointees".
- SUPERIOR COURT OF CALIFORNIA COUNTY OF SACRAMENTO RULING on Petition
- Dr. Moskowitz webpage detailing the release and court case.
- Read Press Release California Department Of Health Releases Cell Phone Warning Same As Issued A Decade Ago
- San Francisco Chronicle News Article - Long-overdue release of information about cell phone risks
- San Francisco Examiner News Article - "California Health Officials release report on cell phone radiation"
- NBC Bay Area News Article - "Cell Phone Cancer Debate Heats up With Document Release"
- San Francisco Chronicle News Article - **"**New records show how state reworked secret cell phone warning" May 19, 2017
- All Guidelines (2009 -2017) and Full Details of CDPH Cell Phone Document

2016 - American Academy of Pediatrics Issues Recommendations to Reduce Exposure

- Healthy Children Webpage on Cell Phones
- The webpage reiterated children's unique vulnerability to cell phone radiation stating, *"Another problem is that the cell phone radiation test used by the FCC is based on the devices' possible effect on large adults—not children. Children's skulls are thinner and can absorb more radiation."*
- The AAP issued the following cell phone safety tips specifically to reduce exposure to wireless radiation:
- Use text messaging when possible, and use cell phones in speaker mode or with the use of hands-free kits.
- When talking on the cell phone, try holding it an inch or more away from your head.
- Make only short or essential calls on cell phones.
- Avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level.
- Do not talk on the phone or text while driving. This increases the risk of automobile crashes.
- Exercise caution when using a phone or texting while walking or performing other activities. "Distracted walking" injuries are also on the rise.
- If you plan to watch a movie on your device, download it first, then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure.
- Keep an eye on your signal strength (i.e. how many bars you have). The weaker your cell signal, the harder your phone has to work and the more radiation it gives off. It's better to wait until you have a stronger signal before using your device.

- Avoid making calls in cars, elevators, trains, and buses. The cell phone works harder to get a signal through metal, so the power level increases.
- Remember that cell phones are not toys or teething items.
- Press Release: The AAP responds to study showing link between cell phone radiation, tumors in rats May 27, 2016

2015 - AAP Healthy Child Web Page on Electromagnetic Fields: A Hazard to Your Health?

- This webpage states: "Cell Phones: In recent years, concern has increased about exposure to radio frequency electromagnetic radiation emitted from cell phones and phone station antennae. An Egyptian study confirmed concerns that living nearby mobile phone base stations increased the risk for developing: *Headaches, Memory problems, Dizziness, Depression, Sleep problems."*
- "Short-term exposure to these fields in experimental studies have not always shown negative effects, but this does not rule out cumulative damage from these fields, so larger studies over longer periods are needed to help understand who is at risk. In large studies, an association has been observed between symptoms and exposure to these fields in the everyday environment."

2013 AAP Letter to FCC

- 2013 Letter to Commissioner Mignon Clyburn and FDA Commissioner Margaret Hamburg calling for a review of RF guidelines

2012 AAP Letter to US Representative Dennis Kucinich in Support of the Cell Phone Right to Know Act

- Original Letter
- Time Magazine News Article - "Pediatricians Say Cell Phone Radiation Standards Need Another Look"

2012 - AAP published Pediatric Environmental Health, Textbook of Children's Environmental Health

- *Chapter 41: Electromagnetic Fields*
- Oxford Medicine Chapter 41

2001 AAP News Article - *More study needed on risk of brain tumors from cell phone use*

2014 - The California Medical Association Passed a Wireless Resolution

- Full CMA Resolution
- "Whereas scientists are increasingly identifying EMF from wireless devices as a new form of environmental pollution … Whereas peer reviewed research has demonstrated adverse biological effects of wireless EMF including single and double stranded DNA breaks, creation of reactive oxygen species, immune dysfunction, cognitive processing effects, stress protein synthesis in the brain, altered brain development, sleep and memory disturbances, ADHD, abnormal behavior, sperm dysfunction, and brain tumors; and...Resolved, That CMA support efforts to implement new safety exposure limits for wireless devices to levels that do not cause human or environmental harm based on scientific research."
- Santa Clara Medical Bulletin article that explains the CMA resolution and gives recommendations for schools.

2014 - The Connecticut Department of Public Health issued specific recommendations to reduce exposure to cellphone radiation.

- Connecticut Department of Public Health Cell Phone Q and A about Cell phones
- It is notable that the Department has provided information more in depth than the CDC, EPA and FDA in detailing 7 steps on *how* people can reduce exposure. Furthermore, the Department states

"It is wise to reduce your exposure to radiofrequency energy from cell phones whenever possible."

2014 - Greenbelt, Maryland City Council voted unanimously for the following policy actions:

- Original letter to the FCC
- Alert citizens about the fine print warnings and possible health risks of cell phones and wireless devices By sharing the Environmental Health Trusts 10 Steps to Safe Tech and Doctors Advice on Cell Phones Brochure in City health fairs and city centers.
- Send the FCC Chairman a letter urging the adoption of "radiation standards that will protect human health and safety."
- Oppose cell towers on school grounds and write a letter to the local school board and County Executive.
- Press Release - "Maryland City Votes Unanimously to Alert Citizens to the Health Risks of Cell Phone/Wireless Radiation and to Oppose Cell Towers on School Grounds"

2011 - San Francisco, California; Cell Phone Radiation (How to Reduce Exposures) Webpages launched

- Webpage - "Cellphones"
- San Francisco developed the following public health information resources:
- Answers on How to reduce exposures to cell phone radiation.
- A Poster on Cell Phones and RF Radiation
- A Factsheet for the Public
- Display stickers for Cell Phone packaging.

2012 - Jackson Hole, Wyoming issued a Proclamation of Cell Phone Awareness

- Original Proclamation
- The proclamation cites concern over long term health effects as well as the increased risk that the radiation poses to children.

2012 - Pembroke Pines, Florida passed Resolution

- Resolution 3362
- Resolution expresses the City's "Urgent Concerns" about Wireless Radiation and Health and which encourages citizens to read their manuals and presents information on how to reduce exposure by using a headset or speakerphone. Jimmy Gonzalez, an attorney who had developed brain cancer after heavy cell use, initially petitioned the Commission.
- Video of Jimmy Gonzalez's powerful testimony

2010- California: Burlingame California City Council voted to include cell phone safety guidelines in their Healthy Living in Burlingame initiative which gives recommendations on how to reduce exposure and states:

"The Federal Communications Commission (FCC) mandates that all cell phone manuals caution users to hold the phone a short distance (.6 inch to 1 inch) from the body. (See your manual's fine print.)

While scientists continue to research and debate this matter, here are some simple things you can do to minimize your exposure to cell phone emissions" Red the Original Guidelines

2010 - Maine, Portland Mayor Mavodenes, Jr. declared October "Cell Phone Awareness Month"

2009 - Governor of Colorado issued a Proclamation on Electrical Hypersensitivity.

- Original Proclamation
- "*Electromagnetic Sensitivity is a painful chronic illness of hypersensitive reactions to electromagnetic radiations.*
- *WHEREAS, the symptoms of EMS include, dermal changes, acute numbness and tingling, dermatitis, flashing, headaches, arrhythmia, muscular weakness, tinnitus, malaise, gastric problems, nausea, visual disturbances, severe neurological, respiratory, speech problems, and numerous other physiological symptoms.*
- *WHEREAS, Electromagnetic Sensitivity is recognized by the Americans with Disabilities Act, the US Access Board and numerous commissions;"*

2009 - Governor of Connecticut issued a Proclamation on Electrical Hypersensitivity.

- Original Proclamation
- "*WHEREAS, the health of the general population is at risk from electromagnetic exposures that can lead to illness indicted by electromagnetic radiations; and, WHEREAS, this illness may be preventable through the reduction or avoidance of electromagnetic radiations, in both outdoor and indoor environments and by conducting further scientific research..."*

2009 - Broward County, Florida; The Mayor issued a Proclamation on Electrical Hypersensitivity.

- Original Proclamation
- "*WHEREAS, as a result of global electromagnetic pollution, people of all ages in Broward County and throughout the world have developed an illness known as Electromagnetic Sensitivity..."*

US Proposed Legislation

2012 The Cell Phone Right to Know Act H.R. 6358

- The Act was introduced receiving strong **s**upport from many organizations including the American Academy of Pediatrics.This legislation called for labels on mobile devices at point of sale, a comprehensive national research program to study whether exposure to wireless devices causes adverse biological effects directed by NIEHS and the EPA and exposure level regulation.
- Congressional hearings in 2009 provided expert testimony to Congress.
- CSPAN VIDEO.
- **Library of Congress Summary:** Written by the Congressional Research Service
- Cell Phone Right to Know Act - Requires the Director of the National Institute of Environmental Health Sciences and the Administrator of the Environmental Protection Agency (EPA) to:

1. conduct or support a comprehensive research program to determine whether exposure to electromagnetic fields from mobile communication devices causes adverse biological effects in humans, including vulnerable subpopulations such as children, pregnant women, those with compromised immune systems and hypersensitivity reactions, men and women of reproductive age, and the elderly;
2. disseminate research results to the general public; and
3. report findings and conclusions to Congress.

Directives:

- Directs the Federal Communications Commission (FCC) to promulgate regulations to allow a subscriber to access personally or to give consent to allow researchers with institutional review board approval to access specific usage data required to investigate the link between electromagnetic radiation exposure and potential adverse biological effects in humans.
- Directs the EPA to promulgate regulations establishing maximum exposure level goals and

maximum exposure levels for exposure to electromagnetic fields generated by mobile communication devices.

- Directs the Commissioner of Food and Drugs (FDA) to promulgate regulations to provide for labeling (including exposure ratings and the maximum allowable exposure levels and goals) on mobile communication devices, packaging, instruction manuals, and at points of sale in stores and on websites.
- Requires the Secretary of Health and Human Services (HHS) to increase: (1) the number and size of grants to institutions for training scientists in the field of examining the relationship between electromagnetic fields and human health; and (2) the number of career development awards for such training for health professionals pursuing careers in pediatric basic and clinical research, including pediatric pharmacological research.
- Amends the Public Health Service Act to establish a graduate educational loan repayment program and authorize national awards for researchers in such fields.
- Amends the Communications Act of 1934 with respect to the prohibition on state or local government zoning regulation of personal wireless service facilities on the basis of the environmental effects of radiofrequency emissions.
- Excludes from such prohibition state or local regulation based on the adverse human health effects of emissions of radiofrequency electromagnetic fields.

Oregon

- 2017 Legislation about to be introduced.
- 2015 Oregon HB 3350: This proposed legislation directs the Department of Education to prepare statement that discloses potential health risks of wireless technology and requires public and private schools to distribute statement to employees and parents of students. It declares an emergency effective July 1, 2015.
- **2015 Oregon HB 3351:** This proposed legislation states that cell phones must have a visible written label that advises consumers of possible risks and steps that consumers can take to reduce the risk of radiofrequency radiation exposure from cellular telephone use. Read it here.

Massachusetts
Watch Video of Briefing to Massachusetts Legislators https://vimeo.com/134411701

- 2017: Three Massachusetts Senators and one Representative introduced bills to examine wireless radiation and protect the public. Click here for details.
  - S.1268 Resolve creating a special commission to examine the health impacts of electromagnetic fields (Senator Karen E. Spilka).
  - S.1864 An Act relative to utilities, smart meters, and ratepayers' rights (gives people the no-fee choice of keeping their non-radiation-emitting water, gas and electrical meters instead of "smart" utility meters; Senator Michael O. Moore).
  - S.107 An Act relative to disclosure of radiofrequency notifications (requires warning labels on radiation-emitting products; Senator Julian Cyr).
  - S.108 An Act relative to the safe use of hand-held devices by children (requires specific language on packaging as modeled by an ordinance unanimously passed in Berkeley, California; Senator Julian Cyr).
  - H.2030 An Act relative to best management practices for wireless in schools and public institutions of higher education (asks the Massachusetts Department of Elementary and Secondary Education to set wi-fi standards for all schools; Representative Carolyn Dykema).
- 2016 Proposed Bill MA 1222 An Act creating a special commission to study the health impacts of electromagnetic fields

- 2015 Bill H2007: An Act relative to a special commission to study electric and magnetic fields. *Bills Still in Process as of August,2015.* Watch a view of the statehouse briefing on RF here.

2015 - Nassau County Proposed a Wireless Router Labeling Act

- The act would place visible warning signs in all county buildings and facilities where a wireless router is located.
- Media coverage of the initiative

2014 - The Maine LD 1013 **"The Wireless Information Act"**

- The act passed the State Senate and House but then failed to pass the second vote. he Bill requires manufacturer's information on radio-frequency exposure be visible on the outside of the cell phone's product packaging.
- Please a video of State Representative Andrea Boland on how the legislation was thwarted.
- News Article - Cell Phone Radiation Label Bill Passes Maine Legislature Before Dying
- Maine's 2015 "Cellular Telephone Labeling Act"

2011 - San Francisco Cell Phone Right to Know Ordinance

- Ordinance requires cell phone retailers to distribute an educational sheet created by the San Francisco Department of Environment that explains radiofrequency emissions from cell phones and how consumers can minimize their exposure. The CTIA sued the city and settled with the City to block implementation of the Ordinance in exchange for a waiver of attorney's' fees.
- The City Cell Phone Radiation Webpage.

2014 - Hawaii Senate Bill SB 2571

- Senate bill was introduced calling for a warning label encouraging consumers to follow the enclosed product safety guidelines to reduce exposure to radiation that may be hazardous to their health.

2011 - California Legislation SB 932

- This 2011 legislation would have required retailers to include notices on product packaging that cell phones emit radio frequency (RF) energy. A second notice would be posted at the point of sale when purchasing online or in a physical store.

2011 - New Mexico Proposed Law HM 32

- This 2011 proposed law request the Department of Health and the Department of Environment to study and review all available literature and reports on the effects of cell phone radiation on human health.

2011 - Pennsylvania Proposed Law HB 1408

- This 2011 proposed law would require warning labels on cell phones "to inform all citizens about possible health dangers that have been linked to microwave radiation that is emitted by cellular telephones and the steps that can be taken to mitigate those dangers, especially as they relate to children and pregnant women."
- Dr. Ronald B. Herberman, former director of the University of Pittsburgh Cancer Institute (UPCI) and the UPMC Cancer Center offered testimony at a PA House Democratic Policy Committee hearing.
- CBS Local coverage of hearing
- Philadelphia Tribune News coverage

2011- Oregon Proposed Law SB 679 Oregon

- This 2011 proposed law would require warning labels for all new cell phones and cell phone packaging.
- News video about the law

1999 - Proposed Law H.R. 2835

- In 1999 Congressman Bernie Sanders sponsored H.R. 2835 (106th): To require an assessment of research on effects of radio frequency emissions on human health.

Schools Worldwide Removing the WiFi and Reducing Exposure

2017: Worcester Massachusetts, School Committee voted to approve "precautionary options" to be posted on the Worcester District Website.
2017: San Diego California USA Waldorf School: Adopted CHPS guidelines wired internet/electronic free zones/and hardwired phones per article published in Renewal Magazine.
2017: Sacramento California USA Waldorf School: WiFi will be turned off when not in use starting in Fall 2017.
2017: Wi-fi OFF Switches Installed in the Fiskars primary school. Read press release.
2017: Cyprus Bans Wi-Fi from kindergartens, removes Wi-Fi from elementary classrooms and halts deployment. Original Translated Directive from the Cyprus Minister of Culture and Education ; Read Press release on Cyprus Wi-Fi removal from elementary classrooms

2016: Haifa, Israel: Haifa Mayor Yona Yahav (of Israel's 3rd largest city) ordered all schools to have wireless removed and replaced with wired connections. Watch Haifa School IT Chief describe how they removed/reduced wireless.

- Read Krayot news article: Haifa Cuts off Wi-Fi in Schools
- Hamodia article: Haifa to Shut School Wireless Networks
- Reshet TV Report
- News Report Israel CH2 Documentary - "How do we kill our self - Radiation" with unofficial English translation
- News Report "Parents Fight Wireless Radiation in Schools" on Supreme Court Case in Israel

2016 Lowell School, Washington DC

- In the kindergarten wing in 2016, the Wi-Fi hotspots were removed and the teachers are given ethernet and adapters so that computers and class technology can be ethernet connected (corded) to reduce RF-EMF exposure.

2016 Italy: Turin Mayor Chiara Appendino laid out plans "to cut back on Wi-Fi in state schools and government buildings over concerns that radiation might damage people's health".

- News Report Turin could slash Wi-Fi over 'radiation' concerns

2016: Onteora School District in New York State USA

- **April 20, 2016 Meeting Minutes Page 2.**
- District adopts "Best Practices with Wi-Fi stating:

- "Turn off the device when not in use and at the end of each day. If device is to stay on, turn Wi-Fi off when not in use. Always place device on a solid surface.Viewing distance should be a minimum of 12 inches from the screen.Staff was asked by the Principals to post this in areas that contain computers and devices. They are reminding staff to follow it."

2016 Italy: Mayor of Borgofranco d'Ivrea (Italy) orders Wi-Fi to be turned off in schools.

- "Mayor Livio Tola told the town's high school and elementary school to return to using cables to connect to the internet after reading that the electromagnetic waves given off by wireless routers were especially harmful to young children."
- The Local Newspaper article - "Italian town shuts down wifi over health fears"
- Torino News Article - "Ivrea, The Mayor Removes WiFi as it Could Be Dangerous".

2016: Rotokawa School New Zealand, implemented steps to minimize RF Exposure

- Children use ipads in flight mode on desk and parents may request that their child use an Ethernet cord. Children are taught about the health precautions as part of their cyber citizenship.

Denmark Schools that have removed or reduced wireless exposure

Bjedstrup elementary School og Børnehus, (school and kindergarten) Student must hand over cell phones before classes + no wifi in school premises
Hammer Free Private School - all internet connections are hard wired
Vejlernes private school - no wifi
Kastanjely kindergarten - no wifi

2016: Istituto Comprensivo Alighieri- Diaz in Lecce Italy Banned Wifi

- Official resolutions number 1 and Resolution 2
- Their two resolutions decided: a) to ban wifi in school and install a wired system for the use of internet and b) Reject the request of the local government (Municipality) to install an antenna on the school roof for the wireless signal providing for the "Wireless city" program. The resolution also asks the Municipality to install the antenna at a reasonable distance from school.

2016: The Piemonte Region has adopted a resolution to limit EMF exposure

- Original Resolution
- Resolution limits the use of wifi in schools and is considerate to the problem of EHS people.

2015: Ashland Public Schools, Mass (USA)

Ashland is the first school district to vote to enact "Best Practices" in classrooms and publicly post these instructions which include turning off Wi-Fi when not in use and keeping devices in a table, not a lap
News article on these "Best Practices" to turn the WiFi off when not in use,

- Download teacher training PPT slides . Video of parent who initiated this
- Video of school board member discussing the process
- Magazine article on Ashland's Decision

2016: Shearwater The Mullumbimby Steiner School, Australia, 100% Wi-Fi Free School
2016: Yallingup Steiner School Australia , WiFi Free Classrooms
2016: Linuwel School , Australia ,WiFi in some classrooms, Can accommodate children with EHS.
2016: Cairns Hinterland Steiner School , Australia, WiFi Free Classrooms (may be available in other areas)
2016: Wild Cherry School, Australia , 100% Wi-Fi Free
2015: St. Cajetanus School, Belgium: Wired Internet installed and wireless removed.
2015: Washington Waldorf School, Maryland, USA: Removed Wi-Fi Routers from Buildings, Ethernet

installed.
2015: Freshwater Creek School, Australia, 100% Wi-Fi Free
2015: London, Acorn School: Screen Free. Read News article
2015: Lorien Novalis School, Australia, 100% Wi-Fi Free School Preschool to 12th grade.
2015: Cairns Hinterland School, Australia, WiFi Free Classrooms for EHS
2014: Acorn Hill School, Maryland: Reducing exposure to Wi-Fi. In process.
2014: Friends Community School: Wi-Fi turned off in wing for lower elementary school students. WiFi routers moved OUT of classrooms into hallways for older grades to reduce EMF exposure. Ethernet wires made available in classrooms for families who want children on corded (not wireless) computers.
2014: DearCroft Montessori: Hardwired internet to younger grades, limited Wi-Fi Router exposure to older grades.
2014: Portland Waldorf School, Portland Oregon,USA, WiFi removed.
2014: Meeting House Montessori, Braintree Massachusetts, USA, WiFi replaced with ethernet.
2014: Ghent, Belgium, Wi-fi banned from pre-schools and day care.
2014: UPPER Sturt Primary School, Australia. Read article. Read "No WIFI" LOW EMF School Policy.
2014: The St. Augustine School in Italy turned off Wifi and goes back to Wires.
2013 Winlaw Elementary School, B.C. Canada turned off WiFi.
2013 Te Horo Primary School New Zealand Replaced WIFI with cable-based internet.
2013 Kootenay Lakes District School Board BC (One school without Wi-Fi)
2013 Blaise-Cendrars High School, Switzerland. Teachers vote to remove WiFi.
2012 Kivioja primary school in Ylivieska Finland bans phones and minimizes Wireless.
2012: Halton Waldorf, in Burlington Vermont: Remaining free of Wireless Radiation
2011 City of Lakes Waldorf School, WiFi taken out. Minneapolis, Minnesota USA
2011 Aurora School in Ontario removed Wifi and replaced with hardwired.
2011 North Cariboo Christian School in Quesnel, B.C., removed Wi-fi .
2011 Pretty River Academy in Ontario no WiFi.
2011 Wayside Academy, Peterborough, Ontario no Wi Fi.
2010 Surrey, BC Roots and Wings Montessori removed Wi-Fi.
2010 Ontario St. Vincent Euphrasia elementary school: Parents voted to turn off Wi-Fi.
2009 HEROUVILLE-SAINT-CLAIR wi-fi networks removed.

Cell Phone Bans in Schools
This list covers bans of cell phones that occurred after the schools found cell phones in classrooms to be distracting and problematic. It is not necessarily because of the radiofrequency and health issues. This is not a complete list but rather a list as stories make the news starting in 2017. Hyperlinks goto news source
Victoria Middle School: Canada

Teacher Unions and Parent Teacher Organizations

2016: New Jersey Education Association (NJEA) published the article "Minimize health risks from electronic devices" in the September 2016 NJEA Review. Adrienne Markowitz and Eileen Senn detail how to reduce physical health risks from devices including risks from radiation exposure:

- *"Keep devices away from the body and bedroom.*
- *Carry phones in briefcases, etc., not on the body.*
- *Put devices on desks, not laps.*
- *Hard wire all devices that connect to the internet.*
- *Hard wire all fixed devices such as printers, projectors and boards.*
- *Use hard-wired phones instead of cell or cordless phones.*
- *Text rather than call.*

- *Keep conversations short or talk in person.*
- *Put devices in airplane mode, which suspends EMF transmission by the device, thereby disabling Bluetooth, GPS, phone calls, and WiFi.*
- *Use speaker phone or ear buds instead of holding the phone next your head.*
- *Take off Bluetooth devices when not using them."*
- Read the online NJEA article "Minimize health risks from electronic devices"
- PDF of NJEA article Recommendations

2016: Phoenicia Elementary School Onteora School District, New York State
The PTA wrote a letter to the Onteora School District calling for the Wi-Fi to be turned off as a precautionary action

- Watch a video of the School Board Meetings where letter is read here
- Watch videos of parents and students calling for Wi-Fi removal here.
- Read News Report: Some Onteora parents fear Wi-Fi signals in schools are harming their children.

2016: Ontario Secondary School Teachers Federation
The Federation has issued a new call for a moratorium on WIFI and in the Limestone School District and they have taken the issue to the school trustees in that District. "The Teacher Union's president says there is a growing mountain of evidence that WIFI can pose health risks." Andrea Loken/OSSTF District President stated in a 3/2016 news interview that, "There are thousands of published peer reviewed papers that are indicating adverse health effects from WIFI and we are seeing an increased awareness around this issue worldwide."

- Watch the video of the news piece with Union members here .
- Read the National Post article here
- Radio Canada International article here.

2016: Elementary Teachers Federation of Ontario
A 3/2016 News Report states that they are calling for a "WIFI moratorium until further health studies are done, and lawmakers can catch up with new regulations."

- Watch the video of the news piece with Union members here
- Read the National Post article here
- Radio Canada International article here.

2014 United Federation of Teachers (Teachers, nurses and professionals working in New York City).
In 2014 their Wireless Radiation Webpage stated "Wireless radiation is emitted by the myriad of wireless devices we encounter every day. It was once thought to be relatively harmless. However, we now know that wireless radiation can cause non-thermal biological effects as well, including damage to cells and DNA, even at low levels.

Curiously in March of 2016, this statement was removed and replaced with new text mimicking FCC verbiage. However the site *still posts* how to reduce exposure.

- Resources posted on their site still include Dr. Moskowitz' Reducing Your Exposure to Wireless Radiation and the BabySafe Project brochure What You Need to Know About Wireless Radiation and Your Baby. "Taking certain precautions around wireless radiation is appropriate for our most vulnerable populations, including pregnant women."

2014 New York State Teachers Union NYSUT: A federation of more than 1,200 local unions.
"We have enough evidence to justify taking action and we are not willing to wait until our members, their children and the students suffer health consequences from not doing anything," -Paul Pecorale, Vice

President of the New York State United Teachers Union.

- Read the Press Release on Best Practices For Schools prepared for NYSUT
- Download the Guidelines for Safer Use of Wireless Technology in Classrooms Published for NYSUT
- NYSUT hosted a Webinar: Risks of wireless technologies and protecting children and staff in schools.

2014 National Education Association

- **Section C-19 of the NEA 2013-2014 Resolutions**
- "The National Education Association believes that all educational facilities must have healthy indoor air quality, be smoke-free, be safe from environmental and chemical hazards, *and be safe from hazardous electromagnetic fields."*
- "Students and/or their parents/guardians, education employees, and the public should be notified of actual *and potential hazards."*
- "School districts should conduct periodic testing for harmful water *and airborne particles/agents* that are detrimental to the health of students and education employees and shall report the results publicly."
- "The Association also believes in the development and enforcement of health and safety standards specifically for children."

2013 Canadian Teacher Federation's Brief (200,000 elementary and secondary school teachers)

- "CTF is concerned about the lack of definitive research regarding the adverse health effects of Wi-Fi.
- "We propose a prudent approach to the use of Wi-Fi, especially where children are present."
- "We recommend an education program regarding the relative safety of Wi-Fi exposure and that appropriate resources be developed to educate the public regarding ways to avoid potential exposure risks of Wi-Fi access points and devices."
- "Pedagogical needs could be met in schools with an approach that limits exposure to Wi-Fi."
- Read the Briefing The Use of Wi-Fi in Schools - Briefing Document
- 2015: Canadian Teacher's Magazine published *CTF Sounds the Alarm on Wi-Fi*

2013 United Teachers of Los Angeles, representing 40,000 teachers and staff

- Resolution passed: "I move that UTLA will abide by current National NEA Policy for Environmentally Safe Schools which states that all employees and stakeholders should be informed when there are changes in their exposure to environmental hazards including electromagnetic radiation and that all stakeholders and the public should be notified of any actual and potential hazards. UTLA will advocate for technological solutions that maintain technology upgrades while not increasing employees exposure to electromagnetic radiation."
- Health and Human Services Committee 3-6-13 #1: Moved by Kevin Mottus, seconded by John Cabrera.
- **UTLA Newsletter editorial by social worker Kevin Mottus.**

2013 Elementary Teacher's Federation of Ontario Issued a position statement
"There is cause for concern for members' health and safety, especially women," said Sandra Wash, a teacher representing the Peel district when the Federation issued a 2014 position statement supporting an Expert Panel recommendation that Health Canada provide the public with more information about radiofrequency energy, and the safe use of wireless technology.

ETFO voted to:

- Turn cell phones off in classrooms
- Label the location Of Wi-Fi access points.

- Research Radio Frequency radiation.
- Develop a hazard control program related to wireless microwave radiation through JHSC.

2012 The Ontario English Catholic Teachers Association (45,000 Ontario teachers)

- Read the Position Statement here.
- The Teacher Association recommends a wired infrastructure as WIFI "may present a potential Health and Safety risk or hazard in the workplace...The safety of this technology has not thoroughly been researched and therefore the precautionary principle and prudent avoidance of exposure should be practiced."
- "Controls for WiFi would best be guided by the ALARA principle (As Low As Reasonably Achievable), as well as by applying the concept of prudent avoidance (of non-ionizing radiation)."
- Read CBC News article

2013 BC Teachers Federation adopted Wireless Resolutions and Proposed Resolutions

- Wireless Resolutions and Proposed Resolutions
- "The BCTF supports members who are suffering from Electromagnetic Hypersensitivity by ensuring their medical needs are accommodated in the workplace."
- Proposed Resolutions "the World Health Organization's classification of radiofrequency/electromagnetic fields emitted by wireless devices as a 2B possible cancer risk to humans; that the BCTF ensures all teachers have the right to work in a safe environment, including the right to work in a Wi-Fi/ wireless-free environment."
- Recommendation to the Ministry of Education that school boards "begin immediate installation of on/off switches for Wi-Fi routers in schools, thereby reducing microwave radiation exposure and reducing health risks to members, and/or provide safer Ethernet cables or fibre optics".
- Daily News Coverage:Merritt teachers demand protection from wi-fi radiation 'Evidence is piling up that wi-fi radiation may in fact be harmful'
- Vancouver Sun News Report
- Debate about Wi-Fi in B.C. schools heats up, VANCOUVER SUN 05.08.2013

2013 The BC Confederation of Parent Advisory Councils (BCCPAC) of 821 Advisory Councils representing over 500,000 parents in British Columbia passed two resolutions.

- Resolution: On/Off switches for WiFi Routers and Protocol for the Use of Wireless Devices
- Resolution 17 "calls on each Board of Education to have one public school at each education level that is free of Wi-Fi, cordless phones and cell phones. This school will only be equipped with wired computers and wired telephones for personal, educational and administrative purposes."
- Resolution 18 calls on Boards of Education to "cease to install Wi-Fi and other wireless networks in schools where other networking technology is feasible." passed with a clear majority.

2010 UK VOICE ;The Union for Education Professionals- 20,000 members

- Read the Position Statement
- "Voice has advocated that new Wi-Fi systems should not be installed in schools, that existing systems should be turned off when not required and that schools should consider whether they really need to use Wi-Fi, which was developed to facilitate Internet access on the move rather than to be used as a convenient alternative to cables in dedicated IT facilities."
- " In the light of what has happened to one of our members *[who has developed sensitivity to electro-magnetic radiation]*, I am concerned that so many wireless networks are being installed in school and colleges without any real understanding of the possible long-term consequences."- Voice General Secretary Philip Parkin
- Voice Blog post.

Los Angeles California Public Schools

- The LA School District Uses a RF-EMF Exposure Threshold 10,000 Less Than the FCC Limits: The OEHS supported a precautionary threshold level that is 10,000 times lower than the current Federal Communications Commission standard. Read the RF Report the LA School District Used to recommend a cautionary exposure level. RADIOFREQUENCY (RF) EVALUATION REPORT Use of Wireless Devices in Educational Settings

2009 LA School Board Resolution Banning Cell Towers from schools and recommending against WiFi.

- "The Board supports responsible deployment of fiberoptic broadband technology which is superior to wireless in speed, reliability, security, durability and protections it affords people and the environment from the potential hazards of exposure to radio frequency radiation."
- Adopted Resolution
- Press Release: LOS ANGELES BOARD OF EDUCATION MEMBERS VOTE TO PROHIBIT CELL PHONE TOWERS NEAR SCHOOLS
- 2009 December Resolution *Condemning Cell towers NEAR Schools* as was this T-Mobile Cell Tower across the street from an elementary school.
- Original Resolution
  "*As long as questions exist as to the adequacy of these federal regulations, local governments should have the ability to include consideration of health and environmental effects of these facilities*." (referring to cell towers)
- Read the motion by Supervisors Zev Yaroslavsky and Michael Antonovich

2000 LA School Board Resolution Opposing Cell Tower Placement on Schools

- Original Resolution
- Resolution calls for precautions with wireless. 'Whereas, Recent studies suggest there is evidence that radio-frequency radiation may produce "health effects" at "very low field" intensities'

2010 Greater Victoria Teachers' Association

"The GVTA recommends a precautionary approach to the School District with regard to provision of wireless internet in schools. The precautionary approach comes from the environmental movement and has been adopted as common practice in areas regarding potential environmental, ecological or biodiversity damage. It suggests that the lack of significant evidence is not enough of a reason to be unconcerned. The fact that many other countries have instituted regulations to protect children, seniors, pregnant women and other susceptible populations should be the guide for a District policy on WiFi installation and use in the worksites."

The GVTA Wireless in Schools Webpage states now that:

- Wi-Fi free zones should be available.
- On/Off routers recommended and record any adverse Wi-Fi health effects.
- Minimal or non-use within elementary schools.

2008 Lucerne Elementary Secondary Arrow Lakes District SD 10 New Denver BC, Canada Opts for "No WIFI

2001 Fletcher Hills PTA Resolution submitted to the California State PTA

- "RESOLVED, that the California PTA supports local municipal zoning setback rules of at 1000 feet or more from an operating wireless transmitter and a school or residential area; and be it further
- RESOLVED that the California PTA supports encouraging schools to use cable lines for all

communications services on campus and to avoid the endorsement, purchase or use of wireless local area network systems on campus; and be it further

- RESOLVED that the California PTA recommend that teachers and students should limit use of cellular phones or other mobile devices on school property to emergencies and that cellular phones, pagers and other mobile phones be turned off and placed out of sight while the individual is on school property"
- Resolution on Wireless Equipment/Cellular Phones and Antennas Read it here.

DOCTORS AND SCIENTISTS APPEAL FOR STRICTER WIRELESS TECHNOLOGY REGULATION

Vienna Resolution 1998 **Salzburg Resolution 2000** **Stewart Report, UK 2000** **Declaration of Alcalá 2002** **Catania Resolution 2002** **Freiburger Appeal 2002** **Bamberger Appeal 2004** **Maintaler Appeal 2004** **International Association of Fire Fighters Resolution on Cell Towers 2004** **Coburger Appeal 2005** **Oberammergauer Appeal 2005** **Haibacher Appeal 2005** **Pfarrkirchener Appeal 2005** **Freienbacher Appeal 2005** **Lichtenfelser Appeal 2005** **Hofer Appeal 2005**	**Helsinki Appeal 2005** **Parish Kirchner Appeal 2005** **Saarlander Appeal 2005** **Stockacher Appeal 2005** **Vancouver School Resolution 2005** **Benevento Resolution 2006** **Allgäuer Appeal 2006** **WiMax Appeal 2006** **Schlüchterner appeal** **Brussels Appeal 2007** **Venice Resolution 2008** **French Doctor Appeal 2008** **Porto Alegre Resolution 2009** **European Parliament EMF Resolution 2009** **Dutch Appeal 2009** **Int'l Appeal of Würzburg 2010** **Copenhagen Resolution 2010** **Seletun Consensus Statement 2010** **Russian National Committee on Non-Ionizing Radiation Protection 2011**	**Potenza Picena Resolution 2011** **World Health Organization 2011** **Austrian Medical Association 2012** **Resolution on Electromagnetic Health 2012** **British Doctor Initiative 2013** **BabySafe Project: Joint Statement on Pregnancy and Wireless Radiation 2014** **Canadian Doctors Declaration to Health Canada 2014** **Scientific Declaration to Health Canada (International Doctors) 2014** **International Scientists Appeal to U.N. to Protect Humans and Wildlife from Electromagnetic Fields** and Wireless Technology 2015 Over 200 Scientists Reykjavik Iceland Appeal on Wireless in School, 2017

Firefighter Unions Opposing Cell Towers

INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS

- *"The IAFF opposes the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until a study with the highest scientific merit and integrity on health effects of exposure to low-intensity RF/MW radiation is conducted and it is proven that such sitings are not hazardous to the health of our members."*
- The IAFF Official Position *Against* Cell Towers on Fire stations passed in 2004 http://www.iaff.org/HS/Resi/CellTowerFinal.htm
- This Position was initiated after increasing complaints among firefighters with cellular antennas on their stations coupled with the California study showing neurological damage in California firefighters conducted by Dr. Gunnar Heuser. The pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse

control in all 6 firefighters tested (**Read Susan Fosters filed Affidavit to the FCC**, Read the Press Release on the Resolution and Research Study here). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada.

L.A. County Firefighters Local 1014

- Local 1014 has a webpage dedicated to stopping towers because of a plan to install them on over 200 of their stations. http://www.stopcellphonetowers.com/index.html
- "As firefighters and paramedics, we live in these firehouses. What effect will these towers have on us? What are the risks to our neighbors? It's a no-brainer that LA County should at least have done a proper study before before putting 200-foot high-power microwave antennas on top of our heads."

- Dave Gillotte, Active Duty Fire Captain
President, LA County Firefighters Local 1014
Watch him testify on this issue here.

- *The Firefighter's Website in 2015* http://www.stopcellphonetowers.com/index.html

United Firefighters of Los Angeles City Local 112 IAFF-CIO-CLC Opposes Cell Towers on Their Stations.

- " It is inexcusable that once again our firefighters in the field were the last to know about a massive 150 million dollar project that could jeopardize their health and safety. ... nobody talked to us and we have not heard from one single expert who has told us that this project will be safe."
- "UFLAC will strongly oppose the use of Fire Stations as base locations for cell towers and/or antennas "
- **DownLoad the letter from this LA Firefighters Union Local 112 asking for an immediate halt to cell towers on fire stations.**
- **Watch videos the these Firefighter Union Presidents testifying to the LA Board of Supervisors on the Issue here.**

See list of Medical Doctor Consensus Statements at this link http://ehtrust.org/science/medical-doctors-consensus-statements-recommendations-cell-phoneswireless/

List of Notable Statements
Harvard Campus Services: Cell Phone Towers and Radiofrequency (RF) Radiation Safety:

3. Medical Organization Recommendations on Electromagnetic Fields
Worldwide, medical organizations and doctors recommend reducing exposure to wireless radiation.

Medical Doctors and Public Health Organizations

Consensus Statements and Doctors' Recommendations on Cell Phones/Wireless
It is a fact that *not a single medical organization* states that cell phone/wireless radiation is safe. There is no proof of safety.

American Academy of Pediatrics

The American Academy of Pediatrics (AAP), is a non-profit professional organization of 60,000 primary care pediatricians, pediatric medical subspecialists, and pediatric surgical specialists dedicated to the health, safety and well-being of infants, children, adolescents, and young adults.

2016: American Academy of Pediatrics Website - Healthy Children.org, “Cell Phone Radiation & Children’s Health: What Parents Need to Know".

- In response to the National Toxicology Program Cell Phone Radiation Study results, the AAP issued the following cell phone safety tips specifically to reduce exposure to wireless radiation in 2016:
- Use text messaging when possible, and use cell phones in speaker mode or with the use of hands-free kits.
- When talking on the cell phone, try holding it an inch or more away from your head.
- Make only short or essential calls on cell phones.
- Avoid carrying your phone against the body like in a pocket, sock, or bra. Cell phone manufacturers can't guarantee that the amount of radiation you're absorbing will be at a safe level.
- Do not talk on the phone or text while driving. This increases the risk of automobile crashes.
- Exercise caution when using a phone or texting while walking or performing other activities. “Distracted walking” injuries are also on the rise.
- If you plan to watch a movie on your device, download it first, then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure.
- Keep an eye on your signal strength (i.e. how many bars you have). The weaker your cell signal, the harder your phone has to work and the more radiation it gives off. It's better to wait until you have a stronger signal before using your device.
- Avoid making calls in cars, elevators, trains, and buses. The cell phone works harder to get a signal through metal, so the power level increases.
- Remember that cell phones are not toys or teething items.
- Press release on AAP Recommendations

Press Release May 27, 2016: “The AAP responds to study showing link between cell phone radiation, tumors in rats”

> “They’re not toys. They have radiation that is emitted from them and the more we can keep it off the body and use (the phone) in other ways, it will be safer,” said Jennifer A. Lowry, M.D., FAACT, FAAP, chair of the AAP Council on Environmental Health Executive Committee.

2015 AAP Healthy Child Webpage - “Electromagnetic Fields: A Hazard to Your Health?”

This webpage states:

> “Cell Phones: In recent years, concern has increased about exposure to radiofrequency electromagnetic radiation emitted from cell phones and phone station antennae. An Egyptian study confirmed concerns that living nearby mobile phone base stations

increased the risk for developing: *Headaches, Memory problems, Dizziness, Depression, Sleep problems"*

2013 AAP Letter to FCC Commissioner Mignon Clyburn and FDA Commissioner Margaret Hamburg calling for a review of RF guidelines 8/29/2013

"The AAP urges the FCC to adopt radiation standards that: Protect children's health and well-being. Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes."

2012 AAP Letter to US Representative Dennis Kucinich in Support of the Cell Phone Right to Know Act 12/12/2012

" The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults. It is essential that any new standards for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes."

"Time Magazine (2012): Pediatricians Say Cell Phone Radiation Standards Need Another Look"

2012, the AAP published Pediatric Environmental Health, Textbook of Children's Environmental Health, Chapter 41: Electromagnetic Fields, pg. 384

"Exposures can be reduced by encouraging children to use text messaging when possible, make only short and essential calls on cellular phones, use hands free kits and wired headsets and maintain the cellular phone an inch or more away from the head."

AAP News 2011: *"More study needed on risk of brain tumors from cell phone use"*

Maryland Children's Environmental Health and Protection Advisory Council

2017: The Children's Environmental Health and Protection Advisory Council recommends:

1. "The Maryland State Department of Education should recommend that local school systems consider using wired devices" "WiFi can be turned off" and instead "a wired local area network (LAN) can provide a reliable and secure form of networking...without any microwave electromagnetic field exposure."
2. New school construction and renovations to include wired cabled connections: "If a new classroom is to be built, or electrical work is to be carried out in an existing classroom, network cables can be added at the same time, providing wired (not wireless) network access with minimal extra cost and time."

3. The Maryland State Department of Education should recommend that local school systems use strategies to minimize exposures: “Have children place devices on desks to serve as barrier between the device and children’s bodies; Locate laptops in the classroom in a way that keeps pupil heads as far away from the laptop screens (where the antennas are) as practicable; Consider using screens designed to reduce eyestrain; Consider using a switch to shut down the router when it is not in use.”
4. “The Maryland Department of Health and Mental Hygiene should provide suggestions to the public on ways to reduce exposure: Sit away from WiFi routers, especially when people are using it to access the internet. Turn off the wireless on your laptop when you are not using it. Turn off WiFi on smartphones and tablets when not surfing the web. Switch tablets to airplane mode to play games or watch videos stored on the device.”
5. “The General Assembly should consider funding education and research on electromagnetic radiation and health as schools add WiFi to classrooms.”
6. The Maryland Department of Health and Mental Hygiene should “ask the United States Department of Health and Human Services to formally petition the FCC to revisit the exposure limit to ensure it is protective of children’s health and that it relies on current science.”
7. The Report should be shared with the United States Department of Health and Human Services, Federal Communications Commission, Maryland State Department of Education and Maryland General Assembly.

Final Report of the Maryland Children's Environmental Health and Protection Advisory Council
Letters from Physicians on Wireless Health Risks in Public Comments
Press Release 3/3/2017

The BabySafe Project

As of August 2016 over 200 physicians, scientists and public health professionals from around the world have signed onto a Joint Statement “to express their concern about the risk that wireless radiation poses to pregnancy and to urge pregnant women to limit their exposures.”

- The BabySafe Project Website
- “We call on our elected leaders to support such research and to advance policies and regulations that limit exposures for pregnant women. We call on industry to implement and explore technologies and designs that will reduce radiation exposures until such research is carried out.”
- EPA Award: The BabySafe Project was recognized in the US EPA” 2016 Children's Environmental Health Excellence Award from the EPA’s Office of Children's Health Protection. Patricia Wood was awarded based on three distinct initiatives including “the creation and development of the BabySafe Project, a program designed to inform doctors, neonatal health professionals and parents about the potential risks that wireless radiation poses to pregnancy”.
- Press Release June 3, 2014
- Video of Press Conference
- The BabySafe Project Brochure “Ten Ways to Reduce Your Wireless Exposure” which includes “Whenever possible, connect to the internet with wired cables”.

Maryland State Children's Environmental Health And Protection Advisory Council 2017 Recommendations For Wired Internet In School Classrooms:

The Maryland State Children's Environmental Health and Protection Advisory Council (CEHPAC) issued a Report advising the Department of Education to recommend local school districts reduce classroom wireless radiation exposures by providing wired—rather than wireless—internet connections. CEHPAC's health experts include Governor appointed pediatricians, Maryland State House/Senate appointees and representatives of the Department of Education and Department of Health.

Wifi Radiation in Schools in Maryland Final Report
Letters from Physicians CEHPAC's Public Comments
Testimony to the Maryland State Children's Environmental Health and Protection Advisory Council Selections of Testimony
Testimony to Maryland State Board of Education
Testimony of a High School Student to the Board of Education

The California Medical Association

The California Medical Association (CMA) passed a Wireless Resolution in 2014 that states :

"Whereas scientists are increasingly identifying EMF from wireless devices as a new form of environmental pollution ...
Whereas peer reviewed research has demonstrated adverse biological effects of wireless EMF including single and double stranded DNA breaks, creation of reactive oxygen species, immune dysfunction, cognitive processing effects, stress protein synthesis in the brain, altered brain development, sleep and memory disturbances, ADHD, abnormal behavior, sperm dysfunction, and brain tumors; and...Resolved, That CMA support efforts to implement new safety exposure limits for wireless devices to levels that do not cause human or environmental harm based on scientific research."
Read the full CMA Resolution here.
Read a the Santa Clara Medical Bulletin article by Dr. Cindy Russell that explains the CMA resolution and gives recommendations for schools.

Athens Medical Association

On April 1st 2017 the Athens Medical Association voted to issue 16 recommendations to reduce human exposure to wireless radiation. Read the press release here.

16 RULES FOR SAFER USE OF WIRELESS COMMUNICATION

- Use your cell phone with caution and make brief calls as necessary
- Children under the age of 14 should make limited use of cell phones
- Do not put your cell phone in contact with your head
- Do not use your cell phone inside a car, train, aeroplane, or elevator
- Restrict cell phone use when children or pregnant women are near
- Keep mobile phones away from your body
- When using your cell phone keep a safe distance from others
- Do not carry or keep your cell phone inside your pockets
- At bedtime, disable WiFi on your router and switch off your mobile phone

- Do not play games on-line; and if you will, first switch to airplane mode
- Hands-Free option is always preferable though may not be completely safe
- Wireless connections may increase your exposure to microwave radiation
- Limit WiFi connectivity and use hard-wired connection whenever possible
- When signal strength is weak do not attempt to make a call
- If a corded landline is available make use of this as a preferred option
- Disable WiFi, Bluetooth & Data options from your cell phone and other mobile device(s) when not needed.

Athens Medical Association website page on Electromagnetic Radiation and Health Conference

The Vienna Medical Association

The Vienna Medical Association has issued Ten Medical Rules for Cell Phones which includes:

> "Make calls as short and little as possible, Do not position mobile phones directly on the body , Fewer apps means less radiation, Make calls at home and at work via the fixed corded (not wireless) network - Internet access via LAN cable, Constant radiation emitters like DECT cordless telephones, WLAN access points, data sticks and LTE Home base stations (Box, Cube etc.) should be avoided! Avoid Mobile phone calls in places with poor reception "
>
> "The radiation from mobile phones or smartphones is most likely not as safe as cell phone providers claim it to be. Therefore, the Vienna Medical Association has decided to do the responsible thing and inform the Austrian public about possible adverse effects from a medical perspective."

The Connecticut Department of Public Health, USA

Public Health Department recommendations to reduce exposure to cellphone radiation. 7 steps on *how* people can reduce exposure.

> *"It is wise to reduce your exposure to radiofrequency energy from cell phones whenever possible."* Read the Connecticut Department of Public Health Cell Phone Q and A about Cell phones here.

The Massachusetts Environmental Epidemiology Program Bureau of Environmental Health, Massachusetts Department of Public Health in consultation with the Worcester School Committee's Standing Committee on Teaching, Learning and Student Supports

BEST PRACTICES IN THE USE OF WIRELESS TECHNOLOGY

Members of the Worcester School's Standing Committee on Teaching, Learning and Student Supports consulted with the Massachusetts Department of Epidemiology about developing wireless precautionary guidelines that include:

- Use wired communication devices instead of wireless devices
- Limit children's use of cell phones except for emergencies
- Keep cell phones and other sources at a distance
- If using wireless devices like computers, laptops, tablets, and printers, place the wireless router away from where children and adults usually spend time.

Read all of the recommendations from the Mass Department of Health in full at this link.

The French National Agency of Health Security of Food, Environment and Labour 2016 Report "Radiofrequency Exposure and the Health of Children" recommends reducing exposures to young children and strengthening regulations to ensure "sufficiently large safety margins" to adequately protect the health of young children.

- All wireless devices, including tablets, cordless phones, remote controlled toys, wireless toys, baby monitors and surveillance bracelets, should be subjected to the same regulatory obligations as cell phones.
- Compliance with regulatory exposure limits should be insured for the ways that devices are customarily used, such as positioned in contact with the body.
- Exposure limits for radiofrequency electromagnetic fields should be tightened to ensure sufficiently large safety margins to protect the health and safety of the general population, particularly the health and safety of children.
- Reliance on the specific absorption rate (SAR) to set human exposure limits should be re-evaluated and replaced through the development of an indicator to assess real exposures for mobile phone users that applies to various conditions: signal type, good or bad reception, mode of use (call, data loading, etc.), location device is used on the body.
- ANSES reiterated its recommendation, as previously stated, to reduce exposure to children: minimize use and prefer a hands-free kit.

2013 Report "Radiofrequency Electromagnetic Fields and Health" Expert Appraisal: hands free phones, SAR labeling, and "limiting the population's exposure to radiofrequencies… especially for children and intensive users, and controlling the overall exposure that results from relay antennas."

The American Cancer Society (ACS) - 2016 ACS Responds to New Study Linking Cell Phone Radiation to Cancer

> "The NTP report linking radiofrequency radiation (RFR) to two types of cancer marks a paradigm shift in our understanding of radiation and cancer risk. The findings are unexpected; we wouldn't reasonably expect non-ionizing radiation to cause these tumors. This is a striking example of why serious study is so important in evaluating cancer risk. It's interesting to note that early studies on the link between lung cancer and smoking had similar resistance, since theoretical arguments at the time suggested that there could not be a link." -Otis W. Brawley, M.D., The American Cancer Society Chief Medical Officer

2009 Lecture at Cell Phones and Health Conference: In 2009 Michael Thun, Vice President of the American Cancer Society, lectured on cell phone radiation and cancer risk and detailed how it would take decades before definitive evidence is found in the general population due to the slow growing nature of brain cancer but that early signs would be seen in increases in gliomas

Canadian Parliament Standing Committee on Health of the House of Commons - 2015 Canadian Parliament Report "Radio Frequency Electromagnetic Radiation and the Health of Canadians"

- The report has 12 recommendations including "That the Government of Canada develop an awareness campaign relating to the safe use of wireless technologies, such as cell phones and Wi-Fi, in key environments such as the school and home to ensure that Canadian families and children are reducing risks related to radiofrequency exposure."

Environment and Human Health, Inc.

Cell Phones: Technology, Exposures, Health Effects by Environment and Human Health, Inc.
John Wargo, Ph.D., professor of Environmental Risk and Policy at Yale University and lead author of the report, said, *"The scientific evidence is sufficiently robust showing that cellular devices pose significant health risks to children and pregnant women. The weight of the evidence supports stronger precautionary regulation by the federal government. The cellular industry should take immediate steps to reduce emission of electromagnetic radiation (EMR) from phones and avoid marketing their products to children."*

- Download Full Text of Report
- Summary
- Recommendations
- Press Release

The Council of Europe

In 2011 The Parliamentary Assembly of the Council of Europe issued Resolution 1815: *The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment.*

- A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours."
- *"For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises."*

(Note: This is a follow up to the 2009 European Parliament's *Health concerns associated with electromagnetic fields*).

2015 International Scientists Appeal to U.N. to Protect Humans and Wildlife from Electromagnetic Fields and Wireless Technology EMF Scientists

- In May 2015, a group of over 200 scientists from 39 nations who have authored more than 2,000 articles on this topic appealed to the United Nations to address "the emerging public health crisis" related to cell phones and other wireless devices. These scientists state that "the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, and are " insufficient to protect public health."
- They state that "the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF."

The World Health Organization's International Agency for Research on Cancer

The WHO/IARC classified all radiofrequency electromagnetic fields as "possibly carcinogenic to humans" in 2011 based on the opinion of a Working Group of 31 international experts who met in Lyon, France in May, 2011 based largely on positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma, and acoustic neuroma." (p. 421)

- Read article in The Lancet IARC 2011 on the classification,
- Read the The 2011 IARC Press Release by the WHO IARC in which precautions are recommended:

  "Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands free devices or texting."said IARC Director Christopher Wild.
- Read the published the IARC Monograph on Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields (April 2013) with scientific basis for classification.
  - "Due to the closer proximity of the phone to the brain of children compared with adults, the average exposure from use of the same mobile phone is higher by a factor of 2 in a child's brain and higher by a factor of 10 in the bone marrow of the skull."

Swiss Physicians Association of Doctors for Environmental Protection

- 2012 Swiss Physicians Letter "the risk of cancer for this type of [wireless] radiation is similar to that of the insecticide DDT, rightfully banned... From the medical point of view, it is urgent to apply the precautionary principle for mobile telephony, WiFi, power lines, etc."
- 2014: Preliminary draft for a federal law on the protection against dangers: Non-ionizing radiation (NIS) is growing steadily. Especially the everyday stress in the area of low-frequency and high-frequency.
- 2016: Press Release on the NTP Study and Policy Implications: "There are increasingly clear indications that mobile radio is a health hazard. From a medical point of view it is clear: the scientific results so far show it is clear that prudent avoidance of unnecessary exposures is necessary."
- Additional Links by Swiss Physicians for the Environment
  Report on Smartphones- (OEKOSKOP 1/16) AefU-News about Electrosmog

Dr. Eitan Kerem, Chairman, Department of Pediatrics at Hadassah Hebrew University Hospital

In response to the 2016 NIH/NIEHS/NTP Study results finding a link between RF-EMF and Cancer, Dr. Kerem issued a statement which includes:

"It is well known that children are more sensitive to radiation than adults; many of them are using cellphone and other radiating media more frequently than adults. The effect of radiation is accumulative and this may have long term effect on the growing child. Such

findings in the pharma industry may prevent further developing of a drug until safety is proven, and until the findings of this study are confirmed parents should be aware of the potential hazards of carcinogenic potential of radiofrequency radiation." **Read the Statement by Dr. Eitan Kerem, Hadassah Hebrew University Hospital**

The American Academy of Environmental Medicine

The American Academy of Environmental Medicine's Open Letter to the Superintendents of the School Districts of the United States

"Adverse health effects, such as learning disabilities, altered immune responses, headaches, etc. from wireless radio frequency fields do exist and are well documented in the scientific literature. Safer technology, such as using hard-wiring, must be seriously considered in schools for the safety of those susceptible individuals who may be affected by this phenomenon. "

Wireless Radiofrequency Radiation in Schools

American Academy of Environmental Medicine Recommendations Regarding Electromagnetic and Radiofrequency Exposure

Letter to the FCC regarding Radiofrequency Exposure Limits.

International Society of Doctors for the Environment

ISDE has made the following recommendations: Avoid Wi-Fi in home or work if possible, particularly in schools or hospitals and Use wired technology whenever possible.

- "Because of the potentially increased risks for the foetus, infants and young children due to their thinner more permeable skulls and developing systems, particularly the immune and neurological systems, based on the precautionary principle and on the mounting evidence for harm at the sub-cellular level, we recommend that EMR exposure should be kept to a minimum."
- Read the Statement Here.

Irish Doctors Environmental Association

The Irish Doctors Environmental Association wrote a statement in 2013 concerning health concerns with Wi-Fi in school:

"We urge you to use wired technologies for your own safety and that of your pupils and staff." Read the 2013 Letter

Bioinitiative Working Group

Bioinitiative 2012 Report: **A report by 29 independent scientists and health experts from around the world* about possible risks from wireless technologies and electromagnetic fields.**

"The science, public health, public policy and global response to the growing health issue of chronic exposure to electromagnetic fields and radiofrequency radiation in the daily life of billions of people around the world. Covers brain tumor risks from cell phones, damage to DNA and genes, effects on memory, learning, behavior, attention; sleep disruption and cancer and neurological diseases like Alzheimer's disease. Effects

> on sperm and miscarriage (fertility and reproduction), effects of wireless on the brain development of the fetus and infant, and effects of wireless classrooms on children and adolescents is addressed. Mechanisms for biological action and public health responses in other countries are discussed. Therapeutic use of very low intensity EMF and RFR are addressed."

Henry Lai's Research Summaries: These abstracts (data-based to be searchable) cover the RFR scientific literature from both RFR and ELF on research published between 1990-2012.

The Bioinitiative RF Color Charts summarize many studies that report biological effects and adverse health effects relevant for cell towers, WI-FI, 'smart' wireless utility meters, wireless laptops, baby monitors, cell phones and cordless phones. The reader can compare the level of EMF used in specific research studies relative to the health effect.

Bioinitiative Letter to Education Super Highway CEOs the Co-Editors of the Bioinitiative Report Cindy Sage and David Carpenter sent a letter on behalf of the Bioinitiative Working Group to the CEO's on the health risks of wireless infrastructure in US schools stating:

> *"WiFi in schools, in contrast to wired internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Corporations cannot avoid responsibility simply by asserting compliance with existing legal, but outdated and inadequate FCC public safety limits. Today, corporations that deal with educational technology should be looking forward and helping school administrators and municipal leaders to access safe, wired solutions."*

Austrian Medical Association

Guidelines of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses (EMF syndrome): The Austrian Medical Association, on March 3, 2012, released their guide for diagnosing and treating people with EMF-related health problems.

> "Wi-Fi environments will lead to high microwave exposure for students and teachers which might increase the burden of oxidative stress. Oxidative stress might slow down the energy production especially in brain cells and may lead e.g. to concentration difficulties and memory problems in certain individuals. The Austrian Medical Association recommends Wi-Fi free school environments."
>
> Dr Gerd Oberfeld, MD, Public Health Department, Salzburg, Austria, on behalf of the Austrian Medical Association stated, "Schools should provide the best possible learning environments. In this context low noise levels, good air quality and low radiofrequency / microwave radiation are crucial. Wi-Fi environments will lead to high microwave exposure for students and teachers which might increase the burden of oxidative stress. Oxidative stress might slow down the energy production especially in brain cells and may lead e.g. to concentration difficulties and memory problems in certain individuals. The Austrian Medical Association recommends Wi-Fi free school environments".

Consumers Protection Association of Romania on Cell Phones and Wireless

The Association for Consumer Protection in Romania Has 13 Recommendations to the Public on Cell Phones and Wireless

1. Do not allow children younger than 12 years how to use a cell phone, except for emergencies. Developing bodies are more susceptible to negative influences from exposure to electromagnetic fields.
2. Limit cell phone use calls the most important and limit the length of calls. The biological effects are directly related to the duration of exposure; research results have shown that only a two-minute conversation modifies the natural electrical activity of the brain for up to an hour after that call. Communicate via SMS rather than by telephone (it limits the duration of exposure and the proximity of the body).
3. During the call, hold the phone a body as large . Regularly change the head of the supported phone or, better yet, switch to speakerphone that allows the user to hold the phone away from the head (amplitude field drops 4 times at a distance of 10 cm and 50 times a 1 m distance).
4. Read The Full List here.

Center for Environmental Oncology University of Pittsburgh Cancer Institute
Frequently Asked Questions about Cancer and the Environment recommends reducing exposure.
Dr. Ronald B. Herberman, Director of the University of Pittsburgh Cancer Institute, issued a Memo to PCI Staff: Important Precautionary Advice Regarding Cell Phone Use

> "Do not allow children to use a cell phone, except for emergencies. The developing organs of a fetus or child are the most likely to be sensitive to any possible effects of exposure to electromagnetic fields".
>
> - *Prominent Cancer Doctor Warns About Cellphones*: New York Times article
> - Statement Of Ronald B. Herberman, MD Director University of Pittsburgh Cancer Institute and UPMC Cancer Centers to the Domestic Policy Subcommittee Oversight and Government Reform Committee Thursday, September 25, 2008 2154 Rayburn HOB 11:00 a.m. "Tumors and Cell Phone use: What the Science Says"

The Cancer Association of South Africa (CANSA)
"In order to prove that the use of cell phones can cause cancer, many thousands of cell phone users would need to be studied over many years. Such studies are now in progress in many countries and it is expected that definitive results will be forthcoming in the near future. However, just because there is no definite evidence at this stage, does not mean that there is no potential danger."
Recommendations to reduce Exposure: CANSA has issued a Fact Sheet and Position Statement on Exposure to Radiofrequency Electromagnetic Fields

> "CANSA proposes that exposure to cell phone radiation be kept to a minimum by: Limiting the number and duration of calls Texting rather than making calls Switching the

sides of the head when a call is long – one should, however, avoid long conversations Making use of hands-free kits or speaker phone mode to keep the phone a distance from the head. Instructing children and teenagers to limit calls to emergencies only as they are more vulnerable to electro-magnetic radiation because of the thickness of their skulls and their brains are still developing Not sleeping with one's cell phone close to one's bed or under one's pillow Women not to keep their cell phones in their brassiere Men not to carry their cell phones in the pockets of their pants (close to their testicles)."

The Canadian Medical Association
2011 Resolution on Cell Phone Radiation
"The Canadian Medical Association will educate and advise the profession and the public on methods of cellphone operation that will minimize radio frequency penetration to the brain."
Read the 2011 General_Council_of the Canadian Medical Association Proceedings (page 54)

Canadian Medical Association Journal reports Health Canada's wireless limits are "A Disaster to Public Health" Read the article here.

Canadian Doctors
2014 Letter by 55 Canadian Doctors
The Doctors wrote Health Canada calling for more protective limits stating, *"There is considerable evidence and research from various scientific experts that exposure to microwave radiation from wireless devices; Wi-Fi, smart meters and cell towers can have an adverse impact on human physiological function".*
International Group in Support of Safer Standards for Canadians
53 Doctors sign a Scientific Declaration on Health Canada EMF Limits July 9,2014

The Russian National Committee on Non-Ionizing Radiation Protection
ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECT ON CHILDREN AND TEENAGERS (2011) warns about electromagnetic radiation impacts on children and recommended WiFi not be used in schools.

- **Official Recommendations:** Those under the age of 18 should not use a mobile phone at all, recommends low- emission phones; and requires the following: on-device labelling notifying users that it is a source of RF-EMF, user guide information advising that ''it is a source of harmful RF-EMF exposure'' and the inclusion of courses in schools regarding mobile phones use and RF-EMF exposure issues. "Thus, for the first time in the human history, children using mobile telecommunications along with the adult population are included into the health risk group due to the RF EMF exposure."
    - "In children, the amount of so-called stem cells is larger than in adults and the stem cells were shown to be the most sensitive to RF EMF exposure."
    - "It is reasonable to set limits on mobile telecommunications use by children and adolescents, including ban on all types of advertisement of mobile telecommunications for children."

Decision of Russian National Committee on Non-Ionizing Radiation Protection 2008, "Children and Mobile Phones: The Health of the Following Generations is in Danger"

The Cyprus National Committee on Environment and Child Health
This Health Committee was created by the Cyprus government to advise on children's environmental health issues and is comprised of pediatricians. They have issued strong recommendations to reduce exposure to children.

- Protecting children from radiation emitted by Wi-Fi, mobile phones and wireless by Dr. Stella Kanna Michailidou of the National Committee Chairman "Environment and Children's Health"
- See the Commission's EMF brochure on reducing the risks to children from exposure to the Non Ionizing Radiation (mobile phones, Wi-Fi, tablets, etc.).
- The Cyprus National Committee on Environment and Child Health created a short PSA for citizens about children and wireless radiation and how to reduce Wi-Fi exposure.

The Italian Society for Preventive and Social Pediatrics
The Society has officially called to prohibit cell phones for children under 10 years old.
"We do not know all the consequences associated with cell phone use, but excessive use could can lead to concentration and memory loss, increase in aggressiveness and sleep disturbances," stated Giuseppe Di Mauro, President of The Italian Society for Preventive and Social Pediatrics stating, "The damage to health are increasingly evident."

-Read the News Article Pediatricians Sound Alarm for Kids on Cell Phones

European Academy for Environmental Medicine

2016 EMF Guidelines were published giving an overview of the current knowledge regarding EMF-related health risks and provides recommendations for the diagnosis, treatment and accessibility measures of EHS to improve and restore individual health outcomes as well as for the development of strategies for prevention.

- Read the **EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses**

British Medical Doctors
In 2014 a group of **British Medical Doctors issued *Health and safety of Wi-Fi and mobile phones*:**

> *"We wish to highlight our concern over the safety of exposure to microwave radiation from wireless technology, particularly for vulnerable groups like children, pregnant women, the elderly and those with compromised health".*

U. S. President's Cancer Panel, 2009
The 2009 U.S. President's Cancer Panel pointed to cell phones and other wireless technologies as potential causes of cancer. In its recommendations, the panel stated:

> "Several steps can be taken to reduce personal exposure to RF fields from cell phones. Landlines or text messaging should be used whenever possible. If a mobile phone must be used, a headset is preferable to holding the phone to the ear. Children should be

prohibited from using mobile phones except in emergencies. Active phones should not be kept on belts or in pockets. Phones should not be kept in close proximity during sleep.
Reduction of exposure to other sources of RF can be accomplished by keeping AM, FM, television, and mobile phone towers far from homes, schools, and businesses. Wireless networks should not be used in schools; wired connections should be used instead. There should be resistance to the general trend toward making everything wireless without consideration of negative consequences."
DR. MARTHA LINET: CELLULAR (MOBILE) TELEPHONE USE AND CANCER RISK
DR. DAVID CARPENTER: ELECTROMAGNETIC FIELDS AND CANCER: THE COST OF DOING NOTHING Page 15

"Since latency for brain cancer from environmental exposures is thought to be 20 to 30 years, comprehensive studies looking at longer-term human exposure are needed. Participants urged that a precautionary approach be taken with respect to the use of cell phones by children, who are more susceptible than adults to radiation risks."
- Summary of of the President's Cancer Panel 2009 January 27 Phoenix, AZ

Israel Dental Association

Israeli Dental Association issued a recommendation to decrease exposure after their research showed links to salivary gland tumors.

"One in every five rare malignant tumors of the cheek occurs in someone under age 20 Young people should limit direct exposure of the head to microwave radiation from cell phones." News Article:Israeli Study Sees Link Between Oral Cancer, Cell Phones Israel Dental Association: Number of cases of parotid salivary cancer rose dramatically in past five years.

The Seletun Scientific Statement

In November, 2009, a scientific panel met in Seletun, Norway, for three days of intensive discussion on existing scientific evidence and public health implications of the unprecedented global exposures to artificial electromagnetic fields (EMF). EMF exposures (static to 300 GHz) result from the use of electric power and from wireless telecommunications technologies for voice and data transmission, energy, security, military and radar use in weather and transportation. The Scientific Panel recognizes that the body of evidence on EMF requires a new approach to protection of public health; the growth and development of the fetus, and of children; and argues for strong preventative actions. New, biologically-based public exposure standards are urgently needed to protect public health worldwide.
The report and Consensus Statement, published in the journal Reviews on Environmental Health (http://www.ncbi.nlm.nih.gov/pubmed/21268443),
Seletun Consensus Statement

Potenza Picena Resolution 2011

> On April 20th , 2013 the International Congress of Potenza Picena entitled "Radar, radiofrequency and health risk" concluded that stricter safety standards for EMF needs to be adopted by governments and public health agencies because the existing ones are obsolete and they are not based on recent literature about biological effects." Potenza Picena Resolution 2011

Porto Alegre Resolution, **Brazil**
Dozens of Doctors, (primarily from Brazil) have issued recommendations

> "We are deeply concerned that current uses of non-ionizing radiation for mobile phones, wireless computers and other technologies place at risk the health of children and teens, pregnant women, 2 seniors and others who are most vulnerable due to age or disability, including a health condition known as electromagnetic hypersensitivity. We strongly recommend these precautionary practices: 1. Children under the age of 16 should not use mobile phones and cordless phones, except for emergency calls;" Read more at **Porto Alegre Resolution**

Even as far back as 1997, dozens of Boston Doctors and Health experts signed onto a petition with concerns about Sprint's Wireless Rollout.

1997 Boston Physicians' and Scientists' Petition To Avert Public Exposures to Microwaves

> "We the undersigned physicians and scientists call upon public health officials to intervene to halt the initiation of communication transmissions employing ground level, horizontally transmitting, pulsed microwaves in Boston."

MORE RECOMMENDATIONS TO KNOW

Consumer Reports
May 2016 Consumer Reports Recommendations in article: Does Cell Phone Use Cause Brain Cancer? What the New Study Means For You: Groundbreaking study reveals the strongest link yet between cell phone radiation and cancer. Important advice for all consumers.

- Try to keep the cell phone away from your head and body. Keeping it an arm's distance away significantly reduces exposure to the low-level radiation it emits. This is particularly important when the cellular signal is weak—when your phone has only one bar, for example—because phones may increase their power then to compensate.
- Text or video call when possible, because this allows you to hold the phone farther from your body.
- When speaking, use the speakerphone on your device or a hands-free headset.
- Don't stow your phone in your pants or shirt pocket. Instead, carry it in a bag or use a belt clip.

May 2016 Consumer Reports Recommendations to Government and Industry

"The substantial questions and concerns raised by this and previous research regarding cell phones and cancer requires swift and decisive action by the government and industry. Specifically, Consumer Reports believes that:

- The National Institutes of Health should commission another animal study using current cell phone technology to determine if it poses the same risks as found in this new study.
- The Federal Communications Commission should update its requirements for testing the effect of cell phone radiation on human heads. The agency's current test is based on the devices' possible effect on large adults, though research suggests that children's thinner skulls mean they may absorb more radiation. The FCC should develop new tests that take into account the potential increased vulnerability of children.
- The Food and Drug Administration and the FCC should determine whether the maximum specific absorption rate of 1.6 W/kg over a gram of tissue is an adequate maximum limit of radiation from cell phones.
- The Centers for Disease Control and Prevention should repost it's advice on the potential hazard of cell phone radiation and cautionary advice that was taken down in August 2014.
- Cell phone manufacturers should prominently display advice on steps that cell phone users can take to reduce exposure to cell phone radiation."

September 2015 Consumer Reports Recommendations in article Does Cell-Phone Radiation Cause Cancer?: As the debate over cell-phone radiation heats up, consumers deserve answers to whether there's a cancer connection

"We feel that the research does raise enough questions that taking some common-sense precautions when using your cell phone can make sense."

New Jersey Education Association (NJEA)

The September 2016 NJEA Review recommends staff and students "*Minimize health risks from electronic devices"* and issues these steps to reduce radiation exposure:

- *Keep devices away from the body and bedroom.*
- *Carry phones in briefcases, etc., not on the body.*
- *Put devices on desks, not laps.*
- *Hard wire all devices that connect to the internet.*
- *Hard wire all fixed devices such as printers, projectors and boards.*
- *Use hard-wired phones instead of cell or cordless phones.*
- *Text rather than call.*
- *Keep conversations short or talk in person.*
- *Put devices in airplane mode, which suspends EMF transmission by the device, thereby disabling Bluetooth, GPS, phone calls, and WiFi.*
- *Use speaker phone or ear buds instead of holding the phone next your head.*
- *Take off Bluetooth devices when not using them."*
- *Read the article on the NJEA Review here. Download a PDF of the article here.*

The Israeli Psoriasis Association

2016: The Israeli Psoriasis Association started selling retro headsets to reduce exposure from cell phones with the logo of the association on the headsets.

See the link at the Israeli Psoriasis Association.

National Center for Health Research

2015: Children and cell phones: is phone radiation risky for kids? Article explains what we know, what we do not know and what we can do.

> "By the time we find out, many people will have been harmed if cell phones are found to be dangerous. Here are some precautionary tips on how to protect your children from the health issues that could be connected to cell phone radiation.9
>
> 1. Turn airplane mode on when giving a child a technology device or when a cell phone is near a pregnant abdomen, to prevent exposure to radiation.
> 2. Turn off wireless networks and devices to decrease your family's radiation exposure whenever you aren't actively using them. As an easy first step, turn your Wi-Fi router off at bedtime.
> 3. Decrease use of phones or wifi where wireless coverage is difficult, in order to avoid an increase in radiation exposure."

Over 17 Government Health Agencies

Health agencies of countries worldwide have issued recommendations to reduce exposure to cell phones and wireless devices because of the lack of safety data. Please see a full list of the recommendations of health agencies at http://ehtrust.org/policy/international-policy-actions-on-wireless/

Seletun Consensus Statement

> The report and Consensus Statement, published in the journal Reviews on Environmental Health (http://www.ncbi.nlm.nih.gov/pubmed/21268443) by a consortium of international scientists urges global governments to adopt significantly lower human exposure standards for electromagnetic fields. "Government actions are urgently warranted now, based on evidence of serious disruption to biological systems"
> Go to the webpage of the Seletun Consensus Statement

Stockach Germany Doctors

> "As physicians and pharmacists, we believe that the further development of the mobile phone network is a matter of concern and appeals to politicians, scientists and health care providers, to protect the protection of life and health from all of us with due diligence

and to act immediately. We strongly demand: no further expansion of mobile technology, because it involves involuntary risks with probably permanent burdens."
Read the Stockacher Appeal

Copenhagen Resolution

The Copenhagen Resolution was passed at the conference "The shadow-side of the Wireless Society" on October 9, 2010 at the Parliament building, Christiansborg, Copenhagen.
"Minimize wireless radiation exposure in public spaces occupied by vulnerable groups, like schools, day care facilities and public transport."
Read the Copenhagen Resolution

The Declaration of the Official Association of Biologists of Galician:

"It is necessary to adopt the principle of Precautionary measures as defined in Law 33/2011, General of Public Health, of the Spanish state, which identifies first and specifically and unequivocally emissions Electromagnetic are a risk to health… To monitor environmental risks and their health effects, including the presence of pollutants in the environment."
The Declaration of the Official Association of Biologists of Galician, Spanish

Benevento Resolution

"Based on our review of the science, biological effects can occur from exposures to both extremely low frequency fields (ELF EMF) and radiation frequency fields (RF EMF). Epidemiological and in vivo as well as in vitro experimental evidence demonstrates that exposure to some ELF EMF can increase cancer risk in children and induce other health problems in both children and adults."
Read the 2006 Benevento Resolution

Doctors of Lake Constance-Upper Swabia-Allgäu (373 Physicians)

As physicians, we believe that the further development of the mobile phone network is a matter of concern and appeals to politicians, scientists and persons in charge of education and health, to protect the life and health of all of us with due diligence and to act immediately.

We urge:
1. No further development of mobile technology, because it is involuntary risks with permanent burdens.
2. Massive reduction of the limits and radio loads.
3. Enlighten the population about the health risks of electromagnetic fields (Mobile phones, cordless (DECT) phones, WLAN, bluetooth)
4. Limitations of use of mobile phones and the prohibition of DECT cordless telephones in kindergartens, schools, hospitals,senior homes, public buildings and transports, similar to the ban on smoking
Read the full 2006 Allgäuer Appeal, Read the list of Doctors

European/International Medical Doctors and Experts/Civic Organizations

In Madrid, on June 2013 a group of Doctors, medical organizations, researchers and representatives of civil organizations signed a statement in support of the application of ALARA (As Low As Reasonably Achievable) AND ALATA (As Low As Technically Achievable) The list of signatories includes many medica;l doctors in addition to: Domingo Jiménez Beltrán, the former Executive Director of the European Environment Agency (1994-2002), Dr. Tomica Ancevski, President of the Macedonian section of International Society of Doctors for the Environment; Dr. Roberto Romizi, President and on behalf of The Italian section of International Society of Doctors for the Environment; Dr Philip Michael, on behalf of the Irish Doctors Environmental Association and as VP (Europe) International Society of Doctors for the Environment; Prof. Dr. Hanns Moshammer, on behalf of the Austrian Doctors for a Healthy Environment; Fiorella Belpoggi, Ph.D., FIATP, Director and Chief of Pathology of the Cesare Maltoni /Cancer Research Centre of the Ramazzini Institute, Dr. Morando Soffritti, M.D; Oncologist, Scientific Director of the European Foundation for Oncology and Environmental Sciences

Read the European Manifesto in support of a European Citizens' Initiative (last updated July 2016)

The Freiburg Appeal International Doctors´ Appeal

More than 1000 physicians signed the “Freiburg Appeal” in 2002. Ten years later, Doctors initiated the Appeal in 2012 which is ongoing.

“More and more new wireless technologies are introduced into our daily lives: cell phone networks, TETRA, LTE, cordless phones, Wi-Fi, baby monitors, wireless meters, digital radio and TV, and many others. All of these wireless technologies interfere with the biophysical organization of life with increasing layers and densities of electromagnetic fields.”

Freiburg Appeal: Wireless Radiation Poses a Health Risk.

Wuerzburg Appeal , 2010

The European Academy for Environmental Medicine (EUROPAEM) invited many renowned national and international scientists and health care professionals to a medical conference held in Wuerzburg, Germany from April 23 to April 25, 2010. This appeal was unanimously adopted by the congress.

Read the Wuerzburg Appeal, 2010

Letters by Medical Doctors to Schools on Wireless Installations in Schools

Letters to Petaluma Public Schools California, 2016

(Note: These letters are important as they were written after the NTP study release and include an analysis of how the research impacts an understanding of the risk to children).

- Letter from Dr. Carpenter to Petaluma Public Schools 8/3/2016
- Letter from Dr. Anthony Miller to Petaluma Public Schools 8/4/2016
- Letter from Dr. Martha Herbert to Petaluma Public Schools 9/2016

- Letter from Dr. Lennart Hardell to Petaluma Public Schools 8/4/2016

Letters to Montgomery County Public Schools Maryland, 2015

- Lennart Hardell, MD, PhD, and Michael Carlberg, MSc, Department of Oncology, Orebro University Hospital, Sweden to Montgomery County Schools 11/30/2015
- Dr. Olle Johansson, Karolinska Institute to Montgomery County Schools 12/8/2015
- Dr. Martha Herbert, Harvard Pediatric Neurologist to Montgomery County Schools 12/12/2015
- Anthony B. Miller, MD FACE, Professor Emeritus Dalla Lana School of Public Health, University of Toronto, World Health Organization Advisor to Montgomery County Schools
- Dr. David O. Carpenter, M.D. University of Albany to Montgomery County Schools
- Dr. Martin L. Pall, Professor Emeritus, Biochemistry and Basic Medical Sciences, Washington State University to Montgomery County Schools
- Devra Davis, PhD MPH, President and Founder Environmental Health Trust to Montgomery County Schools
- Mikko Ahonen, PhD, Finland, Institute of Environmental Health and Safety, Mrs. Lena Hedendahl, MD Practitioner, Luleå, Sweden, Mr. Tarmo Koppel, MSc., PhD to Montgomery County Schools December 13, 2015
- Cindy Sage. MA, Sage Associates, Co-Editor, BioInitiative 2007 and 2012 Reports and Prof. Trevor Marshall, PhD. Director, Autoimmunity Research Foundation,Senior Member IEEE, Founding chair (retired) IEEE EMBS (Buenaventura Chapter)Fellow, European Association for Predictive, Preventive and Personalised Medicine (Brussels) International Expert Council, Community of Practice: Preventative Medicine (Moscow) to Montgomery County Schools
- Dr. Ronald Powell, retired U.S. Government scientist (Ph.D., Applied Physics, Harvard University) to Montgomery County Schools
- Cris Rowan, BScBi, BScOT, SIPT, to Montgomery County Schools
- Lloyd Morgan, Engineer, Scientific Advisor, Environmental Health Trust to Montgomery County

Letters to the Los Angeles School District

- Olle Johansson's Letter to the LAUSD
- Dr. Martin Blank's Letter to the LAUSD
- Dr. Joel Moskowitz Letter to the LAUSD
- Dr. Blanks Letter on Cell Towers near Schools.
- A Compilation of Letters by Doctors at Dr. Moskowitz website UC Berkeley

Letters by Experts

- Ron Powell, PhD Message to Public Schools about Wireless Devices, 2016
- Ron Powell PhD, The Health Argument against Cell Phones and Cell Towers, 2016
- Bioinitiative Letter to Education Super Highway CEOs
    - This letter was written by Cindy Sage and David Carpenter, Co-Editors of the Bioinitiative Report to the CEO's on wireless infrastructure in US schools.

- The American Academy of Environmental Medicine's Open Letter to the Superintendents of the School Districts of the United States
- Irish Doctors Environmental Association 2013 Letter Recommending Wired Connections
- Cris Rowan, Open Letter to the Canadian Council of Education Ministers asking for removal of wireless radiation from school environments
- Frank Clegg' Letter to Denmark's Committee on Radiation Protection
- Dr. David Carpenter's Letter to Kawartha Pine Ridge District School Board, 2011
- Dr. Steven Sinatra Letter to the Kawartha School Board, 2011
- 2009 Dr. Magda Havas' Open Letter: Open Letter to Parents, Teachers, & School Boards Regarding Wi-Fi Networks in Schools and Cell Phone Antennas near School Property
- British Medical Doctor's Letter *Health and safety of Wi-Fi and mobile phones*
- Olle Johansson, PhD Letter on WiFi in Schools Australia, 2013

Q: Why do federal regulations allow cell phones to be sold to children if Doctors are so concerned?
A: As history shows, federal protections are usually implemented **decades after** research shows an environmental exposure is harmful. In the United States, for example, the American Academy of Pediatricians recommends reducing exposure to cell phones *and at the same time,* the federal government's FCC - lead by a former Chief of the Wireless Industry- is rolling out more and more wireless infrastructure. Not a single US federal health agency has done a systematic research review on the issue and -as far as we know- there are currently no plans to do so. Therefore, it is important for people to be made aware of these issues and take precautions *now*- in their homes, work, school and community.

4. Telecom and Insurance Companies Warn of Liability and Risk 2017 10K filings,

ENVIRONMENTAL HEALTH TRUST

Legal and Liability Issues Related to Cell Phones

Table of Contents:

1. Insurance Reports and White Papers that Cover EMFs
2. Company Investor Warnings in Annual Reports and Security and Exchange (SEC) mandated annual 10-K Filings
3. Examples of Policy Exclusions for Electromagnetic Radiation
4. Lawsuits

1. Insurance Reports & Whitepapers

REPORTS AND WHITE PAPERS

2016 Austrian Accident Insurance Institute (AUVA) ATHEM Report 2

"Investigation of athermal effects of electromagnetic fields in mobile communications."

> "The ATHEM 2 project investigated cognitive effects as well as whether and how the RF-EMF changes cells of the human body."

2011 Austrian Accident Insurance Institute (AUVA) ATHEM Report 1

"Investigation of athermal effects of electromagnetic fields in mobile radio areas."

> "The ATHEM project investigates the athermal (heat-independent) biological effects of radiofrequency electromagnetic fields on an interdisciplinary basis."

2009 Austrian Accident Insurance Institute (AUVA) Focus: ATHEM Report

"Athermal effects confirmed - Limits questioned - Precaution required."

> "The Austrian General Accident Insurance provides a research report on athermal effects of mobile radio radiation and calls for precautionary policies."

2009 Austrian Accident Insurance Institute Report on Health Risks from Cell Phone Radiation

"Nonthermal Effects of Electromagnetic Radiation in the Cell Phone Frequency Range"

> "The AUVA studies have verified that: Electromagnetic fields from cell phone radiation have an impact on the: Central Nervous System (brain), Immune System, Protein Syntheses."
>
> "The radiation-induced effects observed, however, were not always dosage-dependent as would be expected from thermal effects. Some cells showed an even stronger response when the 5-minute expo- sure was followed by a 10-minute break (intermittent exposure). This would also support a nonthermal effect mechanism. The project results, therefore, serve as a further confirmation of the existence of so-called nonthermal effects." (p. 169)
>
> "Any person, of course, can learn important lessons from these results. The findings of the study show that a cell phone user can minimize the potential risks through a prudent use of this technology." (p.169)
>
> "One of the observations showed that, among the different cells, those respond particularly strongly, which are metabolically active. This cell property is especially pronounced in growing tissues, that is, in children and youth. Consequently, these population groups would be more susceptible than average to the described effects."

2014 Swiss Re SONAR Report

"Swiss Re SONAR: New emerging risk insights."

> "This report highlights 26 new emerging risk themes. It is meant to provide a first indication of what might lie beyond the horizon so that our readers can prepare for future challenges. Themes were identified through Swiss Re's SONAR process and have been reviewed by Swiss Re's emerging risk management experts. They draw on all areas of insurance, and many themes have cascading effects across areas and lines of business. Unforeseen consequences of electromagnetic fields are categorized as having high potential impacts."

2013 Swiss Re SONAR Report

Swiss Re SONAR: "Emerging risk insights."

"Unforeseen consequences of electromagnetic fields. Potential impact: High. Time Frame: >10 Years.

The ubiquity of electromagnetic fields (EMF) raises concerns about potential implications for human health, in particular with regard to the use of mobile phones, power lines or antennas for broadcasting. Over the last decade, the spread of wireless devices has accelerated enormously. The convergence of mobile phones with computer technology has led to the proliferation of new and emerging technologies. This development has increased exposure to electromagnetic fields, the health impacts of which remain unknown. Anxiety over the potential risks related to EMF has risen. Studies are difficult to conduct, since time trend studies are inconsistent due to the still rather recent proliferation of wireless technology. The WHO has classified extremely low-frequency magnetic fields and radiofrequency electromagnetic fields, such as radiation emitted by cell phones, as potentially carcinogenic to humans (Class 2B carcinogen). Furthermore, a recent ruling by an Italian court suggested a link between mobile phone radiation and human health impairment. Overall, however, scientific studies are still inconclusive regarding possible adverse health effects of EMF. If a direct link between EMF and human health problems were established, it would open doors for new claims and could ultimately lead to large losses under product liability covers. Liability rates would likely rise."

1996 Swiss Re Report on Electrosmog

"Electrosmog - a phantom risk."

"The following chapters explain in detail why it is not possible to answer with certainty the question of whether weak electromagnetic phenomena pose health risks. While it is true that epidemiological studies could provide evidence that human beings subject to certain conditions of exposure fall ill with greater frequency, such statistics can never be taken as a basis for drawing conclusions with regard to a specific case. As long as the causes of cancer and other diseases have not been identified beyond all doubt, statement concerning them are, at best, conjecture."

This report was later followed up by a 2013 report which stated that the consequences of electromagnetic fields have a high potential impact.

2013 AM Best Briefing

"Emerging Technologies Pose Significant Risks with Possible Long-Tail Losses"

"The risks associated with long term use of cell phones, although much studied over the past 10 years, remains unclear. Dangers to the estimated 250,000 workers per year who come in close contact with cell phone antennas, however, are now more clearly established. Thermal effects of the cellular antennas, which act at close range essentially as open microwave ovens can include eye damage, sterility and cognitive impairments. While workers of cellular companies are well trained on the potential dangers, other workers exposed to the antennas are often unaware of the health risks.The continued exponential growth of cellular towers will significantly increase exposure to these workers and others coming into close contact with high-energy cell phone antenna radiation."

2011 *Business Insurance* White Paper

"The Next Asbestos: Five emerging risks that could shift the liability landscape."

This white paper examines mass tort exposures that may have the potential to cause major difficulties for commercial policyholders and their insurers and includes workers' overexposure to radio frequency waves from rooftop wireless transmitters and also states, "research, meanwhile, also has shown biological effects from lower-level "nonthermal" exposure, and people exposed at lower levels have reported headache, dizziness, nausea, mood disorders, mental slowing and memory loss."

2010 Lloyd's of London Report on Electromagnetic Fields

"Electromagnetic fields from mobile phones: recent developments." Lloyd's Emerging Risks Team Report

This report looks first at current views on EMF as stated by international bodies such as the World Health Organisation and the European Union, and then goes on to examine recent scientific research into the field. It finally considers the implications for the insurance industry by scrutinising current legal cases on EMF and any comparisons which can be drawn with asbestos.

"The danger with EMF is that, like asbestos, the exposure insurers face is underestimated and could grow exponentially and be with us for many years." Lloyd's refuses to cover claims linked with RF radiation .

ARTICLES

2012 Willis Insurance Broker Article on Electromagnetic Fields

"Electromagnetic Fields: More than Just an Eye Sore." pg. 11-12.

"Public health and toxic tort liabilities concerns surrounding EMFs have become contentious among utility companies, regulatory agencies, land owners and other affected stakeholders. While many studies have produced varying (and sometimes contradictory) results, many epidemiological studies suggest a possible human carcinogenic link in a classification group similar to, say – formaldehyde, DDT, dioxins and PCBs."

"From an insurance perspective, when considering the potential legal and toxic tort implications, a layer of defense against EMF liabilities and exposures could be found through an environmental insurance product. Among other coverage grants being provided, these environmental policies cover third-party bodily injury and property damage claims and legal defense associated with EMFs. Many carriers have EMF coverage built directly into their form via their definition of "Pollutants" (e.g.,…any solid, liquid, gaseous or thermal pollutant, irritant or contaminant including but not limited to…smoke, vapors, toxic chemicals, hazardous substances… electromagnetic fields…"). And, most environmental policies include "diminished third-party property value" in their definition of "property damage.""

2011 Business Insurance Article

Geisel, Roseanne White. "Insurers exclude risks associated with electromagnetic radiation."

The article provides a brief overview of electromagnetic radiation and the possible health effects, then notes multiple litigation cases on radiofrequency radiation exposure, as well as interviewing multiple insurance companies.

2011 Business Insurance Article on White Paper "The Next Asbestos: Five Emerging Risks that Could Shift the Liability Landscape"
"White paper explores risks that could become 'the next asbestos.'"

2002 Real Estate Finance Journal Article on the growing presence of electromagnetic field litigation
Forcade, Bill S. "Electromagnetic Field Litigation: A Growing Issue for Real Estate and Building Concerns."

"There is a growing public concern that electromagnetic □elds cause personal injury or property damage. That concern is expressed in toxic tort litigation, commercial property transactions, and insurance considerations. Because the number and variety of con□icts is increasing, it is important for prudent property managers to understand what this con□ict is about, what kind of situations prompt EMF con□icts, what the courts have done, and what to do to reduce the risks of an EMF con□ict."

"Second, EMF litigation is profoundly dependent upon the character of the most recent scienti□c studies on the health e□ects of EMF. Even a single reputable scienti□c study showing that EMF are a direct cause of an adverse health e□ect could lead to an explosion in litigation."

1999 Microwave News Article on Refusal of Lloyd's of London to cover cell phone manufacturers
Microwave News March/April, "Wireless Notes"

"Lloyd's of London, the leading U.K. insurance underwriter, is refusing to cover manufacturers of wireless phones against health risks to users of their phones, the Guardian and its sister publication, the Sunday Observer, both leading British newspapers, reported on April 10 and April 11, respectively. The announcement follows the release of the University of Bristol findings of changes in cognitive function following exposure to signals from a mobile phone."

1999 News Article in the Guardian on Current Status of Britain's Insurance Policies
Ryle, Sarah. "Insurers balk at risks of phones."

News article from the Guardian describing the events leading up to a Lloyd's underwriting refusing insure phone manufacturers against the damage to user's health. The article briefly outlines Britain's efforts in the wake of scientific publications showing harm from cell phone exposure.

2. Company Investor Warnings in Annual Reports and Security and Exchange (SEC) mandated annual 10k Filings

2016 VODAFONE GROUP PUBLIC LTD CO Annual Report
"Identifying and Managing our Risks"

"EMF related health risks:
What is the risk?

Concerns have been expressed that electromagnetic signals emitted by mobile telephone handsets and base stations may pose health risks. Authorities, including the World Health Organization ('WHO') agree there is no evidence that convinces experts that exposure to radio frequency fields from mobile devices and base stations operated within guideline limits has any adverse health effects. A change to this view could result in a range of impacts from a change to national legislation, to a major reduction in mobile phone usage or to major litigation.

How could it impact us?
This is an unlikely risk; however, it would have a major impact on services used by our customers in all our markets – particularly in countries that have a very low tolerance for environmental and health-related risks.

Changes from 2015
There have been no significant changes to this risk over the last 12 months.

How do we manage it?
We have a global health and safety policy that includes standards for electromagnetic fields ('EMF') that are mandated in all our local markets. Compliance to this policy is monitored and overseen by the Risk and Compliance Committee.
We have a Group EMF Board that manages potential risks through cross sector initiatives and which oversees a coordinated global programme to respond to public concern, and develop appropriate advocacy related to possible precautionary legislation.
We monitor scientific developments and engage with relevant bodies to support the delivery and transparent communication of the scientific research agenda set by the WHO."

AT&T Inc.
2016 Annual Report

"Unfavorable litigation or governmental investigation results could require us to pay significant amounts or lead to onerous operating procedures"
"We are subject to a number of lawsuits both in the United States and in foreign countries, including, at any particular time, claims relating to antitrust; patent infringement; wage and hour; personal injury; customer privacy violations; regulatory proceedings; and selling and collection practices. We also spend substantial resources complying with various government standards, which may entail related investigations and litigation. In the wireless area, we also face current and potential litigation relating to alleged adverse health effects on customers or employees who use such technologies including, for example, wireless devices. We may incur significant expenses defending such suits or government charges and may be required to pay amounts or otherwise change our operations in ways that could materially adversely affect our operations or financial results."

Verizon Communications Inc.
2016 10-K ANNUAL REPORT

"We are subject to a significant amount of litigation, which could require us to pay significant damages or settlements.

...our wireless business also faces personal injury and consumer class action lawsuits relating to alleged health effects of wireless phones or radio frequency transmitters, and class action lawsuits that challenge marketing practices and disclosures relating to alleged adverse health effects of handheld wireless phones. We may incur significant expenses in defending these lawsuits. In addition, we may be required to pay significant awards or settlements."

Blackberry Limited

40-F Annual Report for the Fiscal year ended February 28, 2017

*** Important changes from 2014 report

"The Company is subject to risks related to health and safety and hazardous materials usage regulations, and to product certification risks.

The Company must comply with a variety of laws, standards and other requirements governing, among other things, health and safety, hazardous materials usage, packaging and environmental matters, and its products must obtain regulatory approvals and satisfy other regulatory concerns in the various jurisdictions in which they are sold. There can be no assurance that the costs of complying with such laws, standards and requirements will not adversely affect the Company's business, results of operations or financial condition. Any failure to comply with such laws, standards and requirements may subject the Company to regulatory or civil liability, fines or other additional costs, and reputational harm, and may in severe cases prevent it from selling its products in certain jurisdictions.

In addition, any perceived risk of adverse health effects of mobile communication devices could materially adversely affect the Company through litigation or a reduction in sales. In addition to complying with regulatory requirements, the Company must obtain certain product approvals and certifications from governmental authorities, regulated enterprise customers and network carrier partners. Failure to maintain such approvals or certifications for the Company's current products or to obtain such approvals or certifications for any new products on a timely basis could have a material adverse effect on the Company's business, results of operations and financial condition."

40-F Annual Report for the fiscal year ended March 01, 2014

"The Company is subject to regulation and certification risks that could negatively affect its business, and is also subject to allegations of possible health or other risks relating to the use or misuse of the Company's products, or lawsuits and publicity related to such allegations.

The Company must comply with a variety of laws, standards and other requirements governing, among other things, health and safety, hazardous materials usage, packaging and environmental matters, and its products must obtain regulatory approvals and satisfy other regulatory concerns in the various jurisdictions in which they are manufactured or sold. For example, the Company's products must be approved by the FCC before they can be used in commercial quantities in the United States. The FCC requires that access devices meet various standards, including safety standards with respect to human exposure to electromagnetic radiation and basic signal leakage.

Regulatory requirements in Canada, Europe, Asia and other jurisdictions must also be met. Although the Company's products and solutions are designed to meet relevant safety standards and recommendations globally, when used as directed, any perceived risk of adverse health effects of wireless communication devices could materially adversely affect the Company through a reduction in sales.

There has also been public speculation about possible health risks to individuals from exposure to electromagnetic fields or radio frequency energy from the use of mobile devices. Government agencies, international health organizations, industry associations and other scientific bodies continue to conduct research on the topic, and there can be no assurance that future studies, irrespective of their scientific basis, will not suggest a link between electromagnetic fields from mobile devices and adverse health effects. Mobile device manufacturers and cellular services providers have been named in lawsuits alleging that the use of mobile devices poses a risk to human health and that radio emissions have caused or contributed to the development of brain tumors. Other users of mobile devices with multimedia functions, such as MP3 players, have claimed that the use of such products has contributed to or resulted in hearing loss or other adverse health effects. In addition, users of the Company's products who disregard the Company's warnings about using the products while operating a motor vehicle or who use aftermarket accessories, such as batteries, that are not subject to the Company's quality control procedures may also be at risk of bodily harm. The perception of risk to human health or other risks could adversely affect the demand for the Company's Table of Contents 51 products and allegations of risks relating to the Company's products could result in litigation, which could distract management or result in liabilities for the Company, regardless of the merit of such claims."

China Mobile Limited

2016 Form 20-F

"Actual or perceived health risks associated with the use of mobile devices could materially impair our ability to retain and attract customers, reduce wireless telecommunications usage or result in litigation.

There continues to be public speculation about possible health risks to individuals from exposure to electromagnetic fields from base stations and from the use of mobile devices. While a substantial amount of scientific research conducted to date by various independent research bodies has shown that radio signals, at levels within the limits prescribed by public health authority safety standards and recommendations, present no adverse effect to human health, we cannot be certain that future studies, irrespective of their relative reliability or trustworthiness, will not impute a link between electromagnetic fields and adverse health effects. Research into these issues is ongoing by government agencies, international health organizations and other scientific bodies in order to develop a better scientific understanding and public awareness of these issues. In addition, several wireless industry participants were the targets of lawsuits alleging various health consequences as a result of wireless phone usage or seeking protective

measures. While we are not aware of any scientific studies or objective evidence which substantiates such alleged health risks, we cannot assure you that the actual, or perceived, risks associated with radio wave transmission will not materially impair our ability to retain customers and attract new customers, significantly reduce wireless telecommunications usage or result in litigation."

American Tower Corporation

2016 Annual Report

"Our costs could increase and our revenues could decrease due to perceived health risks from radio emissions, especially if these perceived risks are substantiated.

Public perception of possible health risks associated with cellular and other wireless communications technology could slow the growth of wireless companies, which could in turn slow our growth. In particular, negative public perception of, and regulations regarding, these perceived health risks could undermine the market acceptance of wireless communications services and increase opposition to the development and expansion of tower sites. If a scientific study or court decision resulted in a finding that radio frequency emissions pose health risks to consumers, it could negatively impact our tenants and the market for wireless services, which could materially and adversely affect our business, results of operations or financial condition. We do not maintain any significant insurance with respect to these matters."

AMÉRICA MÓVIL, S.A.B. DE C.V.

2016 Form 20-F Annual Report

"Concerns about health risks relating to the use of wireless handsets and base stations may adversely affect our business.

Portable communications devices have been alleged to pose health risks, including cancer, due to radio frequency emissions. Lawsuits have been filed in the United States against certain participants in the wireless industry alleging various adverse health consequences as a result of wireless phone usage, and our subsidiaries may be subject to similar litigation in the future. Research and studies are ongoing, and there can be no assurance that further research and studies will not demonstrate a link between radio frequency emissions and health concerns. Any negative findings in these studies could adversely affect the use of wireless technology and, as a result, our future financial performance."

T Mobile

2016 Form 10-K Annual Report

"Our business could be adversely affected by findings of product liability for health/safety risks from wireless devices and transmission equipment, as well as by changes to regulations/radio frequency emission standards.

We do not manufacture the devices or other equipment that we sell, and we depend on our suppliers to provide defect-free and safe equipment. Suppliers are required by applicable law to manufacture their devices to meet certain governmentally imposed safety criteria. However, even if the devices we sell meet the regulatory safety criteria, we could be held liable with the equipment manufacturers and suppliers for any harm caused by products we sell if such products are later found to have design or manufacturing defects. We generally seek to enter into indemnification agreements with the manufacturers who supply us with devices to protect us from losses associated with product liability, but we cannot guarantee that we will be fully protected against all losses associated with a product that is found to be defective.

Allegations have been made that the use of wireless handsets and wireless transmission equipment, such as cell towers, may be linked to various health concerns, including cancer and brain tumors. Lawsuits have been filed against manufacturers and carriers in the industry claiming damages for alleged health problems arising from the use of wireless handsets. In addition, the FCC has from time to time gathered data regarding wireless handset emissions and its assessment of this issue may evolve based on its findings. The media has also reported incidents of handset battery malfunction, including reports of batteries that have overheated. These allegations may lead to changes in regulatory standards. There have also been other allegations regarding wireless technology, including allegations that wireless handset emissions may interfere with various electronic medical devices (including hearing aids and pacemakers), airbags and anti-lock brakes. Defects in the products of our suppliers, such the recent recalls by a handset Original Equipment Manufacturer ("OEM") on one of its smartphone devices, could have an adverse impact on our operating results.

Additionally, there are safety risks associated with the use of wireless devices while operating vehicles or equipment. Concerns over any of these risks and the effect of any legislation, rules or regulations that have been and may be adopted in response to these risks could limit our ability to sell our wireless services."

GCI INC

2016 Form 10-K Annual Report

"Concerns about health/safety risks associated with wireless equipment may reduce the demand for our wireless services.

We do not manufacture devices or other equipment sold by us, and we depend on our suppliers to provide defect-free and safe equipment. Suppliers are required by applicable law to manufacture their devices to meet certain governmentally imposed safety criteria. However, even if the devices we sell meet the regulatory safety criteria, we could be held liable with the equipment

manufacturers and suppliers for any harm caused by products we sell if such products are later found to have design or manufacturing defects. We cannot guarantee that we will be fully protected against all losses associated with a product that is found to be defective.

Portable communications devices have been alleged to pose health risks, including cancer, due to radio frequency emissions from these devices. Purported class actions and other lawsuits have been filed from time to time against other wireless companies seeking not only damages but also remedies that could increase the cost of doing business. We cannot be sure of the outcome of any such cases or that the industry will not be adversely affected by litigation of this nature or public perception about health risks. The actual or perceived risk of mobile communications devices could adversely affect us through a reduction in subscribers. Further research and studies are ongoing, with no linkage between health risks and mobile phone use established to date by a credible public source. However, we cannot be sure that additional studies will not demonstrate a link between radio frequency emissions and health concerns.

Additionally, there are safety risks associated with the use of wireless devices while operating vehicles or equipment. Concerns over any of these risks and the effect of any legislation, rules or regulations that have been and may be adopted in response to these risks could limit our ability to sell our wireless services."

TELEFÓNICA, S.A.

2016 Form 20-F Annual Report

"The telecommunications industry may be affected by the possible effects that electromagnetic fields, emitted by mobile devices and base stations, may have on human health.

In some countries, there is a concern regarding potential effects of electromagnetic fields, emitted by mobile devices and base stations, on human health. This public concern has caused certain governments and administrations to take measures that have hindered the deployment of the infrastructures necessary to ensure quality of service, and affected the deployment criteria of new networks and digital services such as smart meters development.

There is a consensus between certain expert groups and public health agencies, including the World Health Organization that states that currently there are no established risks associated with exposure to low frequency signals in mobile communications. However, the scientific community is still investigating this issue especially with respect to mobile devices. Exposure limits for radio frequency suggested in the guidelines of the Protection of Non-Ionizing Radiation Protection Committee have been internationally recognized. The mobile industry has adopted these exposure limits and works to request authorities worldwide to adopt these standards.

Worries about radio frequency emissions may discourage the use of mobile devices and new digital services, which could cause the public authorities to implement measures restricting where transmitters and cell sites can be located, how they operate, the use of mobile telephones and the

massive deployment of smart meters and other products using mobile technology. This could lead to Telefónica being unable to expand or improve its mobile network.

The adoption of new measures by governments or administrations or other regulatory interventions in this respect, and any future assessment on the adverse impact of electromagnetic fields on health, may adversely affect the business, financial conditions, results of operations and cash flows of the Telefónica Group."

CROWN CASTLE INTERNATIONAL CORP.

2016 Form 10-K Annual Report

"If radio frequency emissions from wireless handsets or equipment on our wireless infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues.

The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us.

Public perception of possible health risks associated with cellular or other wireless connectivity services may slow or diminish the growth of wireless companies, which may in turn slow or diminish our growth. In particular, negative public perception of, 12 and regulations regarding, these perceived health risks may slow or diminish the market acceptance of wireless services. If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters."

Softbank

(SoftBank is a corporate group comprising the pure holding company SoftBank Corp. and 756 subsidiaries including Sprint, Wireless City Planning and Yahoo Japan. They consolidated Sprint in 2013.)

2014 Annual Report

"Concerns about health risks associated with mobile devices

There have been claims made that the radio waves emitted from mobile devices have adverse health effects, such as increasing the risk of cancer. Such concerns over adverse effects on health associated with use of mobile devices could make it difficult for the Group to acquire and retain customers, which could impact the Group's results of operations. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has prescribed guidelines relating to the amplitudes of the electromagnetic waves emitted from mobile devices and base stations. The World Health Organization (WHO) has issued an opinion that there is no convincing evidence that electromagnetic waves have adverse effects on health when their amplitude is within the

reference values in the ICNIRP's guidelines, and recommends that all countries adopt them. The Group complies with a policy for protection from electromagnetic waves based on the ICNIRP guidelines in Japan, and complies with the requirements of the Federal Communications Commission (FCC) in the U.S. However, the WHO and other organizations continue to conduct research and investigations, the results of which may lead to regulations being revised in the future, or new regulations being introduced."

Nokia

2016 Annual Report

*** Important changes made from 2014 report

"Regulations about health risks associated with electromagnetic waves.
There have been some research results that have indicated the possibility that electromagnetic waves emitted from mobile devices and base stations have adverse health effects, such as increasing the risk of cancer. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) has prescribed guidelines relating to the amplitudes of these electromagnetic waves. The World Health Organization (WHO) has issued an opinion that there is no convincing evidence that electromagnetic waves have adverse effects on health when their amplitude is within the reference values in the ICNIRP's guidelines, and recommends that all countries adopt them. The Group complies with a policy for protection from electromagnetic waves based on the ICNIRP guidelines in Japan, and complies with the requirements of the Federal Communications Commission (FCC) in the U.S. However, the WHO and other organizations continue to conduct research and investigations, the results of which may lead to regulations being revised in the future, or new regulations being introduced. Complying with such revision or introduction of regulations may incur costs, or may restrict the Group's business operations, which could impact the Group's results of operations. Moreover, regardless of the presence of such regulations, concerns over the adverse effects on health associated with use of mobile devices could make it difficult for the Group to acquire and retain customers, which could impact the Group's results of operations." - pg. 71

2014 Annual Report

"An unfavorable outcome of litigation...allegations of health hazards associated with our businesses could have a material adverse effect on us.

Although NOKIA products are designed to meet all relevant safety standard and recommendations globally, we cannot guarantee we will not become subject to product liability claims or be held liable for such claims or be required to comply with future regulatory changes in this area, and these could have a material adverse effect on our business. ' "We have been involved in several lawsuits alleging adverse health effects associated with our products, including those caused by electromagnetic fields and the outcome of such procedures is difficult to predict, including the potentially significant fines or settlements." "Even a perceived risk of adverse health effects of mobile devices or base stations could have a material adverse affect on us through reduction in the demand for mobile devices having an adverse effect, for instance

through decreased demand for mobile networks or increased difficulty in obtaining sites for base stations."

Microsoft

2016 Annual Report

"U.S. cell phone litigation
Nokia, along with other handset manufacturers and network operators, is a defendant in 19 lawsuits filed in the Superior Court for the District of Columbia by individual plaintiffs who allege that radio emissions from cellular handsets caused their brain tumors and other adverse health effects. We assumed responsibility for these claims as part of the NDS acquisition and have been substituted for the Nokia defendants. Nine of these cases were filed in 2002 and are consolidated for certain pre-trial proceedings; the remaining 10 cases are stayed. In a separate 2009 decision, the Court of Appeals for the District of Columbia held that adverse health effect claims arising from the use of cellular handsets that operate within the U.S. Federal Communications Commission radio frequency emission guidelines ("FCC Guidelines") are pre-empted by federal law. The plaintiffs allege that their handsets either operated outside the FCC Guidelines or were manufactured before the FCC Guidelines went into effect. The lawsuits also allege an industry-wide conspiracy to manipulate the science and testing around emission guidelines."

Telstra

2016 Annual Report

"Mobile phones, base stations and health
We acknowledge that some people are concerned about possible health effects from electromagnetic energy (EME), and we are committed to addressing these concerns responsibly. We are proactive, transparent and fact based in our communications regarding EME and comply with the standards set by regulators. We rely on the expert advice of national and international health authorities including the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the World Health Organization (WHO) and actively contribute to scientific research in EME and health.

Helping our customers and the community keep abreast of the latest information is important to us. We provide information on EME on our website at telstra.com/ eme. We also invite customers to go directly to the WHO, ARPANSA and 'EMF Explained' websites for further information. This year, we continued our mobile safety SMS campaign, sending out almost 17 million messages referring customers to telstra.com/mobiletips, our information site for safe and responsible phone use.

We have a dedicated EME help desk and team that proactively reviews new site proposals, develops community consultation plans and works with the community to determine acceptable sites for new base stations."

3. Examples of EMF Policy Exclusions

2015 - The Hartford, "EXCLUSION - ELECTROMAGNETIC HAZARD"

"The following exclusion is added: This insurance does not apply to: Electromagnetic Hazard…."

2015 Canadian ProSurance Architects & Engineers Policy

In 2015 The General Exclusions section of their Canadian ProSurance Architects & Engineers Policy Document places EMF on the same footing as Asbestos: a total exclusion on liability for all EMF radiation.

"GENERAL INSURANCE EXCLUSIONS: Electromagnetic fields directly or indirectly arising out of, resulting from or contributed to by electromagnetic fields, electromagnetic radiation, electromagnetism, radio waves or noise."

2014 Updated Zurich Community Care Liability Insurance

"We will not pay anything under this policy, including claim expenses, in respect of: Electromagnetic fields any liability of whatsoever nature directly or indirectly caused by, in connection with or contributed to by or arising from electromagnetic fields (EMF) or electromagnetic interference (EMI)"

A&M Insurance for Medical Professionals - No Coverage for Electromagnetic Fields; version 3.2, 2013

"GENERAL INSURANCE EXCLUSIONS: Electromagnetic fields directly or indirectly arising out of, resulting from or contributed to by electromagnetic fields, electromagnetic radiation, electromagnetism, radio waves or noise."

AT&T Does Not Cover Damage Caused by Pollutants, Now Including Electromagnetic Fields (2012)

"Exclusions:
F. Loss caused by or resulting from the discharge, dispersal, seepage, migration, release or escape of Pollutants
M. "Pollutants" means: Any solid, liquid, gaseous, or thermal irritant or contaminant including smoke, vapor, soot, fumes, acid, alkalis, chemicals, artificially produced electric fields, magnetic field, electromagnetic field, sound waves, microwaves, and all artificially produced ionizing or non- ionizing radiation and waste. Waste includes materials to be recycled, reconditioned or reclaimed." (pg. 4)

Great American Insurance Group - A Special Environmental Liability Insurance Policy Is needed to cover electromagnetic radiation (2011)

"This insurance covers bodily injury, property damage, legal expenses and clean-up costs resulting from pollution conditions associated with a covered location on a claims-made basis."

"The definition of pollutants includes mold, legionella, electromagnetic fields and methamphetamines."

2007 - Penn National Insurance, "Commercial Liability Umbrella Coverage Form"

"Bodily injury" or "property damage" arising out of any liability loss, cost or expense directly or indirectly arising out of, or resulting as, a consequence of "electromagnetic radiation".

Abu Dhabi National Insurance Company Workman's Compensation Insurance Policy

"Other Exclusions: Any claim bringing of or attributed to electromagnetic fields…"

Mutual of Enumclaw Policy Changes, Edition 9-96 - Pollution Exclusions

"Pollutant or pollutants mean any solid, liquid, gaseous or thermal irritant or contaminant, including:

a. smoke, vapor, -soot, fumes, acids, alkalis, chemicals;
b. radioactive matter, including electromagnetic fields or electromagnetic radiation;
c. petroleum, or petroleum products in any form;
d. asbestos or substances containing asbestos;
e. lead or substances containing lead;
f. waste, including materials to be recycled, reconditioned or reclaimed."

Verizon - Insurance Protects The Phone But Not the Person

"Coverage Excludes Pollution."
Pollution is defined as "The discharge, dispersal, seepage, migration, escape or presence of pollutants. Pollutants means any solid, liquid, gaseous, or thermal irritant or contaminant including smoke, vapor, soot, fumes, acid, alkalis, chemicals, artificially produced electric fields, magnetic field, electromagnetic field, sounds waves, microwaves, all artificially produced ionizing or non-ionizing radiation and/or waste."

4. **Lawsuits**

2017: The Italian Court of Ivrea ruling recognizes causal link between cellphone use and brain tumor. Italian court recognized a causal link in an April 11, 2017 ruling which awarded a Telecom employee, Roberto Romeo, lifetime damages of 500 euros a month after he developed a brain tumor from fifteen years of cellphone use.

- Original Ruling
- EHT Press Release
- The Guardian News Article: "Italian court rules mobile phone use caused brain tumour"
- NY Daily News Article: "Italian Court Finds Link Between Cell Phone Use and Tumor"
- Courthouse News Service Article: "Italian Court Finds Link Between Cell Phone Use and Tumor"

- Cell phones and cancer, court adviser: "Scientific studies Authors work for telephone companies: conflict of interest" by Andrea Tundo (In Italian and can be translated.)

Documents in Italian: The Court's expert report, the defendant's critics and final reply from the experts:

- Consulenza Ivrea Tribunale di Ivrea, Sezione Lavoro:
- Osservazioni CTU Romeo INAIL:
- Risposta CTU:
- Tribunale Ordinario di Ivrea:

2012 Italian Supreme Court Ruling: Man's brain tumor was caused by his cell phone use.
The National Institute for Workmen's Compensation must compensate a worker with head tumor due to cell use. Innocente Marcolini, a 60-year-old retired businessman argued that the excessive use of his mobile phone for around six hours every day for 12 years caused a benign brain tumor that left his face partially paralyzed.

Reuters News Article - "Italy court ruling links mobile phone use to tumor"
RT News Article - "Cancer cells: Italian court rules 'mobile phones can cause brain tumors'"
Daily Mail News Article - Mobile phones CAN cause brain tumours, court rules in landmark case.

USA Thirteen Consolidated Brain Cancer (litigation filed in 2001 and current)
"Ashcraft & Gerel LLP ,Morganroth & Morganroth PLLC, Lundy Lundy, and Soileau & South L.L.P. are representing 13 cases alleging cell phone radiation led to brain cancer. There are 46 defendants including Motorola, Nokia, AT&T, Bell Atlantic, Cellular One, Cingular Wireless, SBC Communications, Verizon, Vodafone, the Telecommunications Industry Association, the IEEE, ANSI, the CTIA, and the FCC".

2016 update: Appeals court decided that a different legal standard for evidence should have been applied.

2016 Wall Street Journal Article - "Lawsuit Over Cellphones and Cancer Hits a Stumbling Block"
2016 About Lawsuits Article - "Wireless Phone Brain Cancer Lawsuits Face New Evidentiary Standard"
2016 MGM Article - "D.C. Court of Appeals Overturns Frye and Adopts Federal Rule of Evidence Rule 702"
2016 Fox News Video - "Court delays decision in cellphone-cancer link trial"

2014 update: Honorable Judge Frederick H. Weisberg ruled that experts testifying against the wireless industry met the Dyas/Frye legal standards and can offer testimony related to injury causation and health effects from cell phone radiation. (The court held evidentiary hearings in December 2013 and January 2014 and reviewed hundreds of exhibits.)

2014 -Plaintiff attorney's press release.
2014 - District Court of Appeals Petition by Motorola
2014 - Court's opinion.
2014 - Press release.

2015 Wall Street Journal Article - "Case on Health Risk From Cellphones Is Back in Court"
2015 Washington Post Article - "D.C. court considers how to screen out 'bad science' in local trials"
2005 News Article: "Lawsuits could have broad ramifications for the industry"

2008 Farina v. Nokia Inc.

Plaintiff brought a putative class action against cell phone manufacturers asserting breach of warranty arising from alleged conspiracy to suppress knowledge of adverse effects from RF emissions. The Third Circuit dismissed the case after holding that "[a] jury determination that cell phones in compliance with the FCC's … guidelines were still unreasonably dangerous would, in essence, permit a jury to second guess the FCC."

2012 Lexology News Article - "The status of cell phone as carcinogens litigations"
2011 Reply Brief for the Petitioner
2010 Opinion of the Court United States Court of Appeals,Third Circuit
2010 Lexology News Article - "Third Circuit rules cell phone radio wave litigation preempted by federal law"
Amicus curiae brief in the Supreme Court in support of the petition for a writ of certiorari in Farina v. Nokia.
U.S. Supreme Court Declines to Consider Cell-Phone Emissions Preemption Case, Bloomberg News 10/3/2011
Federal Judge Dismisses Suit Alleging Cancer Risk From Cell Phone Use, The Legal Intelligencer, September 5, 2008

2009 Murray v. Motorola (982 A. 2d 764)

Motorola employee with brain cancer filed in Superior Court of the District of Columbia. He was diagnosed with a brain tumor behind the ear he used to test phones as a communications technician for Motorola. Michael Murray, got his first cell phone, an early Motorola flip phone model, at age 23. In November 1999, Michael Murray was diagnosed with brain cancer and died April 20, 2003, at age 35. This case was consolidated into the 13 cases now moving forward. D.C. Court of Appeals ruled that the telecommunications companies could not be sued over brain tumors caused by cell phones manufactured after 1996. For plaintiffs that had used pre-1996 phones, their lawsuits were allowed to go forward.

2000 Newman v. Motorola, Inc.

Newman v. Motorola, Inc.

This was a products liability claim by Dr. Christopher Newman, neurologist, who claimed that he developed a brain tumor from using an analog cell phone for a number of years in his medical practice. He claimed that defendants failed to warn him that the phones were dangerous and defective. On September 30, 2002, the United States District Court for the District of Maryland decided Newman v. Motorola, Inc with a summary judgment sustained in favor of defendants -

due to lack of scientific evidence to support causation. , 125 F. Supp. 2d 717 (D. Md. 2000) U.S. District Court for the District of Maryland - 125 F. Supp. 2d 717 (D. Md. 2000) December 21, 2000

1997 Motorola v. Ward

Richard Ward brought a product liability action against Motorola and Cartunes alleging regular cell phone use caused a malignant brain tumor on the right side of his brain. The Court determined that, "When the plaintiff's evidence merely asserts that the defendant's conduct caused the plaintiff's injury, but fails to explain how, the defendant is entitled to summary judgment".
1997 Motorola v. Ward

1997 Busse v. Motorola, Inc. et al.

Originally, the Illinois lawsuit-Jerald P. Busse vs. Motorola Inc.-alleged illegal privacy invasion and an industry cover-up of mobile-phone risks. The industry cover-up count was removed, It was dismissed upon mutual consent of opposing counsel in 2003.
"The 1995 class-action lawsuit, which was certified last year, claims privacy rights were violated when billing records of mobile-phone subscribers were examined without their knowledge as part of an epidemiology study conducted by EPI. Initially, plaintiffs in Busse et al. vs. Motorola Inc. also accused the industry of orchestrating a cover-up of health risks from mobile phones."
Industry opposes settlement in health-related privacy suit, RCR Wireless News , June 25, 2001
WTR settles cancer suit: Accord earmarks $250,000 for Carlo-headed registry, RCR Wireless News, June 4 2001
Health-related privacy suit pending in Cook County this week, RCR Wireless News, July 2001

1996 Wright v. Southwestern Bell Mobile Systems

Filed in 1996 by an employee of mobile phone carrier who developed brain tumor. Her job gave her unlimited cell phone minutes. This was settled as a confidential employer-employee resolution.

1996 Verb v. Motorola

No. 1-93-3248. Appellate Court of Illinois, First District, Second Division. March 29, 1996.

Class action suit against Motorola and other cell phone companies alleging a lack of warning regarding harmful physical effects of cell phones.

1994 Kane v. Motorola Inc.

Robert Kane, a Motorola, Inc. engineer in Scottsdale, Arizona sued his employer in Cook County Court, Chicago, alleging that his brain cancer was caused by experiments in which he tested Motorola cellular-phone antennas.The case was settled as a confidential employer employee resolution.
2001 Read Robert Kane's Book "Cellular Telephone Russian Roulette"

1992 Reynard v. NEC Corporation - First Cell Phone Cancer Case

This was the first cell phone cancer case first filed in 1992. David Reynard filed a tort claim against the cellphone manufacturer NEC and the carrier GTE Mobilnet, claiming that radiation from their phones caused or accelerated his wifes brain tumor. This case was notably decided in 1995 before the FCC had begun to regulate RF emissions from cell phones. Publicity about the Reynard case likely caused the Cellular Telecommunications Industry Association (CTIA) to pledge $25 million for research in the 90's.

1999 Democracy Now Radio Interview - "Cell Phones: Are They Harmful to Your Health?"
Justia US Law Summary Order May 17, 1995 Court Decision
1993 Chicago Tribune News Article - "Motorola Researcher Blames Cellular Tests For Brain Tumor, Sues"
1993 UPI News Article - "Lawsuit claims cellular phones cause cancer"
News Footage of David Reynard from 1990's

Legal Publications on Cell Phone Cancer Lawsuits

Rotondo, James H. and Kaitlin A. Canty. "Cell Phone Usage And Brain Tumors; Recent Developments." *Day Pitney LLP,* 2013.

Carlo, George. "Illusion and Escape: The Cell Phone Disease Quagmire." *The World Foundation for Natural Science*, 2008.

Capriotti, Suzanne. "Is There a Future for Cell Phone Litigation?" *Journal of Contemporary Health Law & Policy*, vol. 18, no. 2, 2002.

Grasso, Laura. "Cellular Telephones and the Potential Hazards of RF Radiation: Responses to the Fear and Controversy." *Virginia Journal of Law and Technology*, vol. 3, no. 2, 1998, pp. 1522-1687.

ENVIRONMENTAL HEALTH TRUST

Myths and Facts About the National Toxicology Program Cell Phone Radiation Cancer Study
Correcting the Misinformation

The National Toxicology Program (NTP) study found an association between cell phone radiation and cancer prompting an astonishing chorus of criticism from almost every prominent media outlet in the country.

Environmental Health Trust analyzed the media response and found a pattern of consistent inaccurate and misleading statements repeated over and over again in literally *hundreds* of news articles. Most of the criticisms levied at the NTP findings are inaccurate and simply do not hold up to scientific scrutiny.

23 Myths About the National Toxicology Program Cell Phone Radiation Study

Overarching Myth #1: The NTP study is just one rat study that is irrelevant to humans because the radiation exposures were far higher than humans get from cell phones.

***Fact: This is the world's largest, most carefully done study on wireless radiation* specifically designed to mimic human exposures in rodents. Every agent that is known to cause cancer in humans has been shown to be carcinogenic in animals when adequately tested.**

Myth: The NTP rats radiation exposure was way too high to be relevant to human health.

Fact: The NTP study was designed to mimic long term human exposure to cell phone radiation and to test the adequacy of safety limits. It is standard practice for rodent studies to have experimental groups with higher exposure levels than average human exposure in carcinogenicity studies.

- **This study was designed to test if government safety limits (which only protect us from thermal radiation levels) are protective.** The results indicate that adverse carcinogenic effects occur at non-thermal (non-heating) levels which means that safety is not assured even if one abides by government regulations. Government regulations for microwave radiation are based on the assumption that "*if it does not heat you, it will not hurt you."* To test the "no-heating" cut-off for harm, NTP animals were exposed up to almost the maximum dose they could tolerate *with no increase in body temperature.* The animals in this experiment *never experienced* an increase in body temperature over one degree Celsius, as this is considered the cut-off point for heating effects. Despite this limit, male rats developed increased cancers compared to controls *and* a dose response was observed with respect to the schwannoma rate. The most important thing to know about the NTP radiation exposures is that the radiation dose in the study did not cause a measurable increase in the animal's body temperature *but still found a carcinogenic effect. This indicates that government safety need to be strengthened to include protection from biological effects found at non-thermal levels.*
- **The NTP study was specifically "designed specifically to mimic the human exposure scenario" and to account for the increased use of technology in the future.** Listen to NIH scientists discuss the exposure set up stating, "Our studies are designed specifically to mimic the human exposure scenario. The NTP studies are

looking at exposures for 10 hours a day. There's heavy cell phone users that may approach the 10 hour mark - that may be excessive, but it allows us to fully investigate whether or not there is an effect of cell phone frequency radiation."

- **The exposures of the brain in the NTP study were not very different from human exposures associated with use of cell phones**. Lawyers and real estate agents are examples of many people who are on their cell phone for many hours every day. In the carefully designed NTP exposure system, animals were exposed to radiation in special reverberation chambers, with whole body specific absorption rates (SAR) values at 1.5, 3, and 6.0 W/kg. Specific absorption rates (SAR), are measures of the rate of RF energy absorbed per unit mass of tissue. With respect to exposures to the brain, SAR values in rats were similar to or slightly higher than human exposures from cell phones held next to the head. In the US, the localized FCC exposure limit for cell phones is 1.6 W/kg averaged over any one gram of tissue when considering the brain (in Europe it is higher at 2 W/kg) and for extremities such as the arms, legs and ears- the limit is 4.0 W/kg.
- **It is standard practice for rodent studies to have higher exposure levels than average human exposure. Mice and rats have far shorter life spans than humans.** Rodents only live up to 3 years whereas humans can live up to 100 years. To identify a hazardous agent, exposure levels in animal studies are often much higher than human exposures, while lower doses are included for analyses of dose-response relationships. The NTP study of RFR could *not* use exposure intensities much higher than that of cell phones in order to prevent any measurable increases in body temperature. Consequently, the duration of exposure was extended to nine hours a day for 106 weeks or less. The cumulative total exposure is comparable to thirty-six years of exposure (and children given a phone in middle school will have many more years of exposure than that) at a rate of 30 minutes per day, hardly excessive.
- **People most commonly hold phones against their ears and are often exposed 24 hours to RF-EMF.** The statement "Many people nowadays rarely hold their cellphones up to their heads at all," is simply false. Many people have given up their landline and *only* use cell phones. All one has to do is stand outside in a public place such as a subway terminal and watch numerous people walk by with the cell phone up to their head. Real estate agents, lawyers, healthcare workers and even retail store employees are occupations where wireless technology is used for hours a day with devices carried on or against the body. It is a fact that many teenagers sleep with their phones at their pillow and carry their phones *on their body* all day long. Furthermore, cell tower and cell antennae placements are only increasing nationwide with the rollout of 5 G and newer technologies- exposing the population to higher levels and a variety of different frequencies.

Additional Info:
In the US, the localized exposure limit for cell phones is 1.6 W/kg averaged over any one gram of tissue. In Europe, it is 2 W/kg averaged over 10 grams of tissue. These exposure values, which are referred to as specific absorption rates (SAR), are measures of the rate of RF energy absorbed per unit mass of tissue. When an individual uses a cell phone and holds it next to his or her head, exposure to the brain will be much higher than exposures to other parts of the

body. Body tissues located nearest to the cell phone antenna receive much higher exposures than tissues located distant from the antenna. When considering organ-specific risk (e.g., risk to the brain), the important measure of exposure is the 1.6 W/kg value in any gram of tissue in that organ. Individual manufacturers and the FCC provide SAR values for cell phone emissions. While some cell phones emit lower radiation levels, other phones emit radiation that can produce an SAR dose near or above 1.5 W/kg.

"Cellphones probably cause cancer if the exposure is close enough, long enough, and in sufficient magnitude. We don't yet know the risk for a given level of exposure in humans. We need more data in this area, not only for cellphones, but for bluetooth devices, wifi and all the other RF-EMF devices out there. Until then, reduce your exposure whenever possible."
- Christopher J. Portier and Wendy L. Leonard, Scientific American, June 13, 2016

Myth: Rat research does not inform human health risk.
Fact: Rat research does inform human health risk.

- **Rats are the preferred animal model for carcinogenicity studies.** Carcinogenicity studies in rodents are important for several reasons: (1) animals and humans exhibit similarities in the biological processes of disease induction - this is why animal models are used in preclinical trials of new pharmaceutical agents, (2) it is unethical to intentionally expose humans to known hazardous agents, (3) every agent that is known to cause cancer in humans is carcinogenic in animals when adequately tested (IARC, preamble), and (4) almost one-third of human carcinogens were identified after carcinogenic effects were found in well-conducted animal studies (Huff, 1993, Chemicals and cancer in humans: first evidence in experimental animals, Environmental Health Perspectives 100:201-210). Read FDA guidance.
- **Regulatory agencies currently rely on rodent carcinogenicity bioassay data to predict whether or not a given chemical poses a carcinogenic threat to humans.** There are strong correlations of the carcinogenic potencies between rats and mice, and the upper limits on potencies in humans are consistent with rodent potencies for chemicals on which human exposure data are available. In 1999, the U.S. Food And Drug Administration (FDA) recommended that the National Toxicology Program initiate this large scale rodent study on radiofrequency and the 1999 FDA Report stated:
    -
    - *"Animal experiments are crucial because meaningful data will not be available from epidemiological studies for many years due to the long latency period between exposure to a carcinogen and the diagnosis of a tumor.*
    - *There is currently insufficient scientific basis for concluding either that wireless communication technologies are safe or that they pose a risk to millions of users. A significant research effort, including well-planned animal experiments, is needed to provide the basis to assess the risk to human health of wireless communications devices."*

- **What happened in the NTP rats is happening in humans.** The rodent cells which developed tumors in the NTP rats are the same cells that display elevated tumor risk in human studies of long-term, heavy cellphone users. This correlation cannot be ignored and is precisely why the NIEHS/NTP released the results. At the May 27, 2016 NIEHS press conference when the report was released, Dr. John Bucher (NTP) stated, "The reason that we're bringing these particular findings to the attention of the public today is the fact that they are in tumor sites, there's tumor sites and types *that have been identified in human studies* – as I mentioned, the IARC human studies."

"These results are particularly interesting in the light of the results of the INTERPHONE international study, which I had the opportunity to coordinate. The study included over 2,700 cases of glioma and 1,100 cases of schwannoma of the acoustic nerve and found evidence of an association between mobile phone use (as well as level of radiofrequency exposure) and increased risk of developing both types of tumours. "
Elisabeth Cardis May 27, 2016
GROWING EVIDENCE FOR THE LINK BETWEEN MOBILE PHONES AND CANCER

Myth: The NTP study is just a small "single rat study."
Fact:

- **This is the largest study ever done on wireless health risks.** Thousands of rodents were used in the NPT's three-phased study design to ensure accuracy in exposure. First, pilot studies and subchronic studies were conducted to determine the maximum intensity of cellphone radiation that could be employed without inducing any heating effect. Then, the final two-year chronic studies exposed rodents prenatally and for the majority of their lifetime (up to 24 months), utilizing the information from the pilot and subchronic studies. Unlike prior studies in which rodents were exposed in tubes or using a ferris wheel design, the NTP rodents were allowed to be roam free in their cages during exposure. This was permitted due to the elaborate underground reverberation system built in Switzerland. (Click here for slides showing the exposure set up.)
- **Double the usual number of rats were used.** Usually 50 rodents are used per group in carcinogenicity studies but 90 were used for each group in the NTP study. As the American Cancer Society states, "The NTP was given the difficult task of trying to answer important questions about the potential cancer risk posed by cell phones, and the group did not shirk from its responsibility. NTP staff were clearly aware of the potential importance of this study and went the extra distance to ensure the best science is used. **They used double the number of animals required for this type of study;** they convened not one but three panels to look at abnormal tissues from treated animals to ensure that what was identified as a brain and heart tumor was indeed a brain and heart tumor; they solicited review from multiple scientists from outside the NTP to critically review all aspects of the data analysis and study findings, to ensure the findings would stand up to the critical assessment expected once these unexpected findings were released." Read the American Cancer Society Press Release here.

Myth: The NTP study was underpowered and statistically unable to detect a true effect.
Fact: A underpowered study is more likely to result in a false negative.

- **Having low statistical power means that there is a greater chance for a false negative rather than a false positive result.** That is, there is a high probability of accepting the no-effect hypothesis even when a true effect exists.
    - **Dr. Melnick responded to one of Dr Lauer's statements in the Hebrew University Press conference** that "One comment was made that the study had low statistical power and that might lead to a false positive. I'm not sure if that was a misstatement by the reviewer because low statistical power means there's a high probability of accepting the null hypothesis even when a true effect may exist. That is, there is a greater chance for a false negative rather than a false positive if there is low statistical power."
- **NTP scientists specifically addressed Dr. Lauer's concerns about the power** in the NTP Report section entitled NTP Comments on Statistical Issues Raised by the Reviewers page 67-74, the NTP responded in full.

  On page 67:

  "Although the NTP conducts statistical tests on multiple cancer endpoints in any given study, numerous authors have shown that the study-wide false positive rate does not greatly exceed 0.05 (Fears et al., 1977; Haseman, 1983; Office of Science and Technology Policy, 1985; Haseman, 1990; Haseman and Elwell, 1996; Lin and Rahman, 1998; Rahman and Lin, 2008; Kissling et al., 2014). One reason for this is that NTP's carcinogenicity decisions are not based solely on statistics and in many instances statistically significant findings are not concluded to be due to the test agent. Many factors go into this determination including whether there were pre-neoplastic lesions, whether there was a dose-response relationship, biological plausibility, background rates and variability of the tumor, etc. Additionally, with rare tumors especially, the actual false positive rate of each individual test is well below 0.05, due to the discrete nature of the data, so the cumulative false positive rate from many such tests is less than person would expect by multiplying 0.05 by the number of tests conducted (Fears et al., 1977; Haseman, 1983; Kissling et al., 2015)."

  On page 69 of NTP Comments on Statistical Issues Raised by the Reviewers the NTP states:

  "Sample size calculations were conducted for this study. However, for detecting carcinogenesis, sample size and power will depend on the baseline (control) tumor rate and the expected magnitude of the increase in tumors. For example, at 80% power, sample size requirements will be quite different for detecting a 2-fold increase in a rare tumor having a spontaneous occurrence of 0.5% compared to 2-fold increase in a more common tumor having a spontaneous occurrence of 10%. Because many different tumor types having wide range of spontaneous occurrence are involved in these studies, there is no "one-size-fits-all" sample size; rather, the sample size is a compromise among several factors, including obtaining reasonable power to

detect moderate to large increases for most tumor types, while staying within budgets of time, space, and funding. A sample of 90 animals per sex per group was selected as providing as much statistical power as possible across the spectrum of tumors, under the constraints imposed by the exposure system.

The NTP's carcinogenicity studies are similar in structure to the OECD's 45 Guideline for carcinogenicity studies and the FDA's guidance for rodent carcinogenicity studies of pharmaceuticals. These guidelines recommend at least 50 animals of each sex per group, but also mention that an increase in group size provides relatively little increase in statistical power. In the NTP's RFR studies, the group sizes were 90 animals of each sex per group, nearly twice as many as the minimum recommendation. Increasing the group sizes further provides diminishing returns, for which additional animals do not substantially increase power.

Page 70:

"It is true that the power is low for detecting moderate increases above a low background tumor rate of approximately – %, as was seen in the brain and heart tumors. However, this low power does not correspond to high risk of false positive findings. The paper by Ioannidis that was cited correctly states that when studies are small or effect sizes are small (i.e., statistical power is low), "the less likely the research findings are to be true." Research findings can be "not true" if the result is a false positive or a false negative. With low statistical power, false negatives are much more likely than false positives. Therefore, the vast majority of false research findings in a low power situation will result from the failure to detect an effect when it exists. The false positive rate on any properly constructed statistical test will not exceed its significance level, alpha. By definition, the significance level of a statistical test is its false positive rate, and it is typically selected by the researcher, often at a low fixed value such as 0.05 or 5%."

On page 74 Dr. Bucher again addresses the issue:

"Although Mike referred to the example of positive findings in underpowered epidemiology studies that could not be replicated in larger follow up studies, there is a growing literature alluding to this problem with respect to experimental animal studies as well. An example is a relatively recent article by one of our collaborators in CAMARADES, Malcolm MacLeod.

http://www.nature.com/news/2011/110928/full/477511a.html

It's important to distinguish between low power to detect effects, **and the constellation of other factors that often accompany low powered experimental animal studies in contributing to this problem.** We've addressed this issue in a recent editorial, and these factors are captured in our published systematic review process for evaluating study quality in environmental health sciences (Rooney et al., 2014).

http://ehp.niehs.nih.gov/wp-content/uploads/122/7/ehp.1408671.pdf
http://ehp.niehs.nih.gov/wp-content/uploads/122/7/ehp.1307972.pdf

Table 1 in the Rooney et al. report outlines risk of bias considerations that commonly plague studies carried out by academic researchers that are accounted for in NTP studies.

I provide these examples to assure you that we are completely cognizant of these issues and take them very seriously. Again, we appreciate the help you've provided in assuring that we appropriately interpret and communicate our findings.

Best
John Bucher "

Overarching Myth #2: The weak and unusual study results prove the risk to humans is small and likely nonexistent.

Fact: When scientifically reviewed and statistically analyzed, the findings of statistically significant increased cancers and precancers in the exposed rats remain valid *despite the gender and survival differences*. Furthermore, the analysis is strengthened by the findings of *other adverse* effects from exposure such as lower birth rate and cardiac abnormalities.

Myth: Cancer rates were only increased in the male rats but were not equally increased in females so the findings are questionable.
Fact:

- **It is extremely common for males to show different cancer rates from females in both laboratory and epidemiological studies with men usually having higher rates.** Specifically, in *previous* NTP toxicology studies, male rats as compared to females had *more than ten times* the incidence of malignant gliomas (brain tumors) and *more than twice* the rate of malignant schwannoma of the heart. These statistics called "historical control incidence" are documented in the NTP report (Tables 1-6). As the American Cancer Society explains in their statement about the NTP results, "It's important to note that these sorts of gender differences often appear in carcinogenic studies, so the fact they show up here should not detract from the importance of the findings."
- **While the tumor incidence was greater in exposed male rats than in female rats, these rare and uncommon tumors were observed only in RFR-exposed animals of both sexes *while no tumors were observed in the control animals*.** In addition, pre-cancerous lesions (glial hyperplasia and Schwann cell hyperplasia) were observed *only* in RFR-exposed male and female rats. Numerical differences are commonly detected

between the sexes in animal carcinogenicity studies as well as in human populations. For example, brain cancer mortality rates are approximately 50% higher in men than in women, and for many human cancers (e.g., colon-rectal, liver, soft tissue including heart, kidney, non-Hodgkin lymphoma, etc.) the incidence and mortality rates are much higher in men than in women.

- **Female RFR-exposed animals *did have higher rates than controls* although it did not reach statistical signifigance.** Seven exposed female rats had cancer or precancerous lesions in the glial cells and nine had cancer or precancerous lesions in their Schwann cells. Rates of cancer or precancerous lesions within the unexposed female rats were zero in the heart nerve and brain. Historically, female rats have much lower rates of both types of cancer. If we compare cancer rates among exposed female rats to historical controls (the average from studies of other exposures), RFR-exposed females developed 3.1 times the rate of gliomas and 1.9 times the rate of Schwannoma. It is essential to remember that **not statistically significant does not equate to "no difference"**. Exposed groups in the NTP study had higher rates of disease in every one of these cases. However, the differences were not high enough to allow researchers to reject the notion that these were chance occurrences with 95% certainty.
- **The different response rate between male and female rats in the RFR study does not alter the relevance of the cancer findings from this study.**

"It is not surprising that the exposed males had more tumors than the females given what we have seen in the historical controls. But we can go one step further, the fact that we saw any of these tumors in the exposed females but none in the concurrent controls adds support to the conclusion that cell phone radiation leads to cancer among rats."
-Ron Melnick in Microwave News

Myth: If the control group had developed cancer at the usual rate (historical controls), there would be no statistically significant difference.
Fact:

- **The concurrent controls are the best controls and the most important to consider in any given study.** The fundamental concept behind a controlled experimental study is that the control group matches the exposed group as closely as possible as every detail of feed, housing and environment are truly identical. If all groups of rats are treated *the same* in *the same* experiment and only the exposed group has a statistically significant effect, then the statistical analysis calculates the probability that chance caused the observed differences by making the control rates artificially low or the exposed rates artificially high.
- **NTP scientists carefully considered the issue of historical controls and factored it into their analysis.** Please listen to Dr. Michael Wyde, lead investigator of the National Toxicology Program study and Dr. Birnbaum, director of the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health specifically explain how this concern is invalid and does not detract from the findings in a video of a

June 15, 2016 presentation of the NTP study. Dr. Birnbaum explains how the historical data was considered in the final analysis and she also points out that prior studies with this rat strain are limited and were under different conditions than in the NTP study. The NTP study on RFR was unique in that no other chronic study housed rats in individual cages (including controls) in reverberation chambers and only one other NTP study (but in a different strain of rats) was conducted in the laboratory where the RFR studies were performed. The reverberation chambers used in the NTP study were fully shielded from external electromagnetic fields. No data are available to evaluate the impact of these unique circumstances on tumor rates in control animals.

- **An analysis comparing all controls—historic and present—with all exposed animals in the present study *still shows* a consistently increased probability of developing cancer**. The argument that *"if the control group had developed these cancers at the normal levels, there wouldn't have been much to report here at all" simply* does not hold up to scientific scrutiny.
- https://www.youtube.com/watch?v=mGbssctlJWQ&feature=youtu.be

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Myth: Since only the rats exposed to super high radiation levels had increased cancer, it must be perfectly safe to use our cell phones which emit a "safe" level of radiation.

Fact:

- **Testing for the absence of an effect requires a completely different study design and uses different methods of statistical analysis than were employed in the NTP study.** Moreover, any discussion of safe exposure levels is not supported by the data. Such safety inferences have no scientific basis. The NTP study was not designed to determine a safe exposure level, but rather was setup to determine if non-heating levels could induce cancer and/or a toxic effect.
- **Adequate research to determine a safe level of radiofrequency *has not been performed by the US Government as of yet.*** As of today, not a single US health and safety agency has determined a "safe" level of wireless radiation. Decades ago, the EPA initiated research and was set to issue standards when it was abruptly defunded in 1996 (see timeline below). Contrary to a widely held belief that premarket safety testing was done, in fact, long term safety testing for cell phones and wireless devices was **never done**. The NTP study was initiated for this very reason.

- *Timeline showing how the US EPA raised concerns and was defunded from setting safety standards.*
    - 1971 U.S. Naval Medical Research Institute, Bibliography of Reported Biological Phenomena (Effects) and Clinical Manifestations Attributed to Microwave and Radio-Frequency Radiation
    - **1984: US Science Advisory Board Recommendation to the EPA:** The Board recommends that the EPA develop radiation protection guidance to protect the public. In 1983 The EPA published Biological Effects Of RadioFrequency

Radiation and in 1981 The EPA published an Index of Publications on Biological Effects of Electromagnetic Radiation. Read the US Science Advisory Board Letter.

- 1990 draft report, ***Evaluation of the Potential Carcinogenicity of Electromagnetic Fields***,contains information regarding the potential carcinogenicity of radiofrequency fields as well as electrical power frequency fields. The EPA Science Advisory Board (SAB) reviewed this draft document in a series of public meetings in 1991 and 1992.This draft document was not finalized after the SAB reported its findings but was leaked.
- **1993, Environmental Protection Agency Letter Criticizes the Federal Communication Commission's (FCC's) proposed RF/MW radiation limits:** The Letter states that certain subgroups are more at risk (pregnant women, children and the elderly) and calls for an updated, comprehensive review that considers the biological effects of RF, specifically pointing to the need to update the NCRP Report 86 (Note: NCRP 86 is still the basis for US regulations according to the FCC and has not been updated to include biological effects). Read the Letter here.
- 1994 (U.S.) Air Force Material Command, Rome Laboratory Radiofrequency / Microwave Radiation Biological Effects and Safety Standards: A Review "It was recognized that the SAR does not encompass all of the important factors necessary to determine safe exposure levels. The modulation frequency and peak power of the incident EM field should also be considered. Some of the investigators warned that extra care should be taken by persons that are subjected to pulsed EM fields or by fields that are modulated near the whole-body resonance frequency."
- **June 1995, the EPA announced to the FCC that the EPA would be releasing its own RF/MW radiation safety limits by early 1996.** In March 1995 the EPA briefed the FCC and NTIA on the development of their guidelines on thermal and non-thermal RF/MW radiation effects. Read the 1995 EPA letter.
- **September 1996 EPA Radiation Research De-Funded:** The EPA Radiation Division that drafted the regulations to protect the public from harmful EMF was de-funded by the Senate Appropriations Committee, which wrote, "The Committee believes EPA should not engage in EMF activities".
- **1996 Federal Communications Commission (FCC) Limits Adopted: IEEE/ANSI C95.1 1992 were the basis of the FCC regulated exposure limits with some minor points coming from the NCRP Report 86 (1986).**
- **1999: Gregory Lotz (NIOSH) Radio -Frequency Interagency Workgroup (RFIW) Letter to Richard Tell:** The members of the federal RFIW identity several critical issues with the RF exposure guidelines. Their concerns include the need for a biological basis for SAR limit and they point out that the limits for brain and bone marrow should be lower than those from muscles and fat as tissues are not equally sensitive. They question the selection criteria for the adverse effect and state there is extensive data on acute effects but that the lower-level non-thermal chronic exposure effects may be very different and

chronic effects need to be accounted for. They state the uncertainties in the data should be addressed. "These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public." Read the Letter.

- **2001:Industry Tied Scientist Becomes Whistleblower:** Martin Schram and George Carlo (the scientist who lead 27 million research funded by wireless industry) publish the book *Cell Phones: Invisible Hazards In the Wireless Age* which alleges that research findings showing cell phone radiation was harmful was then "suppressed" by the Wireless Industry. Watch the C-Span Interview.
- **2002 Letter from Norbert Hankin of the EPA about the inadequacy of the FCC guidelines.** His letter states that children, pregnant women and the elderly were not considered in the regulations and that the regulations were to protect against hearing damage only and did not consider long-term chronic exposure. Read it here.
- **2002: EPA States FCC limits are thermally based and do not apply to long term exposure.** EPA's Norbert Hankin writes Janet Newton of the EMR Network at letter explaining the limitations of FCC RF exposure standards and states that, "the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified." Read the letter here.
- **2003: EPA's Norbert Hankin Letter to CK Chou from the Interagency Radio Frequency Workgroup on A*dditional Concerns about US RF Exposure Guidelines.*** The federal RFIWG writes a second letter with three additional concerns about the exposure limits. To our knowledge neither the 2003 or 1999 letter were ever responded to. Read the Letter here.
- **January 2008: National Research Council Report** "The Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices" called for the critical need to increase our understanding of any potential adverse effects of long term chronic exposure to RF/microwave energy on children and pregnant woman.
- **September 2008 Congressional Hearing: Health Effects of Cell Phone Use** Please watch the C-Span Video of these hearings here.
- **January 2009, The President's Cancer Panel Presented on Cell Phone Radiation:** Raad the PRESIDENT'S CANCER PANEL MEETING SUMMARY, ENVIRONMENTAL FACTORS IN CANCER and Dr Carpenter's testimony to the President's panel was published in Reviews in Environmental Health 2009.
- **September 2009 US Senate Hearings on Health Effects of Cell Phone Wireless Radiation**. Please watch the video of the testimony at the C-SPAN link HERE.
- **2012 Government Accountability Office (GAO) Report**: "Exposure and Testing Requirements for Mobile Phones Should Be Reassessed" calls on the FCC to "formally reassess and, if appropriate, change its current RF energy

(microwave) exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body," because without such a reassessment, the "FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure."

- **2012: FCC opens Inquiry Into Human Exposure Guidelines**: In response to the GAO Report, the FCC opened a proceeding to explore whether it should modify its radiofrequency exposure standards stating, "we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children." Over 900 submissions have been made to the FCC. To access these papers go to the FCC's web site for Proceeding Number 13-84. To date no actions have been taken by the FCC or any other Federal agency on this docket.
- **2014: U.S. Department of the Interior Letter States FCC Guidelines are Outdated:** "However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today". Read the 2014 U.S. Department of the Interior Letter

- **Biological effects from wireless radiation are found at radiation levels thousands of times lower than government safety limits and some studies also report adverse effects even after very short time periods of exposure.** For example, after only 50 minutes of cell phone radiation exposure, cell phone radiation caused an increase in glucose metabolism in the human brain in a 2011 NIH US government study. In a series of studies performed by Dr. Suleyman Kaplan's team, damage to brain cells occurred after cell phone radiation exposures of one hour a day for one month. A research review published in Electromagnetic Biology and Medicine found that among 100 peer-reviewed papers "93 confirmed that RFR induces oxidative effects in biological systems". Long term oxidative stress is known to be related to immune and inflammatory responses, carcinogenesis and metastasis, reproductive damage and even neurological diseases.

Myth: The lower survival rate of the control group skewed the results because the control group did not live long enough to develop tumors.

Fact:

- **There was no statistical difference in survival between control male rats and the exposed group of male rats with the highest incidence of gliomas and heart schwannomas.** At week- 93 of the 2-year study, survival was exactly the same in that exposure group and in control male rats. Second, no glial cell hyperplasias (potential precancerous lesions in the brain) or heart schwannomas were observed in any control rat, even though glial cell hyperplasia was detected as early as week 58 and heart schwannomas were detected as early as week 70 in exposed rats. Thus, survival was sufficient to detect tumors or precancerous lesions in control male rats

- **NTP scientists carefully considered this question in their analysis.** If the control rats were going to develop tumors, these precancerous lesions and tumors would have already been present. Yet not a single control had any evidence of an effect.

Myth: The other effects found in the exposed rats such as decreased birthweight are trivial and irrelevant.
Fact: Low birth weight is *not* a trivial effect.

- **Low birth weight is *not* a trivial effect because it indicates adverse developmental impacts from prenatal exposure.** Smoking during pregnancy also reduces birthweight. Low birthweight is a well known result of toxic prenatal exposures to humans as well as rats. In humans, low birth weight is a risk factor for a variety of other health problems later in life.
- **If birthweight was stunted then what other developmental processes were stunted?** Significant experimental research has shown that radio frequency exposure at legal levels damages brain neurons in prenatally exposed rats. The NTP study was not set up to investigate impacts on nervous system development so this information is not available from the NTP study. When it comes to the lower birthweight of NTP rodents, this effect constitutes an important signal that non thermal radiation levels can impair development.
- https://www.youtube.com/watch?v=VpwcF3Malj8

Myth: The results are weak and confounding.
Fact:

- **A doubling or tripling of risk would never be considered "weak".** In his statement, Foster has misused the term "confounding". Lets consider the potential impact on humans. There are almost as many cell-phone subscriptions (6.8 billion) as there are people on this earth (7 billion). Even a small risk could eventually result in a considerable number of these lethal tumours. Studies carried out in Sweden indicate that those who begin using either cordless or mobile phones regularly before age 20 have greater than a 4-fold increased risk of ipsilateral glioma. If current young users of mobile phones face the risks shown in these case control studies, then several thousand new cases could develop annually *in the U.S. alone.*
- **The results are strong, especially for the heart schwannomas.** In the heart, exposure to RFR in male rats resulted in a statistically significant, positive trend in the incidence of schwannomas. Positive trends for a greater number of tumors at higher doses were observed for both tumor types. Significantly more gliomas were seen in males exposed to CDMA (95% confidence level). Both the trends and the replication make these very strong results.
- **DNA damage was induced with both modulations of radiofrequency radiation (RFR) in brains of both rats and mice.** In the frontal cortex of rats (CDMA) and mice

(GSM and CDMA) the comet assay showed a genotoxic effect with a statistically significant trend and pairwise SAR-dependent increase. How is DNA damage "weak"?

- **Yes, a "low incidence" of tumors were found, but since these are *rare* tumors, the findings are quite significant.** Dr. Moskowitz cites these statistics which help to put it in perspective. :
    - **Overall, one in 18 male rats exposed to cell phone radiation developed cancer-** thirty of 540 (5.5%).
    - **One in 12 male rats exposed to cell phone radiation developed cancer (glioma, schwannomas of the heart) or precancerous cells** as compared to none of the 90 unexposed male rats- 46 of 540. Remember that 16 *precancerous* hyperplasias were diagnosed and these are known to develop into cancer in time. Had the study been a lifetime study, rather than a two year study, we likely would have marked these as cancers in the older rats. Rodents can live up to three years.
    - In the group exposed to the lowest intensity of cell phone radiation (1.5 W/kg), 12 of 180, or **one in 15 male rats** developed cancer or precancerous cells. In the highest exposure group (6 W/kg), 24 of 180, or **one in 8 male rats** developed cancer or precancerous cells.

Bottom line: The results provide significant *animal* evidence that cell phone radiation can cause cancer and DNA damage.

"*Given the extremely large number of people who use wireless communication devices, even a very small increase in the incidence of disease resulting from exposure to the RFR generated by those devices could have broad implications for public health."*
-National Toxicology Program Report

Response:

- **It is scientifically understood that different modulations could have different biological effects.** Cellular communication signals are very complex. Radiofrequency radiation with different modulations and characteristics can produce different effects even though they may produce the same pattern of SAR distribution and tissue heating. For example, there are two mechanistic studies which consider the effects of 2G and 3G signals. Statistical analysis in a study on human stem cells revealed that UMTS exposure had a stronger effect than GSM exposure (Markova et. al., 2010). In an earlier study, an analysis of impacts on the formation of DNA repair foci showed that effects were depend on carrier frequency (Belyaev et.al., 2009. These results are in line with the hypothesis that some signals may have higher biological impacts and possibly larger health risk effects than others.
- **Such findings are consistent with the recent analysis by Swedish cancer researchers which found differences in human gliomas associated with different modulations of cell phone radiation.** They found the *lower power* 3G UMTS phones had a higher glioma (a type of brain cancer) risk than the *higher power* 2G GSM

phones. More recent technologies appear to have more a more dramatic biological effect. Modulations are evolving to transmit more data faster at a given frequency, and this results in higher peak to average power ratios. In the lab, it is notable that experiments using real-life devices are much more likely to find significant effects.

- **The US Federal Interagency Workgroup raised this issue in a 1999 letter citing** how research shows different biological responses to modulated RF radiation exposures *as compared to* unmodulated exposures. Read the Letter. Currently different modulations are in use that were never imagined decades ago when the original research was done to understand human health risk.
- **Decades of research has pointed to the importance of modulation in impacting human health. For example in** 1994 a (U.S.) Air Force "Material Command, Rome Laboratory Radiofrequency / Microwave Radiation Biological Effects and Safety Standards: A Review" stated "It was recognized that the SAR does not encompass all of the important factors necessary to determine safe exposure levels. The modulation frequency and peak power of the incident EM field should also be considered. Some of the investigators warned that extra care should be taken by persons that are subjected to pulsed EM fields or by fields that are modulated near the whole-body resonance frequency."
- **The NTP study was designed to study both modulations *precisely because* the researchers wanted to understand potential effects from the different modulations.**

Overarching Myth #3: Because we don't fully understand the biology behind these results we can ignore them.

Fact: The NTP study confirms the existence of a non-thermal effect. For almost every well established carcinogen ever identified, from cigarettes to asbestos, *the evidence of risk preceded our understanding of the mechanism by many years,* if not decades.

Myth: There is no well understood *mechanism* by which cell phone radiation induces cancer so - *regardless of the findings*- there must be a lack of risk.

Fact: A proven mechanism is not necessary to understand data showing increased risk.

- **The study indicates that a non-thermal mechanism clearly e*xists.*** The NTP study controlled for heating effects by making sure that the body temperatures of exposed rats did not increase by more than 1° C (1.9° F), suggesting that the cancers were triggered by some other mechanism.
- **It could take decades before the mechanism is considered "proven".** For almost every well established carcinogen ever identified, from cigarettes to asbestos, the evidence of risk preceded our understanding of the mechanism by many years, if not decades. The mechanisms by which smoking, for example, causes lung cancer were not

established until the 1980's - decades after the surgeon general began to warn of the massive cancer risks associated with smoking.

- **There is now sufficient evidence that radiofrequency radiation could result in biochemical changes** that alter how our cells functions and increase the oxidative stress (increasing free radicals) in our bodies leading to chronic inflammation and cancer. Several prominent scientists have published (with full documentation) on the possible mechanisms by which cell phone/wireless radiation could result in increased cancer. They explain how long-term exposure to extremely low power levels of radiofrequency fields could initiate a series of biological effects with the end result of an increased risk for cancer and a myriad of other serious health effects.
    - For example, a 2016 article published in IEEE Power Electronics Magazine, scientists propose a hypothesis that long-term exposure to weak magnetic fields can lead to elevated radical concentrations and an association with aging, cancer, and Alzheimer's.
    - The review article "Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression" looks at the literature over the last half-decade, concluding "in summary, then, the mechanism of action of microwave EMFs, the role of the VGCCs in the brain, the impact of non-thermal EMFs on the brain, extensive epidemiological studies performed over the past 50 years, and five criteria testing for causality, all collectively show that various non-thermal microwave EMF exposures produce diverse neuropsychiatric effects."
    - A 2016 published analysis concludes "Our analysis supports a linkage between RF EMF exposure to human cells and changes in the pathways associated with apoptosis, cellular regulation, and cytoskeleton maintenance. There is weaker support for linkage to metabolic pathways and neurological pathways. Based on these linkages alone, there is reason to believe that RF EMF could play a role in carcinogenesis, metabolic disorders, and neurological development and function." (Parham et al. 2016)
    - A 2016 published paper by Dr. Magda Havas When Theory and Observation Collide: Can Non-ionizing Radiation Cause Cancer? states;

        "*Evidence of free-radical damage has been repeatedly documented among humans, animals, plants and microorganisms for both extremely low frequency (ELF) electromagnetic fields (EMF) and for radio frequency (RF) radiation, neither of which is ionizing. While IR directly damages DNA, NIR interferes with the oxidative repair mechanisms resulting in oxidative stress, damage to cellular components including DNA, and damage to cellular processes leading to cancer. Furthermore, free radical damage explains the increased cancer risks associated with mobile phone use, occupational exposure to NIR (ELF EMF and RFR), and residential exposure to power lines and RF transmitters including mobile phones, cell phone base stations,* broadcast antennas, and radar installations".

- A 2016 published study *Mechanism of low-level microwave radiation effect on nervous system* (Hinrikus et al. 2016) aimed to expl*ain the mechanism of the effect of low-level modulated microwave radiation on brain bioelectrical oscillations.*

  "The proposed model of excitation by low-level microwave radiation bases on the influence of water polarization on hydrogen bonding forces between water molecules, caused by this the enhancement of diffusion and consequences on neurotransmitters transit time and neuron resting potential. Modulated microwave radiation causes periodic alteration of the neurophysiologic parameters and parametric excitation of brain bioelectric oscillations. The experiments to detect logical outcome of the mechanism on physiological level were carried out on 15 human volunteers."

Overarching Myth #4: Existing research invalidates the NTP findings of increased cancer and genotoxicity.

Fact: The NTP study substantiates previous research findings from human and animal research indicating increased cancer risk and DNA impacts.

Myth: Previous animal research has not shown a link between cell phone radiation and cancer.

Fact: Previous animal research has shown a link between cell phone radiation and cancer.

- **In fact, previous animal studies are now replicated that indicate a carcinogenic effect, *specifically cancer promotion.*** A 2015 study, which replicated a study done in 2010, found that weak cell phone signals can promote the growth of lymphomas, lung and liver tumors in mice. In 2013, the World Health Organization International Agency for the Research on Cancer specifically noted that "*Four of six co-carcinogenesis studies showed increased cancer incidence after exposure to RF-EMF in combination with a known carcinogen*".
- **The two small-scale studies cited in the CNN article are incomparable to the NTP study.** The 2006 "six hour a day" study cited by CNN was funded by Motorola and had an unusual set up in that the mice were sacrificed starting at 171 days (about 5.5 months) and the mice did not even live an entire year in the study. The "one hour a day" study cited was, well - one hour a day - and only followed animals for one and a half years. The life span of a rodent is approximately three years and the NTP study followed mice for a full two years to allow for a more adequate long term exposure. Importantly, the NTP study trumps all previous animal studies because no other animal study was as well designed and used such an elaborate set up.
- **A 5 year, $5 Million U.S. Air Force study conducted in the early 1980's found that significantly higher numbers of male rats exposed to low-intensity microwave radiation developed cancer in comparison to those not exposed.** The Chou study

exposed experimental animals to 2450 MHz, which is similar to the frequencies used for WiFi, whereas the NTP study exposed rodents to 900 MHz and 1800 MHz microwave radiation. However in the Air Force Study, the rats' average exposure was about 4-10 times *lower* than in the NTP study. Read more about this study in Dr. Moskowitz analysis. It is notable that in this study the researchers state, "Only male rats were used to minimize statistical variation, i.e., to avoid the hormonal variations characteristic of female rats. Use of female rats would have required a substantial increase in the number of animals."

- **In the 1990's, Henry Lai and V.J. Singh demonstrated that low levels of microwave radiation (2.45 GHz) well below that of cell phone radiation levels could increase the frequency of single-strand DNA breaks in the brain cells of live rats.** The in-vitro studies of the $15 Million dollar REFLEX project *lead by Franz Adlkofer* also indicated a genotoxic effect of RF-EMFs at levels below proposed radiation safety levels. In an June 2016 interview, Professor Adlkofer commented that the NTP and Reflex study complement each other, and "intensify in their significance."

Myth: There is no human evidence linking brain and heart tumors to cell phones.

Fact: There is human evidence linking brain and heart tumors to cell phones.

- **Human data *does* show the same type of tumor increases.** The NTP finding of increased gliomas and schwann cell tumors of the heart in rats exposed to RFR is consistent with epidemiological reports of increases in gliomas and acoustic neuromas (schwann cell tumors) *among humans* exposed to cell phone radiation. Research studies that examined long term heavy cellphone users have found a statistically significant increase in glioblastomas (Coureau et. al., 2014, Hardell et al., 2014, Morgan et al, 2015,) The multi-country Interphone study published findings in 2010 and 2011 with results stating higher glioma risks in *heavy* users. In 2016 re-analysis of Interphone data found stronger positive associations to glioma risk among long term users and heavy users (Turner et al. 2016) and a statistically significant association between the intracranial distribution of gliomas and the self-reported (possible bias) location of the phone (Grell et al. 2016).
- **The Swedish studies and the Interphone study not only found elevated glioblastomas, but *also* higher acoustic neuromas, schwann cell tumors at the highest level of cumulative call time.** The acoustic neuroma is also known as vestibular schwannoma, and it is a nonmalignant tumor of the 8th cranial nerve in humans. The NTP rats developed schwannomas- tumors of the nerve sheath but of the heart. Famous individuals diagnosed with an acoustic neuroma include Mark Ruffalo, Tara Subkoff, and Lucille Lewin.
- **"Human evidence" was a large part of the basis for the International Agency for Research on Cancer (IARC) classification of the cancer risk of radiofrequency radiation as a Class 2B "possible" carcinogen in 2011. T**he IARC expert working group noted research studies which indicated brain cancer risks were increased

significantly after 10 years of cellphone use, and risk levels were greatest on the side of the head on which users held their cell phones. The Class 2B classification was based on "positive associations observed between exposure to radiofrequency radiation from wireless phones and glioma, and acoustic neuroma," and for which a causal relationship was considered to be credible. Those associations were not considered to represent "sufficient evidence of carcinogenicity" at that time in 2011 because recall bias in the case-control studies could not be fully ruled out as a possible contributing factor.

- **NIEHS/NTP presented the results at the June 8, 2016 BioEM2016 Meeting, in Ghent, Belgium stating,** "*Tumor types observed in this study are similar type to those observed in some epidemiology studies of cell phone users*" and the study "*Supports IARC conclusions of potential carcinogenic potential of RFR.*" ***(NTP BIOEM 2016 Powerpoint 27 of 32)***

Myth: Large studies such as the Million Women study and Danish study and petri dish studies reassure us there is no problem because they show no evidence.

Fact:

- **Epidemiological cohort studies, like the Danish Cohort or Million Women study, are of poor quality and it is not possible to draw any scientifically reliable conclusions from them.**
- **The Danish Cohort Study has been heavily criticized by scientists worldwide and was originally funded by Danish Telecom.** Many scientists state that the design flaws invalidate the study's conclusions. Why? Because the heavy cell phone users, more than 200,000 corporate subscribers, who used cell phones as part of their job, were placed in the control group. The study authors state, "Because we excluded corporate subscriptions, mobile phone users who do not have a subscription in their own name will have been misclassified as unexposed." This bias explains why the 2011 World Health Organization IARC panel put less weight on the Danish study than on the Interphone and Hardell efforts. The International Agency for the Research on Cancer's Robert Bann wrote that the exclusion of the corporate subscribers for the Danish Studies "seems remarkable" and "could have resulted in considerable misclassification in exposure assessment."
- **The Million Women Study has been criticised for a short observation period, bias and crude exposure assessment.** The researchers did not assess how much time the women spent on a cell phone either before or during the course of the study, so women who spent merely a few minutes almost every day at baseline would be lumped together with women who used their phone one half hour or more per day. Despite these major shortcomings, the study actually reported a statistically significant doubling of risk of acoustic neuroma, a tumor on the nerve from the ear to the brain, among those who had used their cell phone for 10 or more years.
- **Cohort cancer studies are only reliable if they adequately capture the long latency period for cancer development as well as the actual characteristic of cell phone**

use by individuals in these studies (e.g., use of speakers, head sets, frequency and duration of calls, type of phone, etc.). Exposure misclassifications in cohort studies such as those found in the Danish Cohort and Million Women study tend to increase the chances of a negative result.

- **The four year REFLEX studies, involving 12 groups from 7 European countries, studied the effects of radiation on animal and human cells in Petri dishes.** They found GMS-modulated mobile phone radiation caused DNA strand breaks in isolated human fibroblasts and granulosa cells from rats and proved the presence of damage with the Comet Assay. Similar results were obtained with UMTS-modulated mobile phone radiation, the genotoxicity of which seems to be even higher than that of GSM. The NTP study used the same assay tests and found similar DNA damages in specific organs of the exposed male and female rats and mice.

Myth: The lack of an epidemic of brain cancer demonstrates that cell phones pose no risk of brain cancer.

Fact:

- **It will take decades to see an epidemic of brain cancer in the general population because brain tumors have a very long latency period**. While cell phones have been around for decades, the majority of cellphone users have only recently become heavy users, so it is not likely that a large overall increase in incidence rates will have appeared yet.
- **In fact, the most aggressive types of brain cancers and those types specifically associated with cell phone use (the types which NTP rats developed) *are rising.*** According to the American Brain Tumor Association's largest, most comprehensive analysis to date, the incidence of the most aggressive gliomas (a category of brain tumors) are rising in adolescents and young adults within the US. The ABTA study shows increased yearly incidence of the following brain tumors: anaplastic astrocytoma, tumors of the meninges, tumors of the sellar region and unclassified tumors. Glioblastomas, the type of brain cancer found to be linked to cell phone radiation in the NTP study and in human studies, are increasing in those aged 15-39 in the United States. International registries have also indicated an increase (Zada et al, 2012, Danish Cancer Society Press Release, Ho et .al., 2014 and Dobes 2011). These increases are *not* evident in population based research studies when the incidence of all brain cancers "overall" are considered. These increases are only evident when you break down the statistics into specific tumor type.
- **Case control research is a more useful study design than population trends at this time and these studies *do* show an association between cancer and cell phone use**. Population wide based studies are not the best way to assess the link between cellphones and cancer until at least another decade from now (cell phones and wireless have only fully saturated society for a little over a decade). Research looking at high-risk groups using case-control designs are more suited to showing cancer risk from cell

phones and they have found an association. All independent research using case control design examining long term (greater than ten years) cell phone use have showed increases in brain cancer associated with long term cell phone use.

Myth: A recent Australian study showed there is no rise in brain cancer so this NTP study must be bogus.

Fact:

- **The widely publicized article claiming that cell phones are safe by the Australian sociologist Simon Chapman has been critiqued by a series of published articles.** Scientists are calling for a retraction of the Australian study because of a number of errors, false assumptions and cherry-picked data. Newly published appraisals (Bandara 2016, Morgan 2016, Wojcik 2016) debunk the claim by Chapman et. al. that "After nearly 30 years of mobile phone in Australia among millions of people, there is no evidence of any rise in any age-group that could be plausibly attributed to mobile phones."
- Examples of concerns raised about the study:
    - The paper referred to an Australian paper but failed to report the full statement that found a significant increasing incidence in glioblastoma.
    - The scientists also point out that Chapman does not analyze information on actual minutes of mobile phone use by a person, but rather estimates this based only on the number of mobile phone subscriptions.
    - Clinical director and forensic expert Damian Wojcik of New Zealand wrote that the Chapman study fails to take into account evidence that the locations of brain tumors that are increasing in the young are precisely those locations associated with mobile phones.

"By showing only that part of the data that supports his view, Chapman is playing fast and loose with science and putting us all at grave risk," stated Devra Lee Davis, "He basically ignores rising brain cancer rates in the U.S. and Australia that have grown rapidly in those under age 65 that have incurred the greatest use of phones for the longest time. Instead he points to the lack of an overall population increase in the disease as proof phones have no effect."

Overarching Myth #5: Experts overwhelmingly have discredited the study results and conclude it to be irrelevant.

Fact: The majority of NIH scientific reviewers to the NTP dataset believe the findings are valid and that the radiation exposure is related to the cancer.

Myth: NIH's *own* reviewers could not accept the study conclusions.

Fact: The majority of NIH scientists who reviewed the data agreed with the study conclusions.

- **Dr. Lauer's comments are incorrectly presented as representing the general tone of scientific reception to the study.** In fact, Dr. Lauer's review comments were comprehensively and scientifically rebutted in the NTP report itself (in the section entitled *NTP Responses to NIH Reviewer's Comments, page 67-74*). It is standard process to solicit peer reviews, then to explain the analysis or make changes if necessary in response to the critiques and this process is fully documented in the NTP report. The repeated presentation of Dr. Lauer's review statements without explaining the review process and NTPs later response to the statements paints an inaccurate depiction of the scientific discourse on the study.
- **The majority of NIH scientific reviewers to the NTP dataset believe the findings are valid and that the radiation exposure is related to the cancer.** The NTP study had three panels of reviewers rather than the usual one panel. Dr. John Bucher, Director of the National Toxicology Program Division, has repeatedly stated in his presentations of the NTP study that "the majority" of reviewers agreed with the analysis. Watch the NIEHS video presentation in June 2016.
- **Dr. Michael Lauer's criticisms have been invalidated by not only the NTP (in their response to his statements) but also by experts.**
    - **Dr. Melnick responded to one of Dr Lauer's statements in the Hebrew University Press conference** that "One comment was made that the study had low statistical power and that might lead to a false positive. I'm not sure if that was a misstatement by the reviewer because low statistical power means there's a high probability of accepting the null hypothesis even when a true effect may exist. That is, there is a greater chance for a false negative rather than a false positive if there is low statistical power."
- **Despite these facts, Dr. Michael Lauer's comments have repeatedly and incorrectly been presented as evidence of a flawed study.** The New York News article headline misleadingly states, "*National Institutes of Health expert reviewers are finding flaws in the agency's new study that connects heavy cell phone radiation to a slight increase in brain tumors in male rats."*

Background: Aaron Carroll, a pediatrician at the Indiana University School, authored a New York Times column titled "*Why It's Not Time to Panic About Cell Phones and Cancer.*" Following his publication in the New York Times, his column has been cited numerous times as "proof" by an "expert" that the NTP study is fundamentally flawed. However, he presented multiple inaccurate and misleading statements regarding the NTP study results and when concerns were raised by experts, the New York Times refused to publish the concerns nor correct the false statements.

Myth: The New York Times review of the NTP study proves the study is bad.

Fact: Dr. Carroll's column contained 8 serious false and misleading statements prompting a response from Dr. Ronald Melnick, who led the NTP study' design team. Dr. Melnick sent the New York Times a letter going point by point through Carroll's column pointing out each of the false and misleading statements.The New York Times responded that "We do not see anything in the article that needs to be corrected" and did not print Dr. Melnick's letter. The full email exchange between Dr. Melnick and the New York Times is available to read.

Read the Letter by Ronald Melnick PhD sent to the New York Times Correcting New York Times Misinformation About the NTP Cell Phone Radiation Study.

> I am compelled to write this letter because of the numerous incorrect and misleading statements made by Aaron Carroll, a pediatric professor at Indiana University School of Medicine (Upshot, *New York Times,* May 31, 2016) in his critique of the cell phone study conducted by the National Toxicology Program (NTP).
>
> 1) The statement that the NTP report had been "shopped for review, but had not been accepted by any editors" is blatantly wrong and makes one wonder where Carroll obtained such false information or did he simply decide to make up his own facts.
>
> 2) While Carroll notes that this was a study in rats, he neglects to note that every known human carcinogen induced tumors in animals when adequately tested. Animals are used as models in toxicity and carcinogenicity studies because it is unethical to intentionally expose humans to agents that might cause an adverse health effect such as cancer that has a long latency period between exposure and manifestation of disease.
>
> 3) The finding of significant increases of cancer in male rats but not in female rats is presented as contempt of the data; however, Carroll neglects to note that such findings are common in animal studies especially at sites that have higher background rates in male rats than females. This gender difference might be a consequence of low statistical power, an issue that I comment on below.
>
> 4) Carroll claims that control rats "dying early could be responsible for all the significant results of the study." This statement is wrong for at least two reasons: First, there was no statistical difference in survival between control male rats and those exposed to CDMA at 6 W/Kg (the group with the highest rate of gliomas and heart schwannomas); at week 94, survival of rats in these two groups were the same. Second, no glial cell hyperplasias (potential pre-cancerous lesions) or heart schwannomas were observed in any control rat, even though glial cell hyperplasia

was detected in a CDMA-exposed rat as early at week 58 and heart schwannomas were detected as early as week 70 in exposed rats.

5) Carroll seems to endorse the incorrect view that because the study had low statistical power, it is likely to have "an increased risk of being a false positive." However, having low statistical power means that there is a greater chance for a false negative rather than a false positive result. That is, there is a high probability of accepting the no-effect hypothesis even when a true effect exists.

6) Carroll warns against accepting results from the NTP study, which he refers to as an "imperfect rat study." He is probably unaware that the design of this study was presented at an annual meeting of the Bioelectromagnetics Society prior to the start of these studies. The overwhelming opinion expressed by the meeting participants was that this would be the largest and most comprehensive study in animals exposed to cell phone radiation, and that the results from this study would trump all other animal carcinogenicity studies of this agent.

7) Carroll criticizes the usefulness of human case-control studies while praising cohort studies. Actually both types of studies are important, though each has its own limitations. Carroll neglects to note that cohort cancer studies are reliable if they adequately capture the long latency period for cancer development as well as the actual characteristic of cell phone use by individuals in these studies (e.g., use of speakers, head sets, frequency and duration of calls, type of phone, etc.). Exposure misclassifications in cohort studies tend to increase the chances of a negative result.

8) While Carroll argues against a relationship between brain cancer and cell phone use because the incidence of brain cancers have not increased in the United States since the late 1980s, he neglects to note that unfortunately the incidence of highly lethal glioblastomas has increased during that same time period.

In my view, a pediatrician would be acting irresponsibly if he or she knew and understood the implications of the human and animal cancer data on cell phone radiation and did not offer precautionary advice to the parents of his or her patients.

—Ronald L Melnick, PhD

Ronald L Melnick, PhD, led the design of the NTP/NIEHS Rodent Study. Melnick was a Senior Toxicologist and Director of Special Programs in the Environmental Toxicology Program at the National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health, and is now retired.

In response to Dr. Melnick's letter the New York Times editor wrote this response
Jun 8, 2016, at 11:24 PM, Darlin, Damon wrote:

Mr. Melnick,

Aaron Carroll forwarded your letter to me. I was one of the editors who worked on the piece with Aaron. Thank you for taking the time to write to us about it. We read through your concerns carefully and discussed each point with Aaron. We do not see anything in the article that needs to be corrected.

I see you have also submitted this to our letters editor. We at The Upshot have no role in their decisions to print the letter or not.

All the best,

Damon Darlin
Editor, The Upshot
The New York Times

Ronald Melnick PhD then sent a letter to Damon Darlin of the New York Times

Mr. Darlin

I find it appalling that the NY Times printed the op-Ed by Aaron Carroll on health effects of cell phone radiation that had numerous inaccurate and misleading assertions, while denying my submission that attempted to correct many of the incorrect statements in that article. The fact that you allowed the author of that op-Ed (who obviously has no background in toxicology) to reject my comments because you and he did not see anything in his article that needed to be corrected is not only absurd, but is also a disservice to the readers of the NY Times.

Sincerely,

Ronald Melnick, PhD,
Retired Senior Scientist,
National Toxicology Program,
National Institute of Environmental Health Sciences,
National Institutes of Health

- **Dr. Carroll has no expertise in electromagnetic fields or understanding rat bioassays, and his misleading and non factual New York Times article was not peer reviewed science.** Yet it is being presented as an “expert” opinion. In fact, Carroll's research instead focuses on integrating information technology into health care. For example, he has published on the use of mobile phones in diabetes management,

and issues in adopting health information technology and integrating computerized clinical decision support systems into clinical practice.

- Caroll again cites the NTP study in a JAMA Forum opinion piece stating, "This is how we can have headlines proclaiming that cell phones cause cancer because of a new small study, regardless of how much data and evidence that we already have that don't fit with those findings." Such a statement seems to be referring to the NTP as a "new small study" yet again perpetuating myths about the study being small.

Myth: The NTP study has been fully discredited by scientists and experts due to major flaws.

Fact:

- **The National Toxicology Program (NTP) of The National Institutes of Health animal toxicology research is considered the "gold standard".** The NTP, established by Congress in 1978 is internationally renowned for its research and toxicological studies, which are used by federal and state regulatory agencies to protect the public from exposure to toxic and carcinogenic substances. Worldwide experts were brought in to validate the exposure setup. Statements that the NTP work is "poor quality" and "failing to meet basic principles of toxicology" are unfounded at best.

  > *"This report from the National Toxicology Program is good science… they convened not one but three panels to look at abnormal tissues from treated animals to ensure that what was identified as a brain and heart tumor was indeed a brain and heart tumor; they solicited review from multiple scientists from outside the NTP to critically review all aspects of the data analysis and study findings, to ensure the findings would stand up to the critical assessment expected once these unexpected findings were released."* - Otis W. Brawley, M.D., American Cancer Society Chief Medical Officer

- **There is not "overwhelming epidemiology data which contradicts these findings" but quite the contrary.** The findings of brain tumors (gliomas) and malignant schwann cell tumors of the heart in the NTP study present a major public health concern because these tumors occurred in the same types of cells in rodents that had been reported to develop into tumors in humans in several epidemiological studies of long term cell phone users.
- **A generalization that the NTP study is "discredited by scientists" is false and misleading.** For example, the Bloomberg article was cited in the Linked-In post as proof of this despite the article being penned by Faye Flam, a columnist (not a scientist) who focuses on sex and evolution and her review of the NTP where she describes it as "just another study" with "just a few rats" propagates most of the myths addressed about the NTP study on this very page. The majority of NIH reviewers to the NTP study data agreed with the study conclusion.
- **Read responses to the NTP study by experts:**

  Dr. Otis W. Brawley, Chief Medical Officer of the American Cancer Society

> "For years, the understanding of the potential risk of radiation from cell phones has been hampered by a lack of good science. This report from the National Toxicology Program (NTP) is good science."
>
> Dr. Jennifer A. Lowry, Chair of the American Academy of Pediatrics Council on Environmental Health Executive Committee
> Dr. Elisabeth Cardis, the Barcelona Institute for Global Health
> Dr. Franz Adlkofer, the Pandora Foundation
> Dr. Joel Moskowitz , University of California at Berkeley
> Dr. Gautam Khurana, CNS Neurosurgery
> Dr. Dariusz Leszczynski, Chief Editor of 'Radiation and Health'
> Dr. Chris Portier, former Director of the Environmental Toxicology Program (ETP) at the NIEHS and Associate Director of the NTP
> EMF Scientists Appeal, 223 scientists that have published in the field
> Dr. Eitan Kerem, Chair of Pediatrics, Hadassah Hebrew University Hospital

- **The majority of NIH scientific reviewers to the NTP dataset believe the findings are valid and that the radiation exposure is related to the cancer.** The NTP study had three panels of reviewers rather than the usual one panel. Dr. John Bucher, Director of the National Toxicology Program Division, has repeatedly stated in his presentations of the NTP study that "the majority" of reviewers agreed with the analysis. Watch this stated in the NIEHS video presentation in June 2016.

Overarching Myth #6: This study still needs to be replicated before it will have an impact on federal regulations or health recommendations to the public.

Fact: This $25 Million dollar study one of the most elaborate studies of any potentially hazardous exposure ever conducted. The concordance between the NTP study and human epidemiological studies is stunning and should guide federal agencies to issue protective policy and strong recommendations to reduce exposure.

Myth: This study needs to be replicated first- until then, it will not have an impact.
Fact: This $25 Million dollar study one of the most elaborate and expensive studies of any potentially hazardous exposure ever conducted. It will likely not be repeated as the exposure equipment has been dismantled. The concordance between the NTP study and human epidemiological studies is stunning. In addition, NTP also reported statistically significant evidence of DNA damage in mice as well as in rats.

- **This is one of the most elaborate and expensive studies of any potentially hazardous exposure ever conducted.** It will likely not be repeated and there is little scientific reason to do so. The history of science is rich with single studies that have changed our way of thinking. Most importantly, the concordance between the NTP study

and human epidemiological studies that have found evidence of a cancer risk (with the same types of cancers shown in the NTP rats) is stunning. The NTP study cost $25 million dollars. There is nothing small about it. It is the largest, most thorough and meticulously conducted animal study ever conducted. The design of the NTP study was presented at an annual meeting of the Bioelectromagnetics Society prior to the start of the NTP study and Ron Melnick PhD states of that day, *"the overwhelming opinion expressed by the meeting participants was that this would be the largest and most comprehensive study in animals exposed to cell phone radiation, and that the results from this study would trump all other animal carcinogenicity studies of this agent."*

- **The results show a significant effect of DNA damage.** Not only did cancer rates significantly increase in male rats, the NTP also reported statistically significant evidence of DNA damage from nonthermal exposure to cellphone radiation in mice as well as in rats. (male rats: frontal cortex, hippocampus, liver, blood; male mice: frontal cortex; female rats: frontal cortex; female mice: liver, blood.)
- **The NTP study will never be replicated as the exposure equipment no longer exists.** The reverberation chambers have been dismantled. The NTP equipment, design and costs associated with validating the radiofrequency exposures cost roughly 10 million dollars alone.

"Based on this new information, regulatory agencies should make strong recommendations for consumers to take precautionary measures and avoid close contact with their cell phones (use speaker, headset, text –not while driving), and especially avoid use of cell phones by children. The recommendation to take precautions "if you are concerned" is inadequate."

- Ronald Melnick, Ph.D. senior toxicologist in the Environmental Toxicology Program at the National Institute of Environmental Health Sciences when he led the design of the NTP studies on cell phone RFR. He is now retired.

Myth: The NTP study is not groundbreaking and will have little impact on federal health agency recommendations.

Fact: ***The NTP report marks a paradigm shift in our understanding of radiation and cancer risk.***

- ***The NTP report will have an impact on federal health and safety agency recommendations because it shows that federal radiation exposure limits are based on a flawed assumption.***

  The NTP findings indicate our federal exposure limits are not protective of human health. If cell phone radiation were safe then we should have seen *no effect* from these exposures. The NTP tested the hypothesis that low level cell phone radiation -at non thermal levels- could *not* cause health effects. Yet a health effect was shown.This is groundbreaking because US government exposure limits are based on the now disproved hypothesis that non-thermal effects are benign. T*he study results clearly show that cell phone radiation can cause adverse health effects at nonthermal levels.* In order to adequately protect the

public, federal agencies should now reassess federal exposure limits to protect the public from non thermal effects.

"The NTP report linking radiofrequency radiation (RFR) to two types of cancer marks a paradigm shift in our understanding of radiation and cancer risk" and "This new evidence will undoubtedly factor into ongoing assessments by regulators to determine the potential cancer risk posed by cell phones. The American Cancer Society eagerly awaits guidance from government agencies, like the U.S. Food and Drug Administration (FDA) and the Federal Communications Commission (FCC), about the safety of cell phone use."

- *The American Cancer Institute Press Release*

Facts:

- **The NTP findings were reviewed by expert peer reviewers selected by NTP and the National Institutes of Health. These expert reviewers gave comments included as appendices to the NTP report, and as a result revisions to the current document incorporated and addressed these comments. Page 32 of the NTP Report lists the reviewers:**
  - Diana C. Haines, D.V.M., Frederick National Laboratory
  - Michael S. Lauer, M.D., Office of Extramural Research, NIH
  - Maxwell P. Lee, Ph.D., Laboratory of Cancer Biology and Genetics, NCI,
  - Aleksandra M. Michalowski, M.Sc., Ph.D., Laboratory of Cancer Biology and Genetics, NCI
  - R. Mark Simpson, D.V.M., Ph.D., Laboratory of Cancer Biology and Genetics, NCI
  - Sixth reviewer's name and comments are withheld.
- **The NTP also clearly states the charge of these reviewers is to peer review:** " Charge: To peer review the draft report, statistical analyses, and pathology data and comment on whether the scientific evidence supports NTP's conclusions) for the study findings."
- **The NTP also extensively involved outside pathologists including pathologists with extensive experience in human brain tumors.**

  They solicited review from multiple scientists from outside the NTP to critically review all aspects of the data analysis and study findings, to ensure the findings would stand up to the critical assessment expected once these unexpected findings were released." - Otis W. Brawley, M.D., American Cancer Society Chief Medical Officer
- **The NTP typically publishes results of toxicology studies in detailed technical reports. These reports are available on the NIEHS site.**
- **The NTP study will likely result in numerous published papers in medical journals and several manuscripts are being prepared for publication.** The NTP Report states:

  "These manuscripts describe in detail the designs and performance of the RFR exposure system, the dosimetry of RFR exposures in rats and mice, the results to a series of pilot studies establishing the ability of the animals to thermoregulate during RFR exposures, and studies of DNA damage."

Capstick M, Kuster N, Kühn S, Berdinas-Torres V, Wilson P, Ladbury J, Koepke G, McCormick D, Gauger J, Melnick R. A radio frequency radiation reverberation chamber exposure system for rodents.

Yijian G, Capstick M, McCormick D, Gauger J, Horn T, Wilson P, Melnick RL and Kuster N. Life time dosimetric assessment for mice and rats exposed to cell phone radiation.

Wyde ME, Horn TL, Capstick M, Ladbury J, Koepke G, Wilson P, Stout MD, Kuster N, Melnick R, Bucher JR, and McCormick D. Pilot studies of the National Toxicology Program's cell phone radiofrequency radiation reverberation chamber exposure system.

Smith-Roe SL, Wyde ME, Stout MD, Winters J, Hobbs CA, Shepard KG, Green A, Kissling GE, Tice RR, Bucher JR, Witt KL. Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure.
(Page 2 of the NTP Report)

ENVIRONMENTAL HEALTH TRUST

Science For Skeptics: Myth Versus Fact On Cell Phones And Wi-Fi
Common Myths About Cell Phone And Wireless Radiation "Safety" Debunked

The public relations strategy of manufacturing doubt has often been used to delay policies to control or reduce environmental hazards, whether tobacco, climate change, asbestos, vinyl chloride, cell phone radiation or other agents. Here we identify and debunk erroneous statements that appear in the media in response to scientific results suggesting that cell phone radiation could be hazardous.

MYTH: "No research has found evidence of a link between regular cell phone use and glioma."

FACT: In fact, multiple research studies of humans indicate that long-term cell phone use could increase a person's risk for brain tumors. The latest animal study conducted by the U.S. government finds increases in the same types of tumors found to be increased in humans who used phones regularly for a decade or longer. The World Health Organization International Agency for Research on Cancer classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B) in 2011, based on epidemiological research showing an increased risk for glioma, a malignant type of brain cancer ,

associated with long term wireless phone use. These research studies also show an even higher risk for persons who start using cell phones at a young age.

Full Description:
FACT: In fact, *multiple* research studies indicate that long-term cell phone use can increase the risk for brain tumors. The World Health Organization International Agency for Research on Cancer classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B) in 2011, based on an increased risk for glioma, a malignant type of brain cancer associated with wireless phone use. These research studies also show a higher risk for persons who start using cell phones at a young age. The subjects within these studies have used cell phones for over ten years. In some of these studies "heavy" use was defined as around *30 minutes per day*. The statistically significant risks were seen in long-term and "heavy" cell phone users.

The type of brain cancer increased by cell phones is glioblastomas. Cell phone-related glioblastomas are in fact increasing in the United States in precisely those parts of the brain that absorb most of the microwave radiation emitted or received by phones.

> "A disservice has been done in inaccurately depicting the body of science, which in fact indicates that there are biological effects from the radiation emitted by wireless devices, including damage to DNA, and evidence for increased risk of cancer and other substantial health consequences…The public the world over has been misled by this reporting." —Ronald B. Herberman, MD, Director of University of Pittsburgh Cancer Institute, 2008

The World Health Organization International Agency for the Research on Cancer classifies Radiofrequency as a Class 2B Carcinogen.

A statement that there is "no evidence" is not consistent with the expert findings of the International Agency for Research on Cancer (IARC) of the World Health Organization in 2011. The first sentence of the 2011 press release (IARC classifies Radiofrequency Electromagnetic Fields as possibly carcinogenic to humans) reads: "The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use."

In fact, the research studies considered by the WHO/IARC that looked at brain cancer and cell phone use specifically labeled "highest users of cell phones" or "heavy" cell phone use at about 30 minutes per day for over ten years or over 1625 hours of lifetime use. Twenty years ago, 30 minutes per day of cell phone use was certainly "heavy" use. However *these days*, people use their cell phones day and night. Phones are powered on for 24 hours and used for voice conversation, texts, internet and video/music streaming. The 30 minutes of so-called "heavy use" ten years ago would today be termed as being only "light use."

In 2011 after the IARC classification, Dr. Jonathan Samet (University of Southern California, USA), Chairman of the IARC EMF Working Group, stated that *"the evidence, while still accumulating, is strong enough to support a conclusion and the 2B classification. The conclusion means that there could be some risk, and therefore we need to keep a close watch for a link between cell phones and cancer risk."*

Experts recommend taking precautions with cell phones.

"Given the potential consequences for public health of this classification and findings," said IARC Director Christopher Wild, "it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting." Read more in the Science Daily News Article after the IARC classification..

Research indicates that long-term cell phone radiation exposure can increase brain cancer risk.

The WHO/IARC classification gave weight to evidence from Swedish case control studies and the Interphone study.

The Interphone study, a huge multi-country, multi center study published January 2, 2012 in Occupational and Environmental Medicine , concludes that there is an increased risk of glioma (a type of brain tumor) in long-term mobile phone users with high RF (radiofrequency) exposure and a risk for meningioma (a tumor of the membrane surrounding the brain). This study, unlike other studies, attempted to estimate the amount of radiation at the site of the tumor. The authors state, "This present paper is the first to use estimates of radio frequency energy deposition at the centre of tumours in the brain as a measure of radio frequency dose." Scientists observed an increasing trend in gliomas with increasing radiofrequency dose for exposures *after 7 years*. Tumors were located primarily in the part of the brain receiving the maximum RF exposure.

The evidence has increased since 2011.

Epidemiology of brain tumors is quite complex, but has strengthened in the years after the 2011 IARC Class 2B Carcinogen classification. A more recent (2015) publication, by Lennart Hardell's group, combines results of two previous studies (including 1498 cases and 3530 controls) in conjunction with numerous other findings from others, indicating that the evidence is now sufficient to conclude that radiofrequency radiation (RFR) does cause cancer (IARC Class 1). Hardell is very familiar with the IARC process, as he sat on the expert panel that evaluated radiofrequency radiation, as well as a previous panel considering phenoxy herbicides. We recommend reading the European Environmental Agency's report: Late Lessons from Early Warnings Mobile phone use and brain tumour risk: early warnings, early actions? This report details the critical need to take precautions to protect public health regarding cell phones.

After the IARC classification, a multicenter case control study in France (Coureau 2014) reported the presence of significantly more brain tumors in heaviest cell phone users with long-term use in comparison to non-users. The published paper concludes, "These additional data support previous findings concerning a possible association between heavy mobile phone use and brain tumours."

Due to the accumulating research (after the 2011 IARC classification) indicating a higher risk in long-term cell phone users, several cancer researchers affiliated with EHT published a paper in the *International Journal of Oncology* stating that the weight of evidence now shows that the carcinogen should be moved up to a Group 2A 'probable' human carcinogen. They "advise that the as low as reasonably achievable (ALARA) principle be adopted for uses of this technology, while a major cross-disciplinary effort is generated to train researchers in bioelectromagnetics and provide monitoring of potential health impacts of RF-EMF."

For additional information see the following research studies:

Non-ionizing radiation, Part II: Radiofrequency electromagnetic fields / IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. (2011) IARC Monogr Eval Carcinog Risks Hum, 102.2: 1-460.

- Radiofrequency electromagnetic fields are *possibly carcinogenic to humans* (Group 2B)" (p. 421).
- "In children using mobile phones, the average deposition of RF energy may be two times higher in the brain and up to ten times higher in the bone marrow of the skull than in adult users" (page 42).

Coureau G, Bouvier G, Lebailly P, Fabbro-Peray P, Gruber A, Leffondre K, Guillamo JS, Loiseau H, Mathoulin-Pélissier S, Salamon R, Baldi I. (2014). Mobile phone use and brain tumours in the CERENAT case-control study. *Occup Environ Med*, 71.7: 514-22.

- "A positive association was statistically significant in the heaviest users when considering life-long cumulative duration for meningiomas and number of calls for gliomas. These additional data support previous findings concerning a possible association between heavy mobile phone use and brain tumours."

Hardell, Lennart and Michael Carlberg. "Re: Mobile Phone Use and Brain Tumours in the CERENAT Case–control Study." *Occupational and Environmental Medicine*, 72:79–79. doi:10.1136/oemed-2014-102448.

Coureau, Gaëlle, Karen Leffondre, Anne Gruber, Ghislaine Bouvier and Isabelle Baldi. "Author's Response: Re 'Mobile Phone Use and Brain Tumours in the CERENAT Case–control Study.'" *Occupational and Environmental Medicine*. 72:79–80. doi:10.1136/oemed-2014-102649.

- "As requested by Dr Hardell, table 1 presents results of the laterality analysis using Interphone's method, 3 for the main indicator (cumulative duration of use). As with our method, the results give higher OR for ipsilateral use (OR=4.21, 95% CI 0.70 to 25.52 for gliomas) compared with contralateral use (OR=1.61, 95% CI 0.36 to 7.14), without significant association. Moreover, as with our method, the two estimates of the 'stratified' OR are not grouped around the 'total' estimated OR for meningiomas. Such a result was also observed in a recent publication by Hardell et al 5 (in table 4). All these results suggest higher ORs for heavy ipsilateral use than for heavy contralateral use, however, they are not all statistically significant. Furthermore, when using cases only as in Inskip et al's6 study, we found a significant association between the side of phone use and the side of the tumour for glioma (OR=2.40, 95% CI 1.002 to 5.73) but not for meningiomas (OR=0.77, 95% CI 0.26 to 2.22)."

Morgan LL, Miller AB, Sasco A, Davis DL. (2015). Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (review). *International Journal of Oncology*, 46.5:1865-71.

- The CERENAT finding of increased risk of glioma is consistent with studies that evaluated use of mobile phones for a decade or longer and corroborate those that have shown a risk of meningioma from mobile phone use.

- We conclude that radiofrequency fields should be classified as a Group 2A 'probable' human carcinogen under the criteria used by the International Agency for Research on Cancer (Lyon, France).
- We advise that the as low as reasonably achievable (ALARA) principle be adopted for uses of this technology, while a major cross□disciplinary effort is generated to train researchers in bioelectromagnetics and provide monitoring of potential health impacts of RF□EMF.

Carlberg M, Hardell L. (2014). Decreased Survival of Glioma Patients with Astrocytoma Grade IV (Glioblastoma Multiforme) Associated with Long-Term Use of Mobile and Cordless Phones. *International Journal of Environmental Research and Public Health*, 11.10:10790-10805.

- Use of wireless phones in the >20 years latency group (time since first use) was correlated with decreased survival for those diagnosed with astrocytoma grade IV.
- "The study strengthens the proposed causal association between use of mobile and cordless phones and glioma. Due to the relationship to survival, the classification of IARC is strengthened and RF-EMF should be regarded as human carcinogen requiring urgent revision of current exposure guidelines.

Cardis et al. (2011). Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. *Occup. Environ. Med.*, 68.10: 631–640.

- Conclusions: There were suggestions of an increased risk of glioma in long-term mobile phone users with high RF exposure and of similar, but apparently much smaller increases in meningioma risk. The uncertainty of these results requires that they be replicated before a causal interpretation can be made.

1. Hardell, M. Carlberg (2014). Cell and cordless phone risk for glioma – Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009. *Pathophysiology*, 22.1: 1-13.

- "Conclusion. We previously analysed the evidence on glioma associated with the use of wireless phones using the Hill criteria [20]. We concluded that glioma and also acoustic neuroma are caused by RF-EMF emissions from wireless phones, and thus regarded as carcinogenic, under Group 1 according to the IARC classification, indicating that current guidelines for exposure should be urgently revised. This pooled analysis gives further support to that conclusion regarding glioma."

Hardell L, Carlberg M, Söderqvist F and Mild K. (2013). Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. *International Journal of Oncology* 43(6): 1833-45.

- For persons with more than 25 years latency period (time since first use until tumour diagnosis) a 3-fold increased risk was found. The risk increased further for tumours located in the most exposed area of the brain, the temporal lobe, to a 5-fold increased risk.
- "This study confirmed previous results of an association between mobile and cordless phone use and malignant brain tumours. These findings provide support for the hypothesis that RF-EMFs play a role both in the initiation and promotion stages of carcinogenesis".

Hardell L, Carlberg M. (2013). Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. *Rev Environ Health*, 28.2-3: 97-106.

- "All nine issues on causation according to [Bradford] Hill were evaluated. The criteria on strength, consistency, specificity, temporality, and biologic gradient for evidence of increased risk for glioma and acoustic neuroma were fulfilled.
- "Based on the Hill criteria, glioma and acoustic neuroma should be considered to be caused by RF-EMF emissions from wireless phones and regarded as carcinogenic to humans, classifying it as group 1 according to the IARC classification. Current guidelines for exposure need to be urgently revised."

Lerchl et al. (2015). Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. *Biochemical and Biophysical Research Communications*, 459.4: 585-590.

- "Numbers of tumors of the lungs and livers in exposed animals were significantly higher than in sham-exposed controls. In addition, lymphomas were also found to be significantly elevated by exposure. A clear dose–response effect is absent. We hypothesize that these tumor-promoting effects may be caused by metabolic changes due to exposure. Since many of the tumor-promoting effects in our study were seen at low to moderate exposure levels (0.04 and 0.4 W/kg SAR), thus well below exposure limits for the users of mobile phones, further studies are warranted to investigate the underlying mechanisms. Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones."

MYTH: "There is no known biological mechanism for cell phone radiation to cause cancer."

FACT: Cell phone radiation does not *directly* "cause" cancer in the same way that X-rays and atomic bombs do. However, several prominent scientists have published (with full documentation) on the mechanisms by which cell phone/wireless radiation *could result in increased cancer*. They explain how long-term exposure to extremely low power levels of radiofrequency fields could initiate a series of biological effects with the end result of an increased risk for cancer and a myriad of other serious health effects. There is now sufficient evidence that radiofrequency radiation could result in biochemical changes that alter how our cells functions and increase the oxidative stress (increasing free radicals) in our bodies leading to chronic inflammation and cancer.

Full Description:
Several prominent scientists have published (with full documentation) on the mechanisms by which cell phone/wireless radiation could result in increased cancer. They explain how long-term exposure to extremely low power levels of radiofrequency fields could initiate a series of biological effects with the end result of an increased risk for cancer and a myriad of other serious health effects. Cell phone radiation does not directly "cause" cancer in the same way that X-rays and atomic bombs do.

Significant evidence exists.

There is sufficient evidence that radiofrequency radiation could result in biochemical changes that alter how our cells functions and increase the oxidative stress (increasing free radicals) in our bodies leading to chronic inflammation, cancer and neurological impacts. Consider the following:

Radiofrequency radiation increases oxidative stress which in turn increases cancer risk:

There is sufficient evidence that radiofrequency radiation could result in biochemical changes that alter how our cells functions and increase the oxidative stress (increasing free radicals) in our bodies. Extensive research during last two decades has revealed that continued oxidative stress can lead to chronic inflammation, which in turn can mediate cancer risk.

Two leading EMF/RF researchers, Frank Barnes and Ben Greenebaum, have offered theoretical arguments to explain how low-level RF radiation can alter the growth rates of cancer cells. Frank Barnes, Senior Member of the U.S. National Academy of Engineering, and his students have researched and published some fascinating indications that weak magnetic fields can either increase or decrease the growth of cancer cells and bacteria depending on specific conditions. Co-author of this important paper is Professor Emeritus of Physics, Ben Greenebaum, who also served as editor in chief of the peer-reviewed journal *Bioelectromagnetics* from 1993 to 2006. In a 2016 article published in IEEE Power Electronics Magazine, they propose a hypothesis that long-term exposure to weak magnetic fields can lead to elevated radical concentrations and an association with aging, cancer, and Alzheimer's.

Their theory indicates that low-level, long-term EMF exposures involve radicals, such as superoxide, nitric oxide, and hydrogen peroxide, which is readily converted into the radical OH-. These molecules contain unpaired electron spins that are highly reactive. Furthermore, these molecules are bifunctional in that they can serve as both signaling molecules and molecules that can cause damage to important biological molecules, such as lipids and DNA. The damage that unpaired reactive radicals can induce includes a host of inflammatory processes typical of aging, cancer, and neurodegenerative diseases. Their work provides an important theoretical foundation and new experimental data showing that long-term exposures to relatively weak static, low-frequency and RF magnetic fields affect free radical concentrations in biological systems.

While these exposures are inherently non-thermal they can be highly damaging. Long-term exposures to nonthermal RF and EMF can thereby affect the capacity of a biological system to defend and repair itself from attack, modify the rate of cell growth and repair, and ultimately lead to increased risks of a wide range of diseases.

> "We think that there are now both the theoretical bases and sufficient experimental results for further consideration of the possibility that long-term exposures to magnetic fields can lead to both useful applications in treating diseases and to undesired health effects. It is expected that these effects are frequency, amplitude, and time dependent." —Frank Barnes and Ben Greenebaum 2016.

A 2015 research review published in *Electromagnetic Biology and Medicine* found 93 out of 100 published peer-reviewed research studies indicated increased oxidative stress after exposure to radiofrequency radiation. The authors state, "In conclusion, our analysis demonstrates that low-intensity RFR is an expressive oxidative agent for living cells with a high pathogenic potential and that the oxidative stress induced by RFR exposure should be recognized as one of the primary mechanisms of the biological activity of this kind of radiation."

Electromagnetic fields act via activation of voltage-gated calcium channels.

In 2013, Martin Pall PhD published a paper in the Journal of Cellular and Molecular Medicine detailing the research indicating that electromagnetic fields act via activation of voltage-gated calcium channels (VGCC) to produce beneficial or adverse effects at low intensity non-thermal levels. As Pall states in his published paper critiquing Canada's Safety Code 6 Report, "Downstream effects of VGCC activation include calcium signaling, elevated nitric oxide (NO), NO signaling, peroxynitrite, free radical formation, and oxidative stress. Downstream effects explain repeatedly reported biological responses to non-thermal exposures: oxidative stress; single and double strand breaks in cellular DNA; cancer; male and female infertility; lowered melatonin/sleep disruption; cardiac changes including tachycardia, arrhythmia, and sudden cardiac death; diverse neuropsychiatric effects including depression; and therapeutic effects."

The review article "Microwave frequency electromagnetic fields (EMFs) produce widespread neuropsychiatric effects including depression" looks at the literature over the last half-decade, concluding "in summary, then, the mechanism of action of microwave EMFs, the role of the VGCCs in the brain, the impact of non-thermal EMFs on the brain, extensive epidemiological studies performed over the past 50 years, and five criteria testing for causality, all collectively show that various non-thermal microwave EMF exposures produce diverse neuropsychiatric effects."

In short, Dr. Pall's research details in full how EMFs produce VGCC activation which leads, in turn, to large increases in intracellular calcium and is the most probable mechanism of EMFs causing neurological damage. Such large increases in intracellular calcium have a central role in causing both Alzheimer's disease and also other neurodegenerative diseases. "Among what are called 'downstream effects' of excess intracellular calcium include excessive levels of peroxynitrite and peroxynitrite and its breakdown products can increase the activity of matrix metalloproteinases which degrade the proteins making up the tight junctions that are needed for the blood barrier to function."

In "The Biological Effects of Weak Electromagnetic Fields: Problems and Solutions" (2012), Andrew Goldsworthy explains this issue in layperson's terms. This report is a follow-up to his "The Biological Effects of Weak Electromagnetic Fields" from 2007 where he details how "well□replicated studies have shown that weak electromagnetic fields remove calcium ions bound to the membranes of living cells, making them more likely to tear, develop temporary pores and leak."

Efflux of calcium ions was a known effect for decades.

It is important to note that when the Unites States set guidelines in 1996 the authors of the ANSI C95.1-1982 Exposure Limit Standard were aware of "*modulation-specific effects, such as efflux of calcium ions*" but *chose*, in effect, to ignore these results stating they were not linked to health effects.

"In addition, modulation-specific effects, such as efflux of calcium ions from brain materials were not considered adverse because of the inability of the subcommittee's members to relate them to human health. The narrow ranges of power density and the low and narrow range of modulation frequencies associated with field-induced efflux of calcium ions, and the authors' findings that the phenomenon is reversible, are factors that entered into the subcommittee's deliberations." (ANSI Page 13, column 2)

Current science (20 years later) indicates that calcium efflux is critical to understanding cell functioning and the transport of energy in the brain and *does* have a health impact. For example. the U.S. National Institute of Mental Health's research found that "alterations in calcium-channel signaling could represent

a fundamental mechanism contributing to a broad vulnerability to psychopathology" and genetic alterations in calcium-channel signaling could be a crucial factor in the susceptibility to several psychiatric disorders.

Electromagnetic radiation impacts brain health.

In 2016, Dr. Martha Herbert spoke at the Pediatric Academic Societies detailing the mechanisms by which EMF/RFR stresses cells, damages cell membranes, damages mitochondria, and can impact brain health. "Given how much we have already learned about the subtle biological, cellular and electrical impacts of EMF/RFR, we need to update our out-of-date regulations to take into account of how exquisitely vulnerable we now know we are."

A statement that there is "no known biological mechanism" implies as if scientists immediately and in all instances understand the underlying mechanisms through which cancer arises. In the history of science, it often takes decades before a mechanism is understood and "proven." The experimental and human data reviewed by the WHO/IARC were substantial enough to bring them to an almost unanimous decision regarding this classification of cell phone radiation as a possible cause of cancer.

Focusing on the statement that research "does not show it causes cancer" is a tactic long used by industries to dismiss research showing health effects. Cancer is not the only problem. It takes several decades to "prove causation" for any toxic exposure. For example, the tobacco industry has a long history of underwriting research to dismiss the dangers of secondhand smoke. A study published in the *British Medical Journal* by researchers funded by the tobacco industry misrepresented data from the American Cancer Society (ACS), and used flawed methodology. It concluded that secondhand smoke does not "cause" an increased risk for lung cancer and heart disease. The author of that work, Geoffrey Kabat, reinvented himself as an expert on cell phone radiation in his article in *Forbes Magazine*, noting that cell phone radiation has "such low energy levels that there is no known mechanism by which they could induce cancer."

For more information, please see the following resources:

Frank Barnes and Ben Greenebaum

> Barnes, F. & B. Greenebaum. (2016). Some Effects of Weak Magnetic Fields on Biological Systems: RF fields can change radical concentrations and cancer cell growth rates. *IEEE Power Electronics*, 3.1: 60-68.
>
> Barnes F. & Greenebaum B. (2015). The effects of weak magnetic fields on radical pairs. *Bioelectromagnetics*. 36.1:45-54.

Castello P., Hill I., Sivo F., Portelli L., Barnes F., Usselman R. and Martino CF. Inhibition of cellular proliferation and enhancement of hydrogen peroxide production in fibrosarcoma cell line by weak radio frequency magnetic fields. *Bioelectromagnetics.* 35.8:598-602.

2008 US National Research Council Report (Frank Barnes as Chair) The Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices.

Martin Pall PhD

> Letter to Montgomery County Schools On Wi-Fi by Dr. Martin Pall detailing this research.

Pall, M. (2013). Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *Journal of Cellular and Molecular Medicine.* 17.8:958–965. DOI: 10.1111/jcmm.12088

Pall, M. (2014). Electromagnetic field activation of voltage-gated calcium channels: role in therapeutic effects. *Electromagn. Biol. Med.*, 33.4:251

Pall, M. (2015). Review: scientific evidence contradicts findings and assumptions of Canadian safety panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts a non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. *Rev. Environ. Health*, 30:99–116.

Andrew Goldsworthy PhD

The Biological Effects of Weak Electromagnetic Fields: Problems and Solutions, 2012

The Biological Effects of Weak Electromagnetic Fields, 2007

Martha Herbert MD

Herbert, M. (2015). Connections in our Environment: Sizing up Electromagnetic Fields. *Autism Notebook*, 24-25.

Herbert, M.R. and Sage, C. (2013). Autism and EMF? Plausibility of a Pathophysiological Link Part I. *Pathophysiology.* 20.3:191-209.

Herbert, M.R. and Sage, C. (2013). Autism and EMF? Plausibility of a Pathophysiological Link Part II. *Pathophysiology.* 20.3:211-34. Pubmed abstract

Wen Y, Alshikho MJ and Herbert MR. (2016). Pathway Network Analyses for Autism Reveal Multisystem Involvement, Major Overlaps with Other Diseases and Convergence upon MAPK and Calcium Signaling. *PLOS ONE*, 11.4.

MYTH: "If cell phones were *really* causing brain tumors, then we should be seeing an epidemic of brain tumors *and we are not.*"

FACT: Brain cancers are slow-growing and can take decades to develop after toxic exposure. Rates of lung cancer did not increase in the general population until more than three decades after American men had begun to smoke heavily. Glioblastomas (the type of brain cancer linked to cell phone radiation) are in fact increasing in young Americans, in precisely the areas of the brain that absorb most of the microwave radiation emitted or received by phones. But an increase in glioblastomas of the frontal and temporal lobes and cerebellum cannot be expected to show up in the general population, especially not where the incidence of all brain cancers are considered. Instead, research using case-control designs that study small groups of highly exposed persons are appropriate for identifying cancer risks tied with cell phone use. Thus, Swedish physician-researcher Lennart Hardell reports that persons who began using cell phones as teenagers have a four- to five-fold greater risk of brain tumors.

Full description:
Brain cancers are slow-growing and can take four or more decades to develop after a toxic exposure. Studies of smokers find no increase in risk just ten years after most have begun to smoke. Glioblastomas (the type of brain cancer linked to cell phone radiation) are in fact increasing in young Americans, in precisely the areas of the brain that absorb most of the microwave radiation emitted or received by phones. But this increase in glioblastomas of the frontal and temporal lobes and cerebellum cannot be detected when examining the incidence of all types of brain cancers together.

The average latency period between exposure and development of a glioma (a malignant brain tumor) is at least 20 to 30 years (similar to all solid tumors such as lung cancer). The lag between when an exposure takes place and evidence of a disease occurs in a population depends on two factors: (1) how many people were in fact exposed and (2) how extensive their exposure has been. While cell phones have been around since the 1990s, they have only lately become an affordable major component of modern life.

A trivial segment of the population was using cell phones three decades ago, when cell phones were introduced to the U.S. marketplace in 1983. Most Americans did not begin using cell phones routinely until the late 1990s, and patterns of use and billing have changed a great deal recently.

Many brain tumor registries are not complete, making it difficult to detect trends in specific types of brain tumors. In the U.S., the CBTRUS now reports on virtually 100% of the U.S. population but previously less than half the population was captured in statistics. We know now that brain tumors are the leading cancer in American adolescents, and incidence is rising in young adults according to the largest, most comprehensive analysis of these age groups to date. Traditionally, leukemia and lymphoma were the most commonly diagnosed cancers in this group. Incidence is rising quickly in the most aggressive astrocytomas, although it is decreasing a bit in the less aggressive forms of glioma.

In fact, some countries' cancer registries are now showing some increased rates of glioma. The incidence of the worst brain cancer, glioblastoma, has increased in the United States and Denmark (Morgan et al, 2014). An Australian study has shown an overall significant increase in primary malignant brain tumors from 2000 to 2008, particularly since 2004 (Dobes 2011). Another recent study (Zada et al, 2012) shows an increase in brain tumors in three major cancer registries in the United States. The increase seen is in the frontal and temporal lobes, which are the two regions closest to where a cell phone is typically held. The National Cancer Institute reported that glioma incidence in the frontal lobe increased among young adults 20-29 years of age (Inskip et al., 2010). Hardell and Carlberg (2015) recently reported that brain tumor rates have been increasing in Sweden based upon the Swedish National Inpatient Registry data. Dr Moskowitz details this research in his PowerPoint presentation, available here.

As Dr. Moskowitz details in STORYLINE vs. REST-OF-THE-STORY: Brain cancer incidence, cellphone use, and trends data, data from 10 nations show increases in specific subgroups or for specific types of tumors:

- among all adults: Norway, Finland.
- among males: Australia, South Korea, England (in frontal & temporal lobes).
- among females: Shanghai (China).
- among young adults: USA, Japan.

- among adults over age 70: Australia, New Zealand.
- among all adults in temporal lobe: England.
- among all adults for glioblastoma (most serious & common brain cancer): Denmark, Netherlands.

among all adults for glioblastoma in frontal & temporal lobes: USA.

The likelihood of developing a *non-malignant brain tumor* has increased in recent years in the U.S. according to newly-released data from the Centers for Disease Control and Prevention (CDC). The age-adjusted incidence of the most common non-malignant tumor, meningioma, significantly increased among adults from 2004 through 2012. It is notable that several studies have found an increased risk for meningioma among heavy cell phone users: Carlberg and Hardell (2015), Coureau et al. (2014) and Cardis et al. (2011). The age-adjusted incidence of pituitary gland tumors has significantly increased among children, and a prospective study of 790,000 women in the United Kingdom reported that the risk for pituitary gland tumors was *more than twice as high* among women who used a cell phone for less than five years as compared to never users (Benson et al., 2013).

An epidemiological study from Australia, on cell phones and brain cancer (Chapman 2016), made headline news alleging that cell phones do not cause brain cancer. However, several cancer researchers have noted that the Chapman report is inaccurate and "misleading." Read Prof. Dariusz Leszczynski's response to the Chapman study where he poses questions to the Australian study's lead author. Leszczynski concludes that "the conclusion of the Australian study: "*...After nearly 30 years of mobile phone use in Australia among the millions of people, there is no evidence of any rise in any age group that could be plausibly attributed to mobile phones...*" is completely false because it is not supported by the evidence."

Read Dr. Davis, Dr. Miller, and Lloyd Morgan's response in Oxford University Press: Why there can be no increase in all brain cancers tied with cell phone use where they state, "The link between the carcinogenic effects of tobacco and cancer did not come about from studying population trends, *but by special study of high-risk groups using case-control designs of selected cases and comparing their histories with those of persons who were otherwise similar but did not smoke, and cohort studies of groups with identified smoking histories followed for up to 40 years*, as in the American Cancer Society and British Doctors studies. The fact that population-based trends in Australia do not yet show an increase in brain cancer does not mean it will not be detectable in the future—perhaps soon."

MYTH: The International Agency for Research on Cancer 2B Carcinogenic classification labeling cell phones as a possible carcinogen is the same classification as pickled vegetables, talcum powder, and coffee.

FACT: In fact, the IARC removed coffee from this list. The myth comment is an attempt to dismiss the seriousness of this determination and mislead the public. Other hazards that made it to the list of 2B

carcinogens remain the subject of major regulatory attention, including pesticides like DDT and Kepone, industrial materials such as PBBs, carbon black and carbon tetrachloride, jet and diesel fuel, and mercury. The IARC classification is based on weight of evidence, not amount of risk. With any toxic exposure, it takes decades to accumulate enough *weight of evidence, meaning enough scientific research and statistics* (in human epidemiology this refers to sick people) to show the exposure is toxic. Cell phone and other wireless emissions cannot be compared with talcum powder, coffee or pickled vegetables. Would you serve your child coffee in class all day long?

Full Description:

In fact, the IARC removed coffee from this list. This myth comment is an attempt to dismiss the seriousness of this determination and mislead the public. Other hazards that made it to the list of 2B carcinogens remain the subject of major regulatory attention, including pesticides like DDT and Kepone, industrial materials such as PBBs, carbon black and carbon tetrachloride, jet and diesel fuel, and mercury. The IARC classification is based on weight of evidence, not amount of risk. With any toxic exposure, it takes decades to accumulate enough *weight of evidence, meaning enough scientific research and statistics* (in human epidemiology this refers to sick people) to show the exposure is toxic.

Cell phone and other wireless emissions cannot be compared with talcum powder or pickled vegetables. Children are now exposed to cell phones and wireless radiation day and night. Are children doused in a new batch of talcum powder thousands of times per second all day in classrooms? Do children eat heavily salted vegetables day and night? Do children go to sleep eating these vegetables? No. However they do sleep with cell phones transmitting under their pillow. Children do go to school and are absorbing radiofrequency continuously in classrooms. There is simply no comparison.

As an example of how long it takes to show an exposure causes cancer, take the case of talcum powder. The talc in talcum powder for years was heavily contaminated with asbestos, which increases the risk of ovarian cancer. In fact, in 2016 Johnson & Johnson was fined to pay $72 million in damages to the family of a woman whose death from ovarian cancer was linked to her use of the company's body powders. According to the Washington Post, more than 1,200 women from across the country are suing Johnson & Johnson for failing to warn consumers of the dangers associated with talc—the mineral used in baby powder. How do they know it is the talcum powder causing the ovarian cancer? Answer: the talc was found within the tumors themselves—many of those tumors took 40 years to develop.

Diets high in heavily salted vegetables in China are tied with unusual increases in esophageal cancer. Rates of this cancer have fallen when people stopped eating these foods.

Learn more about what the World Health Organization International Agency for Research on Cancer states about the classification of RF radiation as a "Class 2B Possible Carcinogen" at this link.

MYTH: The Class 2B Carcinogen classification by the World Health Organization International Agency for Research on Cancer only applies to cell phone emissions *and not* to emissions from other wireless devices.

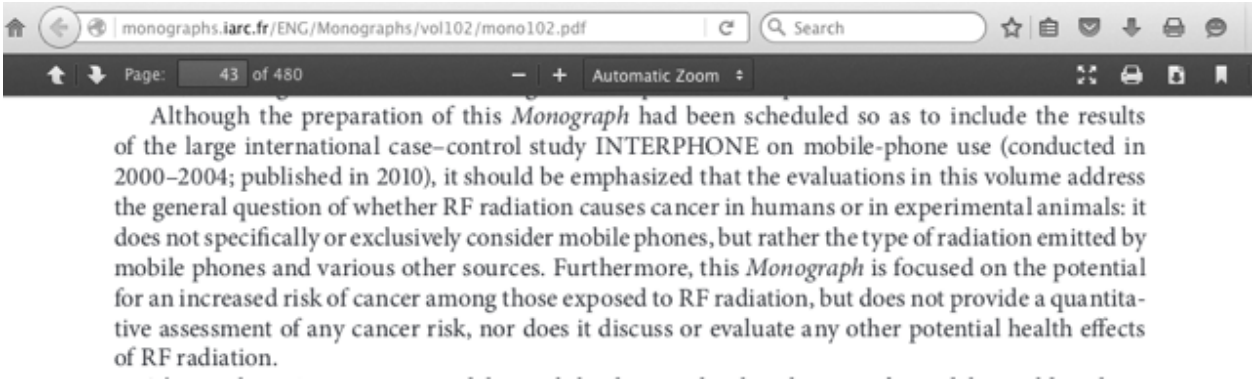
FACT: Wireless radiation from *any device* is included in the Class 2B Carcinogen classification by the World Health Organization International Agency for the Research on Cancer (WHO/IARC). In fact, the WHO/IARC has repeatedly documented that radiofrequency radiation "from any source," be it cell phones, baby monitors, cell towers or Wi-Fi routers, is the "potentially toxic agent." The WHO/IARC Monograph on RF-EMF clearly states that the Class 2B carcinogen classification applies to RF-EMF in the range of 30 KHz to 300 GHz. Senior officials with the IARC, such as Dr. Robert Bann and Dr. Kurt Straif, have clarified this fact repeatedly in lectures and letters since the 2011 classification.

Full Description:

Wireless radiation from *any device* is included in the Class 2B Carcinogen classification by the World Health Organization International Agency for Research on Cancer (WHO/IARC). In fact, the WHO/IARC has repeatedly documented that radiofrequency radiation "from any source," be it cell phones, baby monitors, cell towers of Wi-Fi routers, is the "potentially toxic agent." The WHO/IARC Monograph on RF-EMF clearly states that the Class 2B carcinogen classification applies to RF-EMF in the range of 30 KHz to 300 GHz. Senior officials with the IARC, such as Dr. Robert Bann and Dr. Kurt Straif, have clarified this fact repeatedly in lectures and letters since the 2011 classification.

Research studies on the long-term use of cell phones by people is the only long-term *human* research on radiofrequency exposure we have.

Cell phone research is very important to understanding the health effects of all wireless communications from all sources. Long-term research on cell phone users greatly informs our understanding of the long-term effects from low-level radiofrequency radiation. The radiation from cell phones and WiFi may be a slightly different frequency, but according to the IARC it is effectively "the same agent" as it is the same type of radiation, known as radiofrequency radiation (RF-EMF). If 900 MHz is showing harm, then other frequencies in the RF range—like WiFi at 2.45 GHz (2,450 MHz)—will also harm the body. In fact, higher frequencies could possibly be even more damaging.



Page 43 of the IARC Monograph 102 details why the carcinogenic classification is for RF emissions from 30 kHz to 300 GHz regardless of source.

It is important to note that some iPads have SARs at the same level as cell phones. This means that the body nearest the iPad will absorb similar levels of radiation as when the brain absorbs cell phone radiation. The difference is that if the iPad is on the lap, the radiation will penetrate into reproductive areas and there is no skull to protect the tissues. Radiation emissions from a device on the lap will still be absorbed in the brain, but higher levels will go into the abdominal region and chest.

The World Health Organization/IARC specifically and repeatedly has stated the carcinogenic classification is for radiofrequency radiation from any source, including WiFi. Note this documentation:

- The Lancet WHO/IARC published statement: Wireless radiofrequency radiation is classified as a "Possible Human Carcinogen" by the International Agency for Research on Cancer (IARC) of the World Health Organization(WHO) Read The Lancet's published statement by the IARC from 2011 on cancer risk of wireless radiation.
- WHO/IARC Press Release: The Class 2B classification includes wireless radiation from any transmitting source such as "cell phones, baby monitors, tablets, cell towers, radar, other wifi, etc". It applies to RF-EMF in the range of 30 KHz to 300 GHz emitted from any device. These statements are detailed in The Lancet article and in the related WHO IARC press release in 2011. All wireless emissions from electronic devices are RF-EMF (wireless radiation). It does not matter what type of device is the source.
- The 2013 WHO/IARC Monograph: Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields, which states, "Human exposure to RF radiation can occur from many different sources and under a wide variety of circumstances, including the use of personal devices (mobile phones, cordless phones, Wi-Fi, Bluetooth, amateur radios, etc.), occupational sources (high-frequency dielectric and induction heaters, broadcast antennas, high-power pulsed radars, and medical applications), and environmental sources (mobile-phone base stations, broadcast antennae). These multiple sources contribute to an individual's total exposure, with contributions varying by different characteristics, e.g. place of residence."

Experts of the World Health Organization International Agency for Research on Cancer have stated (on several occasions) how the WHO/IARC experts specifically intended this classification to apply to the full range of radio frequency radiation which includes WiFi as well as cell tower radiation.

- 2011 Symposium on Radiofrequency at Swineburne University of Technology: At minute 37:40, Bann explains that the IARC classification was not for just mobile telephones. He states "So it should be noted here that the working group—in the overall evaluation—decided to make a general, generic evaluation of radiofrequency fields and did not want to limit it to mobile telephone use (hat all other exposures were left out of the evaluation) that was mainly based on the diversity of the exposures in the animal cancer studies where different types of radiation with different frequencies across the radiofrequency part of the electromagnetic spectrum were noted and, in fact, the consideration that the radiation from environmental sources and in the occupational situations and from the mobile telephones is basically and physically speaking the same type of agent. So the overall conclusion was RF EMF are possibly carcinogenic to humans group 2B." Watch all the videos from that Symposium here.

- 2011 Letter to Dr. Hudson where Bann states:

"It should be noted that the working group in the overall evaluation decided to make a generic evaluation of radio frequency fields and did not want to limit it to mobile telephone use and all other exposures .. that was based on the diversity of the exposures in the animal cancer studies where different types of radiation with different frequencies across the radio frequency part of the EMF spectrum were noted and the radiation from the environmental sources (i.e Wi-Fi, Cell Towers etc) and from the mobile telephones is basically and physically speaking the same type of agent ."

In 2016, the World Health Organization's Head of the IARC Monographs Programme, Dr. Kurt Straif, wrote the following:

"IARC's evaluation of the cancer hazards from exposure to Radiofrequency Electromagnetic Fields covers all sources of RF-radiation." and "IARC classified radiofrequency electromagnetic fields (including Wi-Fi signals and mobile phone signals) as possibly carcinogenic to humans (Group 2B) " Read the Email exchange here.

MYTH: "This will never be as serious as tobacco."

FACT: This is potentially far worse than tobacco. We never had 100% of people smoking, but we do have nearly *all people* using cell phones and wireless devices today—and non-users are also exposed to the emissions. Six billion people, including children, use cell phones regularly—some exclusively, as landlines are abandoned—resulting in considerable exposure. Several scientists have compared cigarette smoking to cell phone and wireless radiation. Dr. Franz Adlkofer gave a lecture at the Harvard Law Center for Ethics Lecture in 2011 and specifically paralleled cell phone emissions to cigarette smoke. Furthermore, it is curious how some tobacco industry scientists have moved on and are now defending the wireless industry.

Full Description:

This is potentially far worse than tobacco. We never had 100% of people smoking, but we do have nearly *all people* using cell phones and wireless devices today. Six billion people, including children, use cell phones regularly—some exclusively, as landlines are abandoned—resulting in considerable exposure.

Dr. Franz Adlkofer spoke at the Harvard Law Center for Ethics Lecture in 2011 and specifically paralleled cell phone emissions to cigarette smoke. He presented on how he was unjustly accused of scientific fraud for his REFLEX study findings that cell phone radiation damages DNA. Listen to him describe the results of his research here in 2010.

We do not have the same scientific foundation for understanding cell phone radiation as we had for tobacco and lung cancer for two reasons: 1. The telecom industry has intentionally blocked studies, and 2.

It is more difficult for researchers to get funding now because of the economic downturn and the lack of training and funding in this field.

"It is these hardball tactics that recall 20th century Big Tobacco tactics." states the Harvard Law publication *Captured Agency: How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates*, which details how the wireless industry has unchecked influence on our government due to financial contributions and the revolving door of politics and industry. Read Harvard Book here.

Several scientists well connected to the tobacco industry are now involved in the wireless issue.

Geoffrey Kabat authored a 2003 industry funded (much criticized) study, published in the British Medical Journal, which concluded that secondhand smoke does not cause an increased risk for lung cancer and heart disease. Read a 2005 article where Kabat's research is cited in a paper on how "documents also reveal that the (tobacco) industry funds research to enhance its credibility and endeavours to work with respected scientists to advance its goals."

***Forbes Magazine* articles by Kabat on cell phones:** Kabat has now reinvented himself as an expert on cell phone radiation, writing multiple articles in *Forbes Magazine*, noting that cell phone radiation has "such low energy levels that there is no known mechanism by which they could induce cancer." Note the headlines of his recent *Forbes Magazine* articles:

- 3/10/2013: Do Cell Phones Cause Brain Cancer? The Conspiracy Theorists Say Yes
- 3/5/2013: Do Cell Phones Cause Brain Cancer? The Diehards Cling Desperately To Opinion
- 3/20/2013: Cell Phone Conspiracy Theorists Prefer To Indulge In Ad Hominem Attacks Rather Than Debate The Science
- 4/2013: Should The FCC Re-Examine Cell Phone Radiation?
- 9/4/2013: Yet Another Large Study Discredits The Alleged Link Between Cellphones And Brain Cancer
- 6/2014: The New York Times Revisits The "Debate" Over Electromagnetic Fields, Reviving Baseless Fears, While Ignoring What Has Been Learned
- 3/28/2016: The New Rat Study Of Cell Phone Radiation Is No Smoking Gun

Kabat lectures that movement for safe technology is "cuckoo": "Geoffrey Kabat, former tobacco scientist calls the movement for safe technology and RF precaution in schools 'cuckoo' and puts BPA and endocrine disruptors" in the same category as cell phone emissions. He states, "Just because these compounds can be detected in minute quantities, by ultra-sensitive methods, in the blood of most Americans, this does not mean that they are having some effect on health." Read an article about his lecture at McGill in 2015 Watch his lecture here. (Note: The lecture series is funded by multimillionaire McGill donor Lorne Trottier, President of the computer company Matrox, who makes iPad-specific products and is known to support online websites such as EMF and Health criticising concerned EMF scientists.)

Peter Valberg has been an expert called in by Philip Morris RJ Reynolds and he was Principal and Senior Health Scientist at Gradient Corporation. "Gradient," according to the Texas Tribune, "typically conducts research funded by industry groups like the American Petroleum Institute. One Harvard University epidemiologist calls its work for Texas "bullshit" science that contradicts conclusions by the

vast majority of experts." The Tribune goes on to detail "'This is a company that basically works for industry, and their job is to trash environmental studies,' said Joel Schwartz, a professor of environmental epidemiology at Harvard and director of the University's Center for Risk Analysis."

Valberg is now an "expert" supporting the "Smart Grid," to provide "evidence" that wireless emitting smart utility meters and infrastructure are not proven harmful. He gave a one-hour webinar to the Eugene Water and Energy Board and Oregon citizens and is considered an expert by several utility companies on the subject, submitting several expert testimonies (see News Report on his work the Edison Electric Institute).

MYTH: "The Interphone study showed no link between cell phones and brain tumors."

FACT: In the Interphone study, those who used a mobile phone for 10 or more years were found to be twice as likely to develop a brain tumor, a statistically significant finding. The heaviest users with the longest use had increased risk. While it is true that the final conclusion of the Interphone study states, "*Overall, no increase in risk of glioma or meningioma was observed*." yet, in the *heaviest users* in the Interphone study, a doubled or greater risk is evident. Lead authors of the study later published an article in the journal *Occupational and Environmental Medicine* calling for precautions to reduce exposures to the brain in light of the Interphone study's findings.

Full Description:

In the Interphone study, those who used a mobile phone for 10 or more years were found to be twice as likely to develop a brain tumor, a statistically significant finding. The heaviest users with *the longest use* had increased risk. It is true that the final conclusion of the Interphone study states, "*Overall, no increase in risk of glioma or meningioma was observed.*" The key word is "overall." The overall absence of risk is due to the fact that the average user in this study used a phone for less than eight years, and that a user was defined as someone who made one call per week for six months. Because overall exposures were so low and limited, it is not surprising that the finding states there is no overall increase in risk.

But in the *heaviest users* in the Interphone study, a doubled or greater risk is evident. This is why the IARC review considered the Interphone study as evidence of increased risk. In fact, lead authors of the study later published an article in the journal Occupational and Environmental Medicine on January 27 calling for precautions in light of the Study's findings:

> *"While more studies are needed to conrm or refute these results, indications of an increased risk [of brain cancer] in high- and long-term users from Interphone and other studies are of concern," Cardis and Sadetzki conclude. "There are now more than 4 billion people, including children, using mobile phones. Even a small risk at the individual level could eventually result in a considerable number of tumours and become an important public-health issue. Simple and low-cost measures, such as the use of text*

> *messages, hands-free kits and/or the loudspeaker mode of the phone could substantially reduce exposure to the brain from mobile phones. Therefore, until denitive scientic answers are available, the adoption of such precautions, particularly among young people, is advisable."*(Cardis and Sadetzki 2011)

MYTH: "The Danish Cohort is proof there is no risk."

FACT: The Danish Cohort Study used flawed data to arrive at a flawed conclusion. The Danish Cohort Study published in the *British Medical Journal* is often quoted as proof of safety as it did not find any causal link between brain cancer and cell phone radiation. However, many scientists (including scientists of the World Health Organization's International Agency for the Research on Cancer) have critiqued the Danish Study for using flawed data resulting in an equally flawed analysis. The problem? Corporate subscribers (in other words: likeliest the heaviest cell phone users) were placed in the control group as they were excluded from the exposed group. When Michael Kundi and colleagues from the Medical University of Vienna mathematically corrected for this concern in the earlier Danish study, they found a significantly increased risk for brain tumors.

Full Description:

The Danish Cohort Study published in the *British Medical Journal* is often quoted as proof of safety as it did not find any causal link between brain cancer and cell phone radiation. However, many scientists (including scientists of the World Health Organization's International Agency for the Research on Cancer) have critiqued the Danish Study for using flawed data resulting in an equally flawed analysis. The problem? Heavy cell phone users were placed in the control group.

The Danish project eliminated more than 200,000 corporate subscribers (that was one-third of the actual number of Danish cell phone users), who were the intended study population and, admittedly, the heaviest cell users. In other words, *heaviest users were analyzed as if they did not use cell phones and ended up in the control group*. The study authors state, "Because we excluded corporate subscriptions, mobile phone users who do not have a subscription in their own name will have been misclassified as unexposed…"

> "This study only looks at 7% of the Danish population who had a personal cellphone subscription for at least one year during the period 1987 to 1995. It ignores corporate subscribers (the heaviest users then) and the researchers have no data at all on cellphone use since 1995 so the extra 86% of the population who started to use a cellphone since 1996 were left in the "non subscriber part of the population. This study uses seriously flawed data to make a flawed analysis and should be condemned as misleading spin." — Alasdair Philips

This bias explains why the 2011 IARC panel put less weight on the Danish study than on the Interphone and Hardell efforts. As corporate subscribers were left out of the exposed group, the International Agency for the Research on Cancer's Robert Bann wrote that the exclusion of the corporate subscribers "seems remarkable" and "could have resulted in considerable misclassification in exposure assessment." When

Michael Kundi and colleagues from the Medical University of Vienna mathematically corrected for this concern in the earlier Danish study, they found a significantly increased risk for brain tumors.

Read what George Carlo has to say about the Danish Cohort study in a published article The Latest Reassurance Ruse About Cell Phones and Cancer. The epidemiologist George Carlo was hired by the U.S. wireless industry to research health risks in the 1990s and ran a $28 million research project.

"Back in the 1990s, two of the authors of the 2006 Danish study, John Boice and Joe McLaughlin, applied to the WTR program for funding to do the same epidemiology study that was released this week. When they made the proposal on behalf of their company, the International Epidemiology Institute, both were employees of the National Cancer Institute. That affiliation was an important part of how they presented their credentials. After consideration of their proposal, we denied them funding because we were not convinced they would provide meaningful findings. We also were not comfortable with the study design that was presented to us. The investigators put too much emphasis on the probability that the study would not find risk increases.

Because the program was funded by the industry, they might have thought the low-risk pitch was what we wanted to hear. When we refused to give them funding to do the work, Boice and McLaughlin went directly to the industry with the same pitch – and they were hired. The Danish study released this week is one of many studies from this group of investigators – all concluding with similar findings of no tumor risk from cell phones. In 2001, they released what they then lauded as one of the largest studies to date.

…the Danish study was epidemiologically constructed to produce a finding of reassurance that may well not have been supported even by a more professionally conceived study designed to really assess risk. The study has been trumpeted far beyond any reasonable reading of the data as proof that cell phones are safe. "

Read the Scientist Opinion Piece (2/25/13): "Scientific Peer Review in Crisis" by Prof. Dariusz Leszczynski at Finland's Radiation and Nuclear Safety Authority, where he details these flaws and calls for a retraction. Additionally, as Leszczynski points out, although the authors of the study declared no conflicts of interest, the original cohort was established with funding from Danish Telecom.

Published science and articles on the flawed Danish Cohort Study

Environmental Health Trust and Other Experts Expose Major Flaws in New Danish Study Claiming No Significant Cancer Risks from Cell Phone Use

The Scientist: "Scientific Peer Review in Crisis" by Prof. Dariusz Leszczynski

Microwave News:The Danish Cohort Study: The Politics and Economics of Bias

Medscape Medical News:Cell Phones and Brain Tumors: No Link, But Is Study Flawed?

C NET Do cell phones cause brain tumors? Danish Study Debate rages

British Medical Journal

Use of mobile phones and risk of brain tumours: update of Danish cohort study Re: Not enough data excluding cellphones' morbidity, *British Medical Journal* November 2011 by Devra L Davis

Ronald B. Herberman and Yael Stein

2012: Review of four publications on the Danish cohort study on mobile phone subscribers and risk of brain tumors. *Rev Environ Health*

2011: The Danish Cellphone Subscriber Study on the Risk of Cancer Among Subscribers Is Fundamentally Flawed, Lloyd Morgan's Commentary in the *British Medical Journal*

2011: Use of mobile phones and risk of brain tumours: update of Danish cohort study, *British Medical Journal*

2007: Re: Cellular Telephone Use and Cancer Risk: Update of a Nationwide Danish Cohort Study, *British Medical Journal*

2006: Cellular Telephone Use and Cancer Risk: Update of a Nationwide Danish Cohort, *British Medical Journal*

MYTH: "The scientific consensus is that cell phones and wireless cannot harm us"

FACT: That is false. There is no scientific consensus that cell phones, wireless and electromagnetic fields are safe, and no medical organization assures us of safety. The opinion of independent scientists is strikingly different than that of industry funded sources who often use the phrase "scientific consensus." The fact is that numerous medical and scientific organizations are calling for urgent action to reduce wireless exposures and protect public health. They have been warning the public for decades.

Full Description:

That is false. There is no scientific consensus that cell phones, wireless and electromagnetic fields are safe, and no medical organization assures us of safety. The opinion of independent scientists is strikingly different than that of industry funded sources who often use the phrase "scientific consensus." The fact is that numerous medical and scientific organizations are calling for urgent action to reduce wireless exposures and protect public health (and have been urging for decades).

The EMF Scientist Appeal

In 2015, over 200 scientists appealed to the United Nations, calling for tighter regulations on wireless radiation and stating, "numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans." These scientists have collectively published over 2,000 peer-reviewed papers on the biological or health effects of non-ionizing radiation and are independent from industry funding conflicts of interest. Read the EMF Scientists Appeal Read the Press Release.

Linda S. Birnbaum, Director of the National Institute of Environmental Health Sciences and National Toxicology Program (USA) stated, "*If some of the studies turn out to be harbingers of things to come, we*

may have major health consequences from the nearly ubiquitous presence of wireless equipment." (Quote from the The Israeli Environmental Health Report 2014, page 90)

Dr. Chris Portier, recently retired CDC Director, Center for Environmental Health and the Agency for Toxic Substances and Disease, officially argued for invoking the precautionary principle at the Bioelectromagnetics Society Conference in June 2015. In that conference he, along with cancer researchers, presented a poster on cellphones and brain cancer risk that refers to new research showing associations between cell phones and brain cancer evidence and states, "IARC should consider convening a Working Group to re-evaluate the classification of RFR. Educational and public health institutions should be encouraged to reduce exposures, especially of young children, to RF devices. Finally, there is a strong need for additional independent research on the effects of RFR on humans, animals and cells." He stated, "*a careful review of the scientific literature demonstrates there are potentially dangerous effects from RF.*"

There is no scientific consensus.

The EMF Scientists Appeal

- In May 2015, a group of over 200 scientists from 39 nations who have authored more than 2,000 articles on this topic appealed to the United Nations to address "the emerging public health crisis" related to cell phones and other wireless devices. These scientists state that "the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, and are " insufficient to protect public health."
- They state that "the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF." See the International EMF Scientist Appeal at https://emfscientist.org.

The French National Agency of Health Security of Food, Environment and Labour

- 2016 "Radiofrequency Exposure and the Health of Children" Report recommends reducing exposures to young children and strengthening regulations to ensure "sufficiently large safety margins" to adequately protect the health of young children.
- 2013 French Agency for Food, Environmental and Occupational Health & Safety Report recommends hands free phones, SAR labeling, and "limiting the population's exposure to radiofrequencies… especially for children and intensive users, and controlling the overall exposure that results from relay antennas."

Canadian Parliament Standing Committee on Health of the House of Commons "Radio Frequency Electromagnetic Radiation and the Health of Canadians"

- This June 2015 Canadian Parliment Report has 12 recommendations including "That the Government of Canada develop an awareness campaign relating to the safe use of wireless technologies, such as cell phones and Wi-Fi, in key environments such as the school and home to ensure that Canadian families and children are reducing risks related to radiofrequency exposure."

The Council of Europe Resolution 1815:

- In 2011 The Parliamentary Assembly of the Council of Europe issued The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment. A call to European governments to

"take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours."

"For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises." Read Resolution 1815

The Vienna Medical Association

The Vienna Medical Association has issued Guidelines on Reducing RF radiation. Vienna Medical Association Guidelines include : "Make calls at home and at work via the fixed corded (not wireless) network – Internet access via LAN cable (eg via ADSL, VDSL, fiber optic) no Radiation, is fast and secure data transfer. Constant radiation emitters like DECT cordless telephones, WLAN access points, data sticks and LTE Home base stations (Box, Cube etc.) should be avoided!"

The World Health Organization's International Agency for Research on Cancer

- The WHO/IARC classified all radiofrequency electromagnetic fields as "possibly carcinogenic to humans". Read the IARC Monograph. The Lancet article indicates how this applies to all radio frequency electromagnetic fields including Wi-Fi.

Swiss Physicians for the Environment

"the risk of cancer for this type of [wireless] radiation is similar to that of the insecticide DDT, rightfully banned… From the medical point of view, it is urgent to apply the precautionary principle for mobile telephony, WiFi, power lines, etc." Read the Swiss Physicians Letter here.

The American Academy of Environmental Medicine

"Adverse health effects, such as learning disabilities, altered immune responses, headaches, etc. from wireless radio frequency fields do exist and are well documented in the scientific literature. Safer technology, such as using hard-wiring, must be seriously considered in schools for the safety of those susceptible individuals who may be affected by this phenomenon. " Read the The American Academy of Environmental Medicine's Open Letter to the Superintendents of the School Districts of the United States

International Society of Doctors for the Environment and Irish Doctors Environmental Association

- These Societies have made the following recommendations: Avoid Wi-Fi in home or work if possible, particularly in schools or hospitals and Use wired technology whenever possible.
- "Because of the potentially increased risks for the foetus, infants and young children due to their thinner more permeable skulls and developing systems, particularly the immune and neurological systems, based on the precautionary principle and on the mounting evidence for harm at the sub-cellular level, we recommend that EMR exposure should be kept to a minimum."
- Read the Statement Here.

Bioinitiative Working Group

In a Letter to Education Super Highway CEOs the Co-Editors of the Bioinitiative Report Cindy Sage and David Carpenter sent a letter on behalf of the Bioinitiative Working Group to the CEO's on the health risks of wireless infrastructure in US schools stating:

"WiFi in schools, in contrast to wired internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Corporations cannot avoid responsibility simply by asserting compliance with existing legal, but outdated and inadequate FCC public safety limits. Today, corporations that deal with educational technology should be looking forward and helping school administrators and municipal leaders to access safe, wired solutions." Read the Letter to Education Super Highway CEOs, Click here to go to the Bioinitiative 2012 Report.

The BabySafe Project Joint Statement

- As of August 2016 over 200 physicians, scientists and public health professionals from around the world have signed onto this Project "to express their concern about the risk that wireless radiation poses to pregnancy and to urge pregnant women to limit their exposures."
- "We call on our elected leaders to support such research and to advance policies and regulations that limit exposures for pregnant women. We call on industry to implement and explore technologies and designs that will reduce radiation exposures until such research is carried out."
- The BabySafe Project Lists "Ten Ways to Reduce Your Wireless Exposure" which includes "Whenever possible, connect to the internet with wired cables". See the Project Website at http://www.babysafeproject.org/

Appeals of Scientists Calling for Tighter Regulation on Electromagnetic Fields

Vienna Resolution 1998

Salzburg Resolution 2000

Stewart Report, UK 2000

Declaration of Alcalá 2002

Catania Resolution 2002

Freiburger Appeal 2002

Bamberger Appeal 2004

Maintaler Appeal 2004

International Association of

Fire Fighters Resolution on Cell Towers 2004

Coburger Appeal 2005

Oberammergauer Appeal 2005

Haibacher Appeal 2005

Pfarrkirchener Appeal 2005

Freienbacher Appeal 2005

Lichtenfelser Appeal 2005

Hofer Appeal 2005

Helsinki Appeal 2005

Parish Kirchner Appeal 2005

Saarlander Appeal 2005

Stockacher Appeal 2005

Vancouver School Resolution 2005

Benevento Resolution 2006

Allgäuer Appeal 2006

WiMax Appeal 2006

Schlüchterner appeal

Brussels Appeal 2007

Venice Resolution 2008

Porto Alegre Resolution 2009

European Parliament

EMF Resolution 2009

Dutch Appeal 2009

Int'l Appeal of Würzburg 2010

Copenhagen Resolution 2010

Seletun Consensus Statement 2010

Russian National Committee on

Non-Ionizing Radiation Protection 2011

Potenza Picena Resolution 2011

World Health Organization 2011

Austrian Medical Association 2012

Resolution on Electromagnetic Health 2012

British Doctor Initiative 2013

BabySafe Project: Joint Statement on Pregnancy and Wireless Radiation 2014

Canadian Doctors Declaration to Health Canada 2014

Scientific Declaration to Health Canada (International Doctors) 2014

International Scientists Appeal to U.N. to Protect Humans and Wildlife from Electromagnetic Fields and Wireless Technology 2015 Over 220 Scientists

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MYTH: "Studies showing effects have not been replicated."
FACT: Research has been replicated in several areas and has repeatedly shown increased brain cancer/tumor risk after over 10 years of cell phone use, increased blood-brain barrier permeability, and the ability of RF to promote cancer and act as a co-carcinogen. All independent research studies looking at long-term cell phone users found increased brain cancer after 10 years and "heavy use" or at about 1625 lifetime hours. Read Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (review) for details.
In the 2016 released findings of the National Toxicology Program (NTP) study of the Carcinogenicity of Radiofrequency Radiation, male rats exposed to wireless radiation develop more unusual, highly malignant brain tumors—gliomas—as well as very rare tumors of the nerves around and within the heart—Schwannomas. The tumors found in the NTP rats parallel the same types of tumors found in human epidemiological studies looking at long-term use of cell phones. The NTP stated, "These findings appear to support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR." Read more about the National Toxicology Program Study here.

Full Description:

Research has been replicated in several areas and has repeatedly shown increased brain cancer/tumor risk after over 10 years of cell phone use, increased blood-brain barrier permeability, and the ability of RF to promote cancer and act as a co-carcinogen.

Long-term studies repeatedly show increased brain cancer risk.

All independent research studies looking at long-term cell phone users found increased brain cancer after 10 years and "heavy use" or about 1625 lifetime hours. "Heavy" was defined as about 30 minutes per day. The WHO/IARC would not base a cancer classification Class 2B risk on just one researcher's study. Read Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A) (review) for details.

$25 Million US Government Study found increased cancers in rats, paralleling cancers found increased in long-term cell phone users.

In the 2016 released findings of the National Toxicology Program (NTP) study of the Carcinogenicity of Radiofrequency Radiation, male rats exposed to wireless radiation develop more unusual, highly malignant brain tumors—gliomas—as well as very rare tumors of the nerves around and within the heart—Schwannomas. The tumors found in the NTP rats parallel the same types of tumors found in human epidemiological studies looking at long-term use of cell phones. The NTP stated, "These findings appear to support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR." Read more about the National Toxicology Program Study here.

Experimental studies show electromagnetic fields act as a cancer promoter.

In the 2015 replication study Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans, published in Biochemical and Biophysical Research Communications, Lerchl et al. describe how the new study replicated an earlier experiment that found that weak cell phone signals can promote the growth of tumors in mice. The abstract states:

"Numbers of tumors of the lungs and livers in exposed animals were significantly higher than in sham-exposed controls. In addition, lymphomas were also found to be significantly elevated by exposure. A clear dose–response effect is absent. We hypothesize that these tumor-promoting effects may be caused by metabolic changes due to exposure. Since many of the tumor-promoting effects in our study were seen at low to moderate exposure levels (0.04 and 0.4 W/kg SAR), thus well below exposure limits for the users of mobile phones, further studies are warranted to investigate the underlying mechanisms. Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones."

Please read more about this replicated research at Microwave News Report. Read the press release here from the University and note it was curiously removed from the University website.

In 2013, the WHO/IARC specifically notes the following co-carcinogenic research studies in their evaluation of radiofrequency as a Class 2B carcinogen:

"Four of six co-carcinogenesis studies showed increased cancer incidence after exposure to RF-EMF in combination with a known carcinogen; however, the predictive value of this type of study for human cancer is unknown." – Page 2 of the Lancet WHO/IARC Press Release on Radiofrequency Fields. Tables showing the research in co-carcinogenicity are found on page 279 of the April 2013 Published IARC Monograph on Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields.

Power-frequency magnetic fields have been repeatedly found to act as a cancer promoter.

> "The new study indicates that ELF EMFs can promote breast cancer…the leukemia findings contribute new pieces of the puzzle supporting the IARC decision of 2001 that ELF EMFs is a possible carcinogen." —Dr. Meike Mevissen Director, Veterinary Pharmacology & Toxicology, University of Bern in Switzerland

This study confirms previous research showing that rats developed higher than expected rates of certain cancers after being exposed to a known carcinogen plus a magnetic field for their lifetime. The researchers conclude, "These results call for a reevaluation of the safety of non-ionizing radiation."

In this study, rats that received a single low-dose of gamma radiation early in life and were exposed to magnetic fields for their entire lifetime developed higher than expected rates of three different types of cancer: breast cancer, leukemia/lymphoma, and an extremely rare and obscure tumor called malignant schwannoma of the heart. Microwave News quotes Morando Soffritti, the director of the research project as stating, "We have confirmed the old epidemiological observations of Milham, Wertheimer and Matanoski regarding the increased risk of lymphoma/leukemia and mammary cancers, as well as the more recent study by Cardis," referring to the pioneering work of Sam Milham, Nancy Wertheimer, and Geneveive Matanoski from 1979 through the 1990s. Please read Microwave News Report on this study for full details.

Research has repeatedly shown radiofrequency radiation impacts blood-brain barrier permeability.

In 2015, the well respected journal Brain Research published a study by Chinese scientists entitled Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. In this study, Gang Zhu and collaborating scientists confirmed the findings of Leif Salford and colleagues showing that exposure of rats to cell phone radiation causes leakage of the blood-brain barrier (BBB). Tang et al. also pointed out that activation of stress response pathway is involved in the effects, concluding, "Taken together, these results demonstrated that exposure to 900 MHz EMF radiation for 28 days can significantly impair spatial memory and damage BBB permeability in rat by activating the mkp-1/ERK pathway."

Read more about these confirmed findings at Dariusz Leszczynski's post Cell Phones and Blood-Brain Barrier: Chinese scientists confirm findings of Swedish Salford group, where he notes, "My research group at STUK also suggested in a study published in 2002 that blood-brain barrier function of human endothelial cells might be impaired due to activation of p38MAP kinase/Hsp27 stress response pathway."

Repeated research shows that radiofrequency radiation impacts the reproductive system.

Epidemiological studies in vitro (cells) laboratory and in vivo (animal) show that RF exposure at non-thermal levels and from using cell phones in common ways is associated with reduced sperm count, motility, and concentration, DNA damage, and altered cell structure. As the British Columbia Center for Disease Control states in its 2013 report A Radiofrequency Toolkit for Environmental Health Practitioners, "The epidemiological studies of men assessed for infertility were consistent in demonstrating decreased sperm motility associated with increased use of mobile phones" and "biological effects on sperm motility related to RF exposure." Several recent reviews document this body of research: Effect of mobile telephones on sperm quality: A systematic review and meta-analysis, Challenging cell phone impact on reproduction: A Review, Effects of the exposure to mobile phones on male reproduction: a review of the literature, Effect of electromagnetic field exposure on the reproductive system. Please read more research on our webpage here.

Industry funded replication studies seem to show that studies cannot be replicated.

However, a deeper investigation shows that what are often referred to as "replication studies" are not actually true replication studies. Allen Frey describes how his early research showing increased blood-brain barrier permeability was supposedly replicated by a Brooks Air Force Base group showing "no effect" but "after much pressure from the scientific community, the Brooks Air Force Base contracting group finally revealed that they had not, in fact, replicated the work." Please read Frey's published commentary "Security concerns during the Cold War may have led to the generation of misinformation on the physiological effects of microwave radiation from mobile," which also speaks to the way microwave research funding was defunded. There are literally thousands of studies showing harm that are "not replicated because there is no funding to even do the replication research studies needed."

Frey concludes, "This suppression of research has now made hundreds of millions of people subjects in a grand experiment that may involve their health, without their informed consent, and the outcome of which can have substantial medical, legal, and economic consequences."

MYTH: "The government safety standards have a safety margin of fifty-fold."

FACT: There is no "fifty-fold safety" margin. The wireless industry repeatedly states that the current guidelines have a fifty-fold safety factor built in to protect the public. This statement is wrong and rests solely on avoiding heating effects rather than considering newer studies finding impacts on reproduction, development, and cancer. The standard refers solely to antiquated evidence based on an animal study of what temperature in the rectum of trained and food-deprived rats causes them to stop seeking a food reward.

Full Description:

Details on the rat study: The level of exposure that produced the cessation of trying to eat was assumed to be 4 Watts/kgm. But in fact, according to another study known to the ANSI authors in 1982, at 1 Watt/kgm food-deprived rats would stop trying to seek a food reward at exposures of 1 W/kgm. The so-called fifty-fold safety factor of .08 W/kgm was based on dividing 4 Watts by 50. If the 1 W/kgm level is used, then the safety factor of .08 W/kgm becomes 2.5.

To have a fifty-fold factor based solely on avoiding heat, the standard would have to be .02 W/kgm.

The Environmental Health Trust has detailed the inaccuracy of the often referenced "fifty-fold safety factor" in their Submission to the FCC.

Note these examples of the complexity of safety factors:

Research shows that stem cells are more impacted by microwave radiation. Stem cells are more active in children. Scientists assume that *the same* amount of radiation will impact children *more* (as experts state worldwide). How does this research translate into quantified impacts on children at various radiation levels? *Answer:* We do not know because that research came out a decade *after* our radiation thresholds were set. Researchers did not have access to this research study nor any other research showing children's increased vulnerability to determine a "safe level."

Research has *repeatedly now shown* that children are more exposed to this radiation because of their smaller stature and thinner skulls. The radiation penetrates deeper into their brain and critical brain centers responsible for memory and thinking. None of this has been factored into the "safety margin."

Children's eyes are not fully developed until age 10. Eye insult at a young age can lead to impacts later in life, such as macular degeneration. Research also shows that the eyes of all humans, *in general*, are more vulnerable to microwave radiation because, unlike other parts of the body, they do not have a mechanism to cool. Research that quantified exposures to the eyes and determined a safety level was available and not taken into account when the standards were set in 1996, as detailed by the EPA's Robert Hankin in a 2002 Letter which states, "the current exposure guidelines used by the FCC are based on the effects resulting from whole body heat, not exposure of and effect on critical organs including the brain and eyes." However, in schools throughout the country, young children are placing transmitting cell phones up to their eyes as part of Google's Virtual Reality School Project and this is not breaking any regulations.

Remember, the EPA did not do research to determine a safe level. The EPA had started this process and was defunded. Instead, guidelines were adapted from "expert" groups involving military and industry groups. Public health researchers, toxicologists, and medical doctors did not determine a safe level of exposure. Such a medically informed process *was never done* in the U.S.

In other words, when it comes to the U.S. "safety" standards: 1. At most there is a 2.5 safety factor built in for thermal effects, 2. The U.S. has not determined a safety limit when it comes to non-thermal effects, and 3. The U.S. has no scientific data to determine how much lower *we should drop that limit* to protect developing children who are far more vulnerable.

When you hear the statement, "federal standards already ensure wireless consumer safety, incorporating a fifty-fold safety factor designed to provide for safe exposure levels for all segments of the population" all you need to do is ask, "Where is the documentation showing such protection?" If you are in the U.S., the FCC will direct you to this document from 1986: *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*. We suggest you read it yourself and decide for yourself if this three decades-old document shows how the special vulnerabilities of children and pregnant women and "all segments of the population" are protected. It states, "the population at large, some members of which could be exposed continuously to RFEM fields, contains subpopulations of debilitated or otherwise potentially vulnerable individuals for whom there is presently inadequate knowledge to set firm standards. For example, the sensitivity of aged individuals, of pregnant females and their conception, of young infants, or of chronically ill persons is not known."

There is no scientific documentation showing that the recommended limits are actually protective of these populations.

Additional Information:

The CTIA highlights the fifty-fold safety factor in it's letter on the Berkeley Ordinance in 2015.

Environmental Health Trust Submission to the FCC 2013.

2014: U.S. Department of the Interior Letter (2014) on FCC Guidelines

2003: Interagency Radio Frequency Workgroup 2003 Letter from EPA Norbert Hankin on Additional Concerns about RF Exposure Guidelines

1999: Radio Frequency Interagency Workgroup Concerns About RF Exposure Gregory Lotz NIOSH Letter

1995: EPA Letter to the FCC on Development of Guidelines by the EPA.

1984: US Science Advisory Board Letter that recommends that the EPA develop radiation protection guidance to protect the public (Note: the standards were never issued.)

1983: EPA: Biological Effects Of RadioFrequency Radiation

1981: EPA: Index of Publications on Biological Effects of Electromagnetic Radiation

8. List of US Government Reports on Cell Phone and Wireless Radiation

1978: The Report on Radiation Health & Safety of the Senate Committee on Commerce, Science, and Transportation

Published on December 1978 ad prepared at the request of Howard W. Cannon, chairman, Committee on Commerce, Science, and Transportation. This report made the following recommendations: The National Bureau of Standards (NBS) should intensify its efforts to provide the physical measurement standards, calibration services, and standardized measurement techniques necessary for research and regulatory activities relating to non-ionizing radiation. Full Text of Report

1979 FCC Notice of Inquiry on the "responsibility of the FCC to consider biological effects of radiofrequency radiation when authorizing the use of radiofrequency devices".

This report details "the considerable differences of opinion about the biological effects of low level and long-term radiation". "A balance must be achieved between serving the public interest by fulfilling it's needs for communications services and adequately protecting the populace against potentially adverse biological effects that may be attributable to excessive RF radiation." The FCC calls for information and data on several matters related to this issue including:
"Does a health risk no matter how small, outweigh economic loss or service cutbacks, no matter how large? By how much? Quantify your contention. Does a health risk to animals have to be considered? What if the species being threatened is on the endangered species list?"
1979 FCC Notice of Inquiry

1979: United States Congressional Hearing "Research on health effects of nonionizing radiation"
House Committee on Science and Technology. Subcommittee on Natural Resources and Environment. Hearing dated July 12, 1979.

"There is only one established mechanism which can explain most of the effects of non-ionizing radiation and that mechanism is gross heating resulting from exposure to high levels of NIR(nonionizing radiation)." and "There is an increasing number of research reports which describe biological effects and exposure levels that are not commensurate with the induction of gross heating. One may cite a large number of Soviet and East European reports as examples. These results suggest that non-ionizing radiation may cause biological effects without producing significant increases in temperature in sensitive tissue. The possibility of such interactions is being pursued by US researchers." (page 195).
Read the Transcript Part 1, Part 2, Part 3.

1979: United State Congress Hearing: Microwave irradiation of the U.S. Embassy in Moscow: review of its history and studies to determine whether or not related health defects were experienced by employees assigned in the period, 1953-1977.

To see transcript please go to this link. Each page is saved separately so to see next page you simply change the end number "-0001" to "-0002" etc. all the way up to "-0032."

1981: EPA Report:Index of Publications on Biological Effects of Electromagnetic Radiation.

This publication produced by the EPA Health Effects Research Laboratory compiles literature on the Bioeffects of EMFs 0-100 GHz. **Read the Index of Publications on Biological Effects of Electromagnetic Radiation.**

1981: United States Congressional Hearing by House Committee on Science and Technology. Subcommittee on Investigations and Oversight.

Potential health effects of video display terminals and radio frequency heaters and sealers, May 12, 13, 1981. Hathai Trust Digital Library link Transcript of Hearing
As a result of this hearing, the June 1981 Report "Requirements for an Effective National Nonionizing Radiation Measurement System" was prepared which provides a detailed assessment of the capabilities, limitations, and requirements of the National Non-ionizing Radiation measurement system. The report concludes that "the need to develop and improve instrumentation, measurement standards, calibration services and standardize measurement techniques far outweighs the need to establish regional calibration laboratories at this time."

1983 The EPA publishes Biological Effects Of RadioFrequency Radiation.

"The objective of this report was to summarize and evaluate the existing database for use in developing RF radiation exposure guidance for the general public. The frequency range covered in this document is .5 MHz to 100 GHz. The existing database provides sufficient evidence about the relation between RF radiation exposure and biological effects to commit development of exposure limits to protect the health of the general public. It has been concluded from this review that biological effects occur at SAR up to about 1 W/kg some of them may be significant under certain environmental conditions." Read the Biological Effects Of RadioFrequency Radiation. EPA Document online, PDF, Read the 1983 Project summary of the EPA Bioeffects research here.

1984: US Science Advisory Board (SAB) Recommendation to the EPA To Develop RF Guidelines:

In this letter, the SAB Board recommends that the EPA develop radiation protection guidance to protect the public. The report contains a 1983 letter from FCC Chairman Mark Fowler to the EPA Administrator Kathleen Bennett which states, "We believe that a definitive federal standard is imperative. Therefore we would like to make clear our support for your guidance development. We encourage the EPA to complete this process as expeditiously as possible so that her uniform federal standard will be available for use by the FCC and other affected agencies."
Page 14 has a list of "Significant events in EPA RF Radiation Guidance Program"
Page 30 lists Biological Effects and has the EPA Proposed Guidance level at .04 W/kg
Read the **US Science Advisory Board (SAB) Recommendation to the EPA To Develop RF Guidelines:**

1985 EPA Report Biological influences of low-frequency sinusoidal electromagnetic signals alone and superimposed on RF carrier waves by Carl Blackman, F. Research Triangle Park, N.C., Health Effects Research Laboratory, U.S. Environmental Protection Agency,

Biological influences of low-frequency sinusoidal electromagnetic signals alone and superimposed on RF carrier waves

1986: EPA Report: The Radiofrequency Radiation Environment: Environmental Exposure Levels and RF Radiation Emitting Sources by Hankin, Norbert N., Office of Radiation Programs, Office of Air and Radiation, U.S. Environmental Protection Agency, July 1986.

"This document summarizes the radio frequency radiation environment, discusses the sources and levels of radiofrequency radiation to which the public is exposed, and provides information pertinent to the development of radiofrequency radiation exposure guidelines."

The Radiofrequency Radiation Environment: Environmental Exposure Levels and RF Radiation Emitting Sources

1989: Biological Effects of Power Frequency Electric and Magnetic Fields Background Paper: US Congress Office of Technology Assessment of Electric Power Wheeling and Dealing: Technological Considerations for Increasing Competition

"In the long run, better scientific understanding is the only way to resolve problems posed by power frequency fields. Yet funding for field-effects research has been irregular over the years and current levels of federal support are modest." "There is a risk of becoming too fixed on cancer as a single health effect of concern. The breadth of cellular and animal findings suggest that other public health effects, including psychological effects such as chronic depression, deserve some attention." 1989: Biological Effects of Power Frequency Electric and Magnetic Fields Background Paper:

1990 EPA ***Evaluation of the Potential Carcinogenicity of Electromagnetic Fields (Draft Report)***

When this report *was first drafted,* the team recommended that power-frequency EMFs should be classified as "probable human carcinogens" and that RF/MW radiation be considered a "possible human carcinogen." However, this review remains a "Draft only" as it was never finalized. The Report was prepared to review and evaluate the available literature on the potential carcinogenicity of electromagnetic fields. With respect to human epidemiologic studies, the EPA found of the strongest link between exposure to 60 HZ magnetic field and human cancer. Consistent modest elevations of cancer risk for leukemia, cancer of the central nervous system and lymphoma were found in children whose exposure to magnetic fields was estimated at two MG or higher. These studies estimate a potential 1.5 to 3 increase in cancer risk from elevated magnetic field exposure as defined by wiring codes.
Read more

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After the initial draft was prepared, the conclusions were leaked and Microwave News shared them internationally (Read 1996 MWN Report). Then, the *Report was updated* - to state that it would be "inappropriate" to compare EMFs to chemical carcinogens.

The conclusion now reads, "In conclusion, several studies showing leukemia, lymphoma, and cancer of the nervous system in children

exposed to magnetic fields from residential 60-Hz electrical power distribution systems, supported by similar findings in adults in several occupational studies also involving electrical power frequency exposures, show a consistent pattern of response that suggests a causal link." The summary *also* states that "a characterization regarding the link between cancer and exposure to EM fields is not appropriate because the basic nature of the interaction between EM fields and biological processes leading to cancer is not understood" and then states more studies are needed. "Because of these uncertainties, it would be inappropriate to classify the carcinogenicity of EM fields in the same way as the agency does for chemical carcinogens...With our current understanding we can identify 60 Hz magnetic fields from power lines and perhaps other sources in the home as a possible, but not proven, cause of cancer In people. The absence of key information summarized above makes it difficult to make quantitative estimates of risk. Such quantitative estimates are necessary before judgments about the degree of safety or hazard of a given exposure can be made."

According to Microwave News, these statements are part of the "update" after the initial draft was leaked.

The EPA now has this final "Draft" posted online. The EPA summary in the front of the posted document has sentences highlighted by bold text which states, "While there are epidemiological studies that indicate an association between EM fields or their surrogates and certain types of cancer, other epidemiological studies do not substantiate this association." and "There are insufficient data to determine whether or not a cause and effect relationship exists."

A 1990 letter attached to the EPA posted draft states, "Given the controversial and uncertain nature of the scientific findings of this report and other reviews of this subject, this review draft should not be construed as representing Agency policy or position."
The EPA Science Advisory Board (SAB) reviewed this draft document in a series of public meetings in 1991 and 1992 and was subsequently reviewed by federal agencies in 1995 and 1996 and was never finalized.
The updated "Draft Report" is available online.

1993 EPA Comments to the Federal Communication Commission's (FCC's) proposed RF/MW radiation limits 93-142 Guidelines For Evaluating the Non Thermal Effects of Radiofrequency Radiation:

The EPA states that certain subgroups are more at risk (pregnant women, children and the elderly) and calls for an updated, comprehensive review that considers the biological effects of RF, specifically pointing to the need to update the NCRP Report 86 (Note: NCRP 86 is still the basis for US regulations according to the FCC and has *not* been updated to include biological effects).

"The FCC should not adopt the 1992 ANSI IEEE standard there are serious flaws in the standard that call into question whether the proposed use the 1992 ANSI IEEE is sufficiently protective." The report also states that "the claim of protection for all persons from all interactive mechanisms" has "not been supported". Read the letter and comments here.

EPA Comments to the Federal Communication Commission's (FCC's) proposed RF/MW radiation limits 93-142 Guidelines For Evaluating the Non Thermal Effects of Radiofrequency Radiation:

1994 (U.S.) Air Force Material Command, Rome Laboratory Report: Radiofrequency / Microwave Radiation Biological Effects and Safety Standards: A Review

"It was recognized that the SAR does not encompass all of the important factors necessary to determine safe exposure levels. The modulation frequency and peak power of the incident EM field should also be considered. Some of the investigators warned that extra care should be taken by persons that are subjected to pulsed EM fields or by fields that are modulated near the whole-body resonance frequency.""Nonresonant pulsed RF/MW radiation may be more harmful to living organisms than CW radiation emitted at nonresonant frequencies." "Even exposure to low levels of RF/MW radiation can impair immunologic functions." (U.S.) Air Force Material Command, Rome Laboratory Radiofrequency / Microwave Radiation Biological Effects and Safety Standards: A Review

1995: Extremely Low Frequency Electric and Magnetic Fields by the National Council on Radiation Protection and Measurements (NCRP) *Draft Report*

NCRP was contracted by the EPA in 1983 to conduct a review of the biological effects of Extremely Low Frequency (ELF) EMFs. According to Microwave News , the 800 page draft report was prepared which generally endorsed a 2 mG exposure limit. Committee chair Dr. Ross Adey, of the Veterans Administration Hospital in Loma Linda, CA, told Microwave News, "It took us nine years but we finally reached agreement," The recommendations "would take effect immediately for new day care centers, schools and playgrounds, as well as for new transmission lines near existing housing."

In July 1995 the NCRP committee Chairman, Ross Adey, stated,"The laboratory evidence for athermal effects of both ELF and RF/MW fields now constitutes a major body of scientific literature in peer-reviewed journals. It is my personal view that to continue to ignore this work in the course of standard setting is irresponsible to the point of being a public scandal." However on October 11, 1995 NCRP put out a press release that "Draft material formulated by NCRP Scientific Committee 89-3 on ELF EMF has been improperly disseminated and does not reflect NCRP recommendation." The final report was supposed to be approved and to be publicly available in early 1996, but final approval of the draft has never been acted upon.

Reference to the NCRP Committee in Letter to US Regulatory Commission

Conclusions/ Recommendations of NCRP, Microwave News July August 1995, pgs 12-15,

1995 EPA Briefing To the FCC and NTIA on EPA "Development of RF/MW Radiation Guidelines"

In this powerpoint presentation, the EPA briefs the FCC and NTIA about their progress in developing human exposure guidelines- that consider thermal AND nonthermal effects for microwave radiation. The EPA was in a two phase process. First they were setting "interim RF radiation guidelines" which "did not account for modulation, chronic exposure or non thermal effects." Then they were going to focus on "modulated and nonthermal exposures" in Phase 2 by convening national experts. A year later, the EPA was defunded from RF work and standards were never set. EPA Briefing To the FCC and NTIA on EPA "Development of RF/MW Radiation Guidelines"

1995 EPA Letter to the FCC on Near Completion of EMF Guidelines: The EPA updated the FCC on their progress in developing safety standards to cover thermal and non-thermal effects.

1996 EPA Research De-Funded by Appropriations Bill S. Rept. 104-140 - DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS BILL

This Bill significantly defunded the EPA Radiation Division that was engaged in research and developing safety standards to protect the public from thermal and non-thermal biological effects. The Senate Appropriations Committee Bill states," ...EPA has pursued a number of unintegrated activities on EMF that are of questionable value. Therefore, the Committee believes EPA should not engage in EMF activities."
S. Rept. 104-140 - DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS BILL

1996 Guidelines for Human Exposure to Radiofrequency Radiation Adopted by the Federal Communications Commission (FCC) Limits

IEEE/ANSI C95.1 1992 were the basis of the FCC regulated exposure limits with some minor points coming from the NCRP Report 86 (1986 Report). Read the FCC Report and Order Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation ET Docket No. 93-62

1998 National Institutes of Environmental Health Sciences (NIEHS) Categorizes EMFs as "Possible" Human Carcinogens.

Power frequency electromagnetic fields (EMFs) are categorized as "possible human carcinogens," according to a working group assembled by the National Institute of Environmental Health Sciences (NIEHS). After ten days of review, on June 24, the 30-member panel voted 19 to 9 in favor of categorizing extremely low frequency (ELF) EMFs, such as those from power lines and electrical appliances, as possible carcinogens. Read Microwave News Report. Read the NIEHS Press Release. Read the NIEHS Report Assessment of Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields.

1999: Federal Radio -Frequency Interagency Workgroup (RFIW) Letter to Richard Tell Chair, IEEE SCC28 (SC4) Risk Assessment Work Group from the Radiofrequency Radiation Interagency Work Group on Critical Concerns About RF guidelines.

In this letter, members of the RFIW identity several critical issues with the RF exposure guidelines. Their concerns include the need for a biological basis for SAR limit and they point out that the limits for brain and bone marrow should be lower than those from muscles and fat as tissues are not equally sensitive. They question the selection criteria for the adverse effect and state there is extensive data on acute effects but that the lower-level non-thermal chronic exposure effects may be very different and chronic effects need to be accounted for. They state the uncertainties in the data should be addressed. "These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public." Read the **1999 Federal Radio -Frequency Interagency Workgroup (RFIW) Letter to Richard Tell**

2001 GAO Report: Research and Regulatory Efforts on Mobile Phone Health Issues

"For its part, FCC makes information on radiofrequency exposure issues publicly available, but this information is typically at a level of technical detail that is not well-suited to a general audience. These shortcomings in consumer information are a particular cause for concern because the industry is including information from both FDA and FCC with most new mobile phones. This report makes recommendations to FCC for improving its review of mobile phone testing and to FCC and FDA for improving consumer information on radiofrequency exposure and health issues….Given the prominence of the mobile phone health issue, FDA and FCC need to provide the public with clear, accurate, and timely information so that they can make informed decisions." Read the May 2001 GAO Report here.

2001: Scientist George Carlo Publishes Expose on Wireless Industry

George Carlo is the scientist who lead a 7 year, 28.5 million dollar research project called the Wireless Technology Research (WTR) funded by the US wireless industry. When research findings found biological effects such as genetic damage in human blood as measured through the formation of micronuclei, he alleges the information was suppressed and the wireless industry tried to discredit him. He shared his story in a book co-authored with Martin Schram called Cell Phones: Invisible Hazards In the Wireless Age. In addition the volume Wireless Phones and Health II: State of the Science 2002 nd Edition assembles papers presented at WTR's Second State of the Science Colloquium and is the result of the 28.5 million dollars research program. "The current science is not definitive about health risks from wireless phones; however, the legitimate questions about safety that have arisen from recent studies make claims of absolute safety no longer supportable". Watch the C-Span Interview with Dr. Carlo.

2002 Letter from the EPA about the Inadequacy of the FCC guidelines sent to Janet Newton.

"The generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified."Norbert Hankin, lead scientist of the EPA Center for Science and Risk Assessment Radiation Protection Division, states that the current FCC human exposure limits, "are thermally based, and do not apply to chronic, nonthermal exposure situations" and that an understanding of the impact on sensitive populations such as children, pregnant women and the elderly still needs to be done. Read the EPA July 6, 2002 Letter on RF Exposure Limits.

2003: The Interagency Radio Frequency Workgroup's Letter to CK Chou on Additional Concerns about US RF Exposure Guidelines.

EPA's Norbert Hankin penned the federal RFIWG's second letter on concerns about RF human exposure guidelines with three additional issues.; the sensitivity of different tissues to temperature; that a relaxation of standards will allow for higher exposures; and that the pinna- or ear- is being considered an extremity and will be allowed far higher RF limits without considerations of different body sizes. To our knowledge neither the 2003 or 1999 letter were ever responded to. Read the 2003 Interagency Radio Frequency Workgroup's Letter to CK Chou on RF Exposures.

January 2008: National Research Council Report "The Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices"

This Report reviewed the research needs and gaps and called for the critical need to increase our understanding of any potential adverse effects of long term chronic exposure to RF/microwave energy on children and pregnant woman. "The Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices"

September 2008 Congressional Hearing: Health Effects of Cell Phone Use

Testimony was presented by David Carpenter, Director State University of New York, Albany, Institute of Health and Environment, Ronald B. Herberman M.D. Director of the University of Pittsburgh Cancer Institute, Robert Hoover, Director of the National Cancer Institute, Epidemiology and Genetics Research Program and Julius P. Knapp II Chief of the Federal Communications Commission, Office of Engineering and Technology, Ellie Marks, Brain Tumor Association of California. Please watch the C-Span Video of this Congressional hearing here.

January 2009, The President's Cancer Panel Presented on Cell Phone Radiation

This meeting was the last in the President's Cancer Panel's 2008/2009 series, Environmental Factors in Cancer and was focused on radiation exposures as they relate to cancer risk. Presenters included Dr. Martha Linet, Chief of the Radiation Epidemiology Branch of the National Cancer Institute, and Dr. David Carpenter, Director of the Institute for Health and the Environment as well as Professor of Environmental Health Sciences

within the School of Public Health at the University at Albany. “The evidence for a direct relationship between power line frequency EMFs and cancer is very strong. The lack of a specific mechanism is not a good reason to ignore this evidence.” “The United States needs to take a stand in issuing warnings about the use of cell phones, especially by children. Other countries have taken a precautionary approach with this issue and are basing their warnings on the same science available in the U.S.” PRESIDENT’S CANCER PANEL MEETING SUMMARY, ENVIRONMENTAL FACTORS IN CANCER. Dr Carpenter’s testimony to the President’s panel was published in Reviews in Environmental Health 2009.

September 2009 US Senate Hearings on Health Effects of Cell Phone Wireless Radiation.

Testimony was given by John Bucher, Associate Director of the National Institute of Environmental Health Sciences, National Toxicology Program, Devra L. Davis Director of the University of Pittsburgh Cancer Institute, Center for Environmental Oncology, Linda Erdreich Senior Scientist with Exponent Engineering and Scientific Consulting, Dariusz Leszczynski Research Professor STUK Radiation and Nuclear Safety Authority, Olga Naidenko Senior Scientist Environmental Working Group, Siegal Sadetzki Director Chaim Sheba Medical Center Cancer and Radiation Epidemiology. Video US Senate Hearings on Health Effects of Cell Phone Wireless Radiation at the C-SPAN link**.**

2012 Government Accountability Office (GAO) Report: “Exposure and Testing Requirements for Mobile Phones Should Be Reassessed.”

This Report calls on the FCC to “formally reassess and, if appropriate, change its current RF energy (microwave) exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body,” because without such a reassessment, the “FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure.” GAO 2012 Report: Exposure and Testing Requirements for Mobile Phones Should Be Reassessed

2012: FCC opens Official Inquiry Into Human Exposure Guidelines:

In response to the GAO Report, the FCC opened a proceeding to explore whether it should modify its radiofrequency exposure standards stating, “we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children.” Over 900 submissions have been made to the FCC. To date no actions have been taken by the FCC or any other Federal agency on this docket. Dr. Moskowitz catalogued Submissions in 2013 on his SAFER EMR website but substantial new submissions have been made. To access all current submissions go to the FCC's web site for Proceeding Number 13-84. Read the FCC Notice of Inquiry ET Docket No. 13-84 and No. 03-137

2014: U.S. Department of the Interior Letter to the National Telecommunications and Information Administration Stating FCC Guidelines are Outdated.

Willie R. Taylor, Director, of the Department of Interior Office of Environmental Policy and Compliance writes that “a significant issue associated with communication towers

involves impacts from non-ionizing electromagnetic radiation emitted by these structures" and details science that found "strong negative correlations between levels of tower-emitted microwave radiation and bird breeding, nesting, and roosting in the vicinity of electromagnetic fields including nest and site abandonment, plumage deterioration, locomotion problems, reduced survivorship, and death in House Sparrows, White Storks, Rock Doves, Magpies, Collared Doves, and other species". The letter states that FCC RF exposure limits are out of date and irrelevant statin, "However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today". Read the 2014 U.S. Department of the Interior Letter

2016: USA National Institutes of Environmental Health Sciences (NIEHS) National Toxicology Program (NTP) issued a Report on Partial Findings of the Studies on Radiofrequency Radiation.

These studies which took took over 15 years and 25 million dollars are the only US government funded studies on chronic exposure to wireless radiation. They exposed rats and mice to long term low level wireless frequencies. In 2016, the NTP findings were released which found adverse effects after long term exposure to cell phone radiation:

- Increased incidences of glioma (a rare, aggressive and highly malignant brain cancer) as well as schwannoma (a rare tumor of the nerve sheath) of the heart were found in both sexes of rats, but reached statistical significance only in males.
- Increased incidences of rare, proliferative changes in glial cells of the brain and in Schwann cells (nerve sheath) in the heart of both sexes of rats, while not a single unexposed control animal developed these precancerous changes.
- DNA damage (comet assay) was induced with both modulations of radiofrequency radiation (RFR) in both rats and mice (mixed results in tissues and brain regions).
- The cancers found in the rats are the same types of cancers found to be increased in human long term users of cell phones and therefore the NTP researchers state that these findings support evidence for the WHO IARC carcinogen classification of radiofrequency.

Results from this study clearly show that biological impacts occur at non-thermal exposures like those that take place from cell phones today. Data analyses in mice are ongoing. The complete results from these rodent studies will be available in NTP Technical Reports by the end of 2017.

NTP Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats
NTP Press Release: NTP Cell Phone Radiofrequency Radiation Study: Partial Release of Findings
New NTP/NIEHS Webpage on Cell Phones
Video of Presentation by NTP at NIEHS June 2016 on the Study Findings
Powerpoint Slides by Dr. Birnbaum, Director of the National Toxicology Program
Full Data for Partial Study Findings

Audio Recording of Media Telebriefing May 27, 2016

9. Millimeter and Submillimeter Frequencies Have Bio Effects And Their Interaction With Human Skin Poses A Health Risk to the Public.

MILLIMETER AND SUBMILLIMETER WAVES ARE BIOLOGICALLY ACTIVE

Current investigations of wireless frequencies in the millimeter and submillimeter range confirm that these waves interact directly with human skin, specifically the sweat glands. Dr. Ben-Ishai of the Department of Physics, Hebrew University, Israel recently detailed how human sweat ducts act like an array of helical antennas when exposed to these wavelengths.

MECHANISM OF ACTION IS PROVEN

Research *already* indicates serious adverse effects from the wireless modalities in use today. Research studies from the Dielectric Spectroscopy Laboratory of the Department of Applied Physics, Hebrew University of Jerusalem, headed by Dr. Yuri Feldman, indicate that 5Gs millimeter and submillimeter waves will uniquely interact with human skin and lead to preferential layer absorption. The number of sweat ducts within human skin varies from two million to four million. Replicated peer research of these biological effects in laboratory research has been conducted internationally and scientists consider this mechanism of action well proven (See documentation further down on this webpage).

5G FREQUENCIES ARE USED IN WEAPONS

For years, the U.S., Russian and Chinese defense agencies have been developing weapons that rely on the capability of this electromagnetic frequency range to induce unpleasant burning sensations on the skin as a form of crowd control. Millimeter waves are utilized by the U.S. Army in crowd dispersal guns called Active Denial Systems. Dr. Paul Ben-Ishai pointed to research that was commissioned by the U.S. Army to find out why people ran away when the beam touched them. "If you are unlucky enough to be standing there when it hits you, you will feel like your body is on fire." The U.S. Department of Defense explains how "The sensation dissipates when the target moves out of the beam. The sensation is intense enough to cause a nearly instantaneous reflex action of the target to flee the beam."

HUMAN SKIN WILL BE CLASSIFIED AS AN EXTREMITY ALLOWING HIGHER EXPOSURES

Our skin is our largest organ. Dariusz Leszczynski, PhD, Chief Editor of Radiation and Health has stated that the international organization – called ICNIRP –who is developing recommendations for public exposure limits of these higher frequencies is planning to classify all the skin in the human body as belonging to the limbs rather than to the head or torso. Leszczynski cautioned that, "If you classify skin as limbs – no matter where the skin is – you are permitted to expose it more than otherwise."

5G DEPLOYMENT WITHOUT HEALTH EFFECT EVALUATION

5G is being developed and implemented without adequate evaluation of the effect of this technology on human health after long term exposure to these frequencies. Peer reviewed research studies have found adverse effects from the electromagnetic frequencies *currently in use* and *that will be in use* for this new technology.

"There is an urgent need to evaluate 5G health effects now before millions are exposed. We need to know if 5G increases the risk of skin diseases such as melanoma or other skin cancers," stated Ron Melnick, the National Institutes of Health scientist, now retired, who led the design of the National Toxicology Program study on cell phone radiofrequency radiation.

In Dr. Cindy Russell's A 5G Wireless Future: Will it give us a smart nation or contribute to an unhealthy one (Text PDF) , published in the the Santa Clara Medical Association, Russell states that "3G, 4G, 5G or a combination of zapping frequencies giving us immersive connection and entertainment but at a potentially steep price." Russell details the scientific documentation on 5G's frequencies which include arrhythmias, heart rate variability, bacterial affects, antibiotic resistance, immune system affects, chromatin affects, teratogenic effects, altered gene expression and cataracts.

Dr. Cindy Russell lists specific recommendations shared by Environmental Health Trust and scientists worldwide.

RECOMMENDATIONS TO PROTECT PUBLIC HEALTH

1. Do not proceed to roll out 5G technologies pending pre-market studies on health effects.

2. Reevaluate safety standards based on long term as well as short term studies on biological effects.

3. Rescind a portion of Section 704 of the Telecommunications Act of 1996 which preempts state and local government regulation for the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects so that health and environmental issues can be addressed.

4. Rescind portions of The Spectrum Act which was passed in 2012 as part of the Middle Class Tax Relief and Job Creation Act, which strips the ability city officials and local governments to regulate cellular communications equipment, provides no public notification or opportunity for public input and may potentially result in environmental impacts.

5. Create an independent multidisciplinary scientific agency tasked with developing appropriate safety regulations, premarket testing and research needs in a transparent environment with public input.

6. Label pertinent EMF information on devices along with appropriate precautionary warnings.

RESOURCES

Potential Risks to Human Health Originating from Future Sub-MM Communication Systems
Expert Forum Lecture at the Israel Institute for Advanced Study at Hebrew University Medical School, January 24, 2017
Watch a lecture on submillimeter and millimeter frequencies by Paul Ben-Ishai, PhD of the Department of Physics, Ariel University, Israel, *Full Bio* and Yuri Feldman, PhD, Head of the

Dielectric Spectroscopy Laboratory, Department of Applied Physics, Hebrew University of Jerusalem, *Full Bio*. Click here for a PDF of Abstract for this Presentation

RECENT MILLIMETER WAVE BIOEFFECT STUDIES

Scientific Citations from Potential Risks to Human Health Originating from Future Sub-MM Communication Systems by Paul Ben-Ishai, PhD and Yuri Feldman, PhD
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Professor Yuri Feldman - Research Study Summaries, The Hebrew University of Jerusalem Department of Applied Physics, Dielectric Spectroscopy Laboratory

RESEARCH ON MILLIMETER WAVES
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REFERENCES ON DEFENSE USE OF MILLIMETER WAVES

US Department of Defense Non-Lethal Weapons Program FAQS
http://jnlwp.defense.gov/About/Frequently-Asked-Questions/Active-Denial-System-FAQs/

A Narrative Summary and Independent Assessment of the Active Denial System The Human Effects Advisory Panel
http://jnlwp.defense.gov/Portals/50/Documents/Future_Non-Lethal_Weapons/HEAP.pdf

SUBMISSIONS TO THE FCC ON SPECTRUM FRONTIERS

On July 14, 2016, the FCC voted to approve Spectrum Frontiers, making the U.S. the first country in the world to open up higher-frequency millimeter wave spectrum for the development of 5G fifth-generation wireless cellular technology. The FCC was flooded with comments in opposition to 5G. Read full details at the EHT website on Spectrum Frontiers

The Berkshire-Litchfield Environmental Council Comments to Thomas Wheeler, Chairman, Federal Communications Commission
"Federally-protected wildlife species are in danger", Briefing Memorandum from Dr. Albert Manville
July 20, 2016 - Dr. Joel Moskowitz Comment to the FCC, "FCC Open Letter Calls for Moratorium on New Commercial Applications of Radiofrequency Radiation"
Dr. Yael Steins Comments to the FCC in Opposition to 5G Spectrum Frontiers Millimeter Wave Technology
Dr. Ronald M. Powell Ph.D. Comment to the FCC
Dr. Devra Davis to FCC, "Long Term Health and Safety Evaluation Needed Before Introduction of 5G"
Comments to FCC by Electrical Pollution, "Parents Write to the FCC: Be on the Right Side of History"
Submission to FCC by Susan Clark, "Stop 5G harm to all living beings: The Science is Conclusive"
Maryland Smartmeter Awareness Comment to the FCC, "FCC Proposed Move to 5G"
Comments by Dafna Tachover and "We are the Evidence" to FCC, "Those Injured by Wireless ask Congress: Please Protect us and help protect the public's health. Say STOP to the FCC and wheeler in 5G vote"
Angela Tsiang to US Senate Committee on Commerce, Science, and Transportation

Children; Letter to Montgomery County Schools,
Prof. Martha Herbert MD. PhD.; 2015

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December 12, 2015

Montgomery County Schools
Carver Educational Services Center
850 Hungerford Drive
Rockville, MD 20850

cc Montgomery County City Council

Dear Montgomery County School District,

I am a pediatric neurologist and neuroscientist on the faculty of Harvard Medical School and on staff at the Massachusetts General Hospital. I am Board Certified in Neurology with Special Competency in Child Neurology, and Subspecialty Certification in Neurodevelopmental Disorders.

I have an extensive history of research and clinical practice in neurodevelopmental disorders, particularly autism spectrum disorders. I have published papers in brain imaging research, in physiological abnormalities in autism spectrum disorders, and in environmental influences on neurodevelopmental disorders such as autism and on brain development and function.

A few years ago I accepted an invitation to review literature pertinent to a potential link between Autism Spectrum Disorders and Electromagnetic Frequencies (EMF) and Radiofrequency Radiation(RFR). I set out to write a paper of modest length, but found much more literature than I had anticipated to review. I ended up producing a 60 page single spaced paper with over 550 citations. It is available at http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf and it was published in a revised and somewhat shortened form in two parts in the peer reviewed indexed journal *Pathophysiology (2013)*with the title: Áutism and EMF? Plausibility of a pathophysiological link." Please also see the appendix to this letter which contains a summary of this material and includes substantial scientific citations.

More recently I published an article entitled "Connections in Our Environment: Sizing up Electromagnetic Fields," in *Autism Notebook Spring 2015* edition in which I summarized and personalized the information in the . In this article I describe how here is a whole series of problems at the cellular, sub-cellular and metabolic levels and immune levels that have been identified in autism. And interestingly, for every single one of those problems, there's literature about how EMFs can create those kinds of problems.

The argument I made in these articles is not that EMF is proven to cause autism, but rather, that EMF can certainly contribute to degrading the physiological integrity of the system at the cellular and molecular level" – and this in turn appears to contribute to the pathogenesis/causation not only of autism but of many highly common chronic illnesses, including cancer, obesity, diabetes and heart disease.. Please see this article on page 24-25 at the link http://virtualpublications.soloprinting.com/publication/?i=252361

In fact, there are thousands of papers that have accumulated over decades –and are now accumulating at an accelerating pace, as our ability to measure impacts become more sensitive – that document adverse health and neurological impacts of EMF/RFR. Children are more vulnerable than adults, and children with chronic illnesses and/or neurodevelopmental disabilities are even more vulnerable. Elderly or chronically ill adults are more vulnerable than healthy adults.

Current technologies were designed and promulgated without taking account of biological impacts other than thermal impacts. We now know that there are a large array of impacts that have nothing to do with the heating of tissue. The claim from wifi proponents that the only concern is thermal impacts is now definitively outdated scientifically.

Radiofrequency electromagnetic radiation from wifi and cell towers can exert a disorganizing effect on the ability to learn and remember, and can also be destabilizing to immune and metabolic function. This will make it harder for some children to learn, particularly those who are already having learning or medical problems in the first place. And since half of the children in this country have some kind of chronic illness, this means that a lot of people are more vulnerable than you might expect to these issues.

Powerful industrial entities have a vested interest in leading the public to believe that EMF/RFR, which we cannot see, taste or touch, is harmless, but this is not true. Please do the right and precautionary thing for our children.

I urge you to opt for wired technologies in Montgomery County classrooms, particularly for those subpopulations that are most sensitive. It will be easier for you to make a healthier decision now than to undo misguided decisions later.

Thank you.

Martha Herbert, PhD, MD

Selected pertinent publications

Connections in our Environment: Sizing up Electromagnetic Fields by M.R. Herbert (published in Autism Notebook Spring 2015, pp.. 24-25) reviews in two pages key points of the more technical Herbert & Sage Autism-EMF paper

Herbert, M.R. and Sage, C. "Autism and EMF? Plausibility of a Pathophysiological Link". Part 1: *Pathophysiology* , 2013, Jun;20(3):191-209, epub Oct 4, PMID 24095003. Pubmed abstract for Part 1. Part II: *Pathophysiology,* 2013 Jun;20(3):211-34. Epub 2013 Oct 8, PMID 24113318. Pubmed abstract for Part II.

APPENDIX: MORE DETAILED SUMMARY OF THE PATHOPHYSIOLOGY

I became interested in the health and brain effects of electromagnetic frequency (EMF) and radiofrequency radiation (RFR) exposures in relation to my brain research because I was interested in how such exposures might alter brain function. In order to familiarize myself in more detail existing literature on the pathophysiological impacts of EMF/RFR, I coauthored a 40,000 word chapter in the 2012 update of the Bioinitiative, [1] and published an updated 30,000 word version of that paper ("Autism and EMF? Plausibility of a Pathophysiological Link") in 2013 in two parts in the peer reviewed journal *Pathophysiology.* [2, 3] My intention was to assess the plausibility of an association between increasing incidence of autism spectrum disorder and increasing EMF/RFR exposures. Rather than directly address the epidemiological issues, I looked at the parallels between the pathophysiological features documented in autism and the pathophysiological impacts of EMF/RFR documented in the peer-reviewed published scientific literature.

I will include here a brief summary of the paper (prepared for a lay audience) of the features of EMF/RFR that I reviewed (with citations at the end of this letter):

- EMF/RFR stresses cells. It lead to cellular stress, such as production of heat shock proteins, even when The EMF/RFR isn't intense enough to cause measurable heat increase. [4-6]
- EMF/RFR damages cell membranes, and make them leaky, which makes it hard for them to maintain important chemical and electrical differences between what is inside and outside the membrane. This degrades metabolism in many ways – makes it inefficient. [7-15]
- EMF/RFR damages mitochondria. Mitochondria are the energy factories of our cells. Mitochondria conduct their chemical reactions on their membranes. When those membranes get damaged, the mitochondria struggle to do their work and don't do it so well. Mitochondria can also be damaged through direct hits to steps in their chemical assembly line. When mitochondria get inefficient, so do we. This can hit our brains especially hard, since electrical communication and synapses in the brain demands huge amounts of energy.
- EMF/RFR creates "oxidative stress." Oxidative stress is something that occurs when the system can't keep up with the stress caused by utilizing oxygen, because the price we pay for using oxygen is that it generates free radicals. These are generated in the normal course of events, and they are "quenched" by antioxidants like we get

in fresh fruits and vegetables; but when the antioxidants can't keep up or the damage is too great, the free radicals start damaging things.

- EMF/RFR is genotoxic and damages proteins, with a major mechanism being EMF/RFR-created free radicals which damage cell membranes, DNA, proteins, anything they touch. When free radicals damage DNA they can cause mutations. This is one of the main ways that EMF/RFR is genotoxic – toxic to the genes. When they damage proteins they can cause them to fold up in peculiar ways. We are learning that diseases like Alzheimer's are related to the accumulation of mis-folded proteins, and the failure of the brain to clear out this biological trash from its tissues and fluids.
- EMF/RFR depletes glutathione, which is the body's premier antioxidant and detoxification substance. So on the one hand EMF/RFR creates damage that increases the need for antioxidants, and on the other hand they deplete those very antioxidants.[1, 16]
- EMF/RFR damages vital barriers in the body, particularly the blood-brain barrier, which protects the brain from things in the blood that might hurt the brain. When the blood-brain barrier gets leaky, cells inside the brain suffer, be damaged, and get killed. [1, 16, 17]
- EMF/RFR can alter the function of calcium channels, which are openings in the cell membranes that play a huge number of vital roles in brain and body. [18-27]
- EMF/RFR degrades the rich, complex integration of brainwaves, and increase the "entropy" or disorganization of signals in the brain – this means that they can become less synchronized or coordinated; such reduced brain coordination has been measured in autism. [28-40]
- EMF/RFR can interfere with sleep and the brain's production of melatonin. [41-43]
- EMF/RFR can contribute to immune problems. [44-50]
- EMF/RFR contribute to increasing stress at the chemical, immune and electrical levels, which we experience psychologically. [51-57] [17, 58-62] [63-68]

Please note that:

1. There are a lot of other things that can create similar damaging effects, such as thousands of "xenobiotic" substances that we call toxicants. Significantly, toxic chemicals (including those that contain naturally occurring toxic elements such as lead and mercury) cause damage through many of the same mechanisms outlined above.
2. In many of the experimental studies with EMF/RFR, damage could be diminished by improving nutrient status, particularly by adding antioxidants and melatonin. [69-72]

I understand that the concept of electromagnetic hypersensitivity is not always well understood in the medical and scientific communities. Indeed, the inter-individual variability is perplexing to those who would expect a more consistent set of features.

But given the range of challenges I have listed that EMF/RFR poses to core processes in biological systems, and given the inter-individually variable vulnerability across these symptoms, it is really not surprising that there would be subgroups with different combinations of symptom clusters.

It also appears to be the case that the onset and duration of symptoms or even brain response to EMR/RFR can be variable. This again is to be expected given the mediation of these symptoms through a variety of the above-listed pathophysiological processes, many of which differ in scale (ranging from molecular to cellular to tissue and organ) and time course of impact. The different parts of the body also absorb this energy differently, both

because of their biophysical properties and as a function of their state of health or compromise thereof.

Here is a list of subgroups of symptom clusters identified by a group of German physicians, t exemplifies these variability issues:

Group 1 no symptoms
Group 2 sleep disturbance, tiredness, depressive mood
Group 3 headaches, restlessness, dazed state, irritability, disturbance of concentration, forgetfulness, learning difficulties, difficulty finding words
Group 4 frequent infections, sinusitis, lymph node swellings, joint and limb pains, nerve and soft tissue pains, numbness or tingling, allergies
Group 5 tinnitus, hearing loss, sudden hearing loss, giddiness, impaired balance, visual disturbances, eye inflammation, dry eyes
Group 6 tachycardia, episodic hypertension, collapse
Group 7 other symptoms: hormonal disturbances, thyroid disease, night sweats, frequent urge to urinate, weight increase, nausea, loss of appetite, nose bleeds, skin complaints, tumors, diabetes

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UNIVERSITY AT ALBANY
State University of New York
Institute for Health and the Environment
WHO Collaborating Center in Environmental Health

3 August 2016

Petaluma City Schools
District Office
200 Douglas Street
Petaluma, California 94952

Dear Sirs/Madams:

I am a public health physician who served as the Co-Editor of the Bioinitiative Report, published in 2007 as a comprehensive review of the adverse health effects of radiofrequency electromagnetic fields.

There is strong and consistent evidence that excessive exposure to radiofrequency electromagnetic fields has adverse human health effects. Of particular concern is the clear evidence that children are more vulnerable than adults. The best-documented adverse effects are an increase in risk of cancer, but cancers do not appear immediately upon exposure but rather come years later. The National Toxicology Program has within the past couple of months reported that even rats exposed to radiofrequency radiation develop brain cancer! Within a school setting there is increasing evidence that excessive exposures reduce learning ability, which is the last thing one wants in a school. Some children will also develop a syndrome of electrohypersensitivity, where they get headaches and reduced ability to pay attention and learn. While these effects are not nearly as well documented as those relating to cancer, they are particularly important within a school. This is especially the case in a wireless computer classroom, where exposure can be very high. However there will be essentially no exposure in a wired computer classroom.

The exposure levels of the Federal Communications Commission are totally outdated and do not protect the health of the public, especially of children. I urge you to abandon any plans for wireless communication within schools. It is of course critical that all children have access to the Internet, but when this is done through wired connections they will not be exposed to excessive electromagnetic fields.

Yours sincerely,

David O Carpenter

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District Office
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4 August, 2016

Dear Petaluma City Schools;
Superintendent Gary Callahan and Board of Trustees

Regarding: Wireless technology should not be used in schools or pre-schools due to health risks for children and employees

We have been asked to declare our opinion about wireless technology in schools by parents that are concerned about their children.

Based on current published scientific studies, we urge your administration to educate themselves on the potential risks from wireless technologies in schools, and to choose wired teaching technologies. The well-being and educational potential of children depends on it.

High-speed connectivity to schools is important but it can be a wired connection instead of Wi-Fi. Wireless classroom infrastructure and wireless devices for schoolchildren should be avoided for these reasons:

- Wireless radiofrequency (RF) radiation emissions were classified as a Possible Human Carcinogen (group 2B) by the World Health Organization International Agency for Research on Cancer (IARC) in May 2011. One of the signers, Dr Hardell, was part of the evaluation group.
- The IARC classification holds for *all forms of radio frequency radiation* including RF-EMF emissions from wireless transmitters (access points), tablets and laptops.
- Epidemiological studies show links between RF radiation exposure and cancer, neurological disorders, hormonal changes, symptoms of electrical hypersensitivity (EHS) and more. Laboratory studies show that RF radiation exposure increases risk of cancer, abnormal sperm, learning and memory deficits, and heart irregularities. Foetal exposures in both animal and human studies may result in altered brain development in the young offspring, with disruption in learning, memory and behaviour.
- Recently a report was released from The National Toxicology Program (NTP) under the National Institutes of Health (NIH) in USA on the largest ever animal study on cell phone RF radiation and cancer (http://biorxiv.org/content/biorxiv/early/2016/05/26/055699.full.pdf). An increased incidence of glioma and malignant schwannoma in the heart was found. Interestingly our research group and others have in epidemiological studies shown that persons using wireless phones (both mobile phones and cordless phones; DECT) have an increased risk for glioma and acoustic neuroma. Acoustic neuroma or vestibular schwannoma is the same type of tumour as the one found in the heart, although benign.
- The research showing increased brain cancer risk in humans *has strengthened* since the IARC 2011 classification as new research has been published which repeatedly shows a significant association after RF radiation exposure. In addition, tumour

promotion studies have now been replicated showing cancer promotion after exposures at low levels.

- It is our opinion and that of many colleagues that the current IARC cancer risk classification should move to an *even higher* risk group. The carcinogenic effect has been shown in human and animal studies. Several laboratory studies have shown mechanistic effects in carcinogenesis such as oxidative stress, down regulation of mRNA, DNA damage with single strand breaks.
- In summary RF radiation should be classified as Carcinogenic to Humans, Group 1 according to the IARC classification. This classification should have a major impact on prevention.

The evidence for these statements is based on hundreds of published, peer-reviewed scientific studies that report adverse health effects at levels much lower than current ICNIRP and FCC public safety limits. Compliance with government regulations does not mean that the school wireless environment is safe for children and staff (especially pregnant staff).

As researchers in cancer epidemiology and RF radiation exposures, we have published extensively in this area and it is our opinion that schools should choose wired Internet connections. Multiple epidemiological research studies show that exposures equivalent to 30 minutes a day of cell phone use over ten years results in a significantly increased brain cancer risk.

What will be the health effect for a child exposed all day long in school for 12 years? Wireless networks in schools result in full body low level RF radiation exposures that can have a cumulative effect on the developing body of a child. No safe level of this radiation has been determined by any health agency and therefore we have no safety assurances. Cancers can have long latency periods (time from first exposure until diagnosis) and it will take decades before we know the full extent of health impacts from this radiation. The statistics and effects will be borne by the children you serve.

Wi-Fi in schools, in contrast to wired Internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Promoting wireless technology in schools disregards the current health warnings from international science and public health experts in this field.

We recommend that your school district install wired Internet connections and develop curriculum that teaches students at all ages safer ways to use their technology devices. If cell phones and other wireless devices are used in the school curriculum (as many schools are now doing with Bring your Own Device Policy) then there should be educational curriculum in place and well posted instructions in classrooms so that the students and staff use these devices in ways that reduce exposure to the radiation as much as possible.

Supporting wired educational technologies is the safe solution in contrast to potentially hazardous exposures from wireless radiation.

Respectfully submitted

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August 4, 2016

Petaluma City Schools
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Re: Adverse Effects of Radiofrequency fields

I am writing to express my concern over the increasing exposure of children in schools to Radiofrequency Fields (e.g. from wi-fi, as required for cell phones and iPads, and emitted by cell towers) and the lack of concern expressed by many councils, governments and School Boards on this issue. In particular, justification for the "safety" of radiofrequency fields is placed upon the use of outdated safety standards, based upon tissue heating, whereas it has now been well demonstrated that adverse biological effects occur at far lower levels of radiofrequency fields that do not induce tissue heating, including a recent animal study performed by the National Toxicology Program in the United States which found an increased incidence of brain cancers and other cancers in rats exposed to prolonged Radiofrequency fields.

I am a physician and epidemiologist specializing in cancer etiology, prevention, and screening, expert in epidemiology, and particularly causes of human cancer. I have performed research on ionizing radiation and cancer, electromagnetic fields and cancer, and have served on many committees assessing the carcinogenicity of various exposures, including working groups of the International Agency for Research on Cancer (IARC), widely regarded as providing unbiased assessment on the carcinogenicity of chemicals and other exposure to humans.

In 2011, an IARC working group designated radiofrequency fields as a class 2B carcinogen, a <u>possible</u> human carcinogen. Since that review a number of additional studies have been reported. One of the most important was a large case-control study in France, which found a doubling of risk of glioma, the most malignant form of brain cancer, after two years of exposure to cell phones. After five years exposure the risk was five-fold. They also found that in those who lived in urban environments the risk was even higher. In my view, and that of many colleagues who have written papers on this issue, these studies provide evidence that radiofrequency fields are not just a <u>possible</u> human carcinogen but a <u>probable</u> human carcinogen, i.e. IARC category 2A. It would be impossible to ignore such an assessment in regulatory approaches.

It is important to recognize that there are no safe levels of exposure to human carcinogens. Risk increases with increasing intensity of exposure, and for many carcinogens, even more with increasing duration of exposure. The only way to avoid the carcinogenic risk is to avoid exposure altogether. This is why we ban known carcinogens from the environment and why much effort is taken to get people, particularly young people, not to smoke. We now recognize that exposure to carcinogens in childhood can increase the risk of cancer in adulthood many years later. Further, people vary in their genetic makeup, and certain genes can make some people more susceptible than others to the effect of carcinogens. It is the young and those who are susceptible we should protect.

As an epidemiologist who has done a great deal of work on breast cancer, I have been concerned by a series of case reports from California and elsewhere of women who developed unusual breast cancers in the exact position where they kept cell phones in their bras. These are unusual cancers. They are multifocal, mirroring where the cell phone was kept. Thus in these relatively young women the radiofrequency radiation from very close contact with a cell phone has caused breast cancer.

Not only brain and breast cancers but parotid gland tumors, tumors of the salivary gland, have been associated with prolonged exposure to cell phones.

Given the long natural history of cancer and the fact that human populations have not been exposed for a sufficient length of time to reveal the full adverse effects of radiofrequency fields, it is extremely important to adopt a precautionary approach to the exposure of humans to such fields. An individual, if appropriately informed, can reduce her or his exposure to radiofrequency fields from devices that use wi-fi, but in the case of cell towers, smart meters and wi-fi in schools, the exposure they receive is outside their control. Then, with the people who manufacture these devices and those who promote wi-fi failing to issue adequate health warnings, we are reaching a situation where schools, work places and homes are being saturated with radiofrequency fields.

Thus to avoid a potential epidemic of cancer caused by radiofrequency fields from wi-fi and other devices, we should introduce means to reduce exposure as much as reasonably achievable, use hard wire connections to the internet and strengthen the codes that are meant to protect the public.

Yours sincerely

Anthony B. Miller, MD, FRCP(C), FRCP, FACE
Professor Emeritus
Dalla Lana School of Public Health, University of Toronto, Ontario, Canada

Karolinska Institutet
Department of Neuroscience
Experimental Dermatology Unit

Stockholm, December 8, 2015

To:
MCPS CEO Dr. Andrew Zuckerman [Andrew_Zuckerman@mcpsmd.org]
MCPS Superintendent Mr. Larry Bowers [Larry_Bowers@mcpsmd.org]
MCPS Chief Technology Officer Mr. Sherwin Collette [Sherwin_Collette@mcpsmd.org]
MCPS Board of Education [boe@mcpsmd.org]
840 Hungerford Drive
Rockville, MD 20850, USA

cc:
Montgomery County Council [county.council@montgomerycountymd.gov]

Dear Madame or Sir,

My name is Olle Johansson, and I am an associate professor, heading the Experimental Dermatology Unit at Sweden's Karolinska Institute in the Department of Neuroscience. I understand you have recently made public pronouncements regarding the safety of Wi-Fi. As a neuroscientist who has been studying the biophysical and epidemiological effects of electromagnetic fields (EMFs) for over 30 years, I believe this designation is short-sighted.

Wireless communication is now being implemented in our daily life in a very fast way. At the same time, it is becoming more and more obvious that the exposure to electromagnetic fields not only may induce acute thermal effects to living organisms, but also non-thermal effects, the latter often after longer exposures. This has been demonstrated in a very large number of **non-ionizing radiation** studies and includes cellular DNA-damage, disruptions and alterations of cellular functions like increases in intracellular stimulatory pathways and calcium handling, disruption of tissue structures like the blood-brain barrier, impact on vessel and immune functions, and loss of fertility. Whereas scientists can observe and reproduce these effects in controlled laboratory experiments, epidemiological and ecological data derived from long-term exposures in well-designed case-control studies reflect this link all the way from molecular and cellular effects to the living organism up to the induction and proliferation of diseases observed in humans. It should be noted that we are not the only species at jeopardy; practically all animals, plants and bacteria may be at stake. Although epidemiological and ecological investigations as such never demonstrate causative effects, due to the vast number of confounders, they confirm the relevance of the controlled observations in the laboratories.

Many times since the early 1980s I have pointed out that the public's usage of cell phones has become the largest full-scale biological and medical experiment ever with mankind, and I was also the first person to firmly point out that this involuntary exposure violates the Nuremberg Code's principles for human experimentation, which clearly states that voluntary

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consent of human subjects is absolutely essential. Among many effects seen, the very serious one is the deterioration of the genome. Such an effect - if seen in a food item under development or in a potential pharmaceutical drug - immediately would completely ban it from further marketing and sale; genotoxic effects are not to be allowed or spread. For these reasons above, we, scientists, can not accept that children undergo an enormous health risk for their present and future, by being exposed to WI-FI in kindergardens or schools (even if the WI-FI masts/routers are not in the children's classroom). The precautionary principle has to be respected. Furthermore, when men place cell phones in their front pocket, or laptops on their laps, it should be noted that experimental studies have demonstrated that after similar exposures there is a decrease in sperm count as well as in the quality of sperm, which is a phenomenon that could affect society's overall ability to procreate in the future. Experiments in mice point to that it may be true already in 5 generations time.

Many other states including France, Russia, Israel and Germany, have employed various precautionary steps and their responses (including labelling cell phones and other transmitting devices with SAR ratings, discouraging the use of cell phones and other wireless gadgets by children, warning parents of the risks, and removing or restricting WiFi in schools and replacing it with hard-wired ethernet) as a result of the *WHO/IARC classification of radiofrequency electromagnetic radiation in 2011 as a Class 2B carcinogen as well as the earlier classification of power-frequent magnetic fields in 2001 also as a Class 2B carcinogen*, the information summarized in the Bioinitiative Reports of 2007 and 2012, and the other considerable international and independent research and reviews, that show adverse biological effects from electromagnetic fields, including heart palpitations, headaches, skin rashes, damage to DNA, mental health effects, impaired concentration, decreased problem-solving capacity, electrohypersensitivity, etc., are about to set a new standard for educational quality with due respect to children's and staff's health.

In the case of "protection from exposure to electromagnetic fields", it is thus of paramount importance to act from a prudence avoidance/precautionary principle point of view. Anything else would be highly hazardous. Total transparency of information is the key sentence here, as I believe the public does not appreciate having the complete truth revealed years after a certain catastrophe already has taken place. For instance, it shall be noted, that today's recommended values for wireless systems, such as the SAR-values, are just recommendations, and not safety levels. Since scientists observe biological effects at as low as 20 microWatts/kg, can it truly be stated that it is safe to allow irradiation of humans at SAR 2 W/kg, or at 100,000 times stronger levels of radiation?

IMBALANCED REPORTING

Another misunderstanding is the use of scientific publications (as the tobacco industry did for many years) as 'weights' to balance each other. But one can NEVER balance a report showing a negative health effect with one showing no effect. This is a misunderstanding which, unfortunately, is very often used both by the industrial representatives as well as official authorities to the detriment of the general public. True balance would be reports showing negative health effects against *exact replications* showing no or positive effects. However, this is not what the public has been led to believe.

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NEED FOR INDEPENDENT RESEARCH
In many commentaries, debate articles and public lectures - for the last 20-30 years – I have urged that completely independent research projects must be inaugurated immediately to ensure our public health. These projects must be entirely independent of all types of commercial interests; public health can not have a price-tag! It is also of paramount importance that scientists involved in such projects must be free of any carrier considerations and that the funding needed is covered to 100%, not 99% or less. This is the clear responsibility of the democratically elected body of every country.

WHO/INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC), 2011
Very recently (in Lyon, France, May 31, 2011) the WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer. This should be added to the previous (2001) 2B classification of power-frequent (ELF) electromagnetic fields – emitted at high levels from handheld gadgets, such as eReaders and mobile phones – as a risk factor for childhood leukemia. Given the 2001 very close votes (9 to 11) for moving it to 2A and all the new knowledge that has accumulated since 2001, today the association between childhood leukemia and power-frequent (ELF) electromagnetic fields would definitely be signed into the much more serious 2A (“probably carcinogenic”) category. So, the ‘red flag’ is – unfortunately – flying very high.

INVOLUNTARY EXPOSURE
According to Article 24 of the UNICEF’s Child Convention “children have the right to … a clean and safe environment, and information to help them stay healthy”. We must all ensure that this article never is violated. This is about our social responsibility, and is very much a public health issue.

In summary, electromagnetic fields may be among the most serious and overlooked health issues today, and having these fields checked and reduced/removed from schools and kindergardens may be essential for health protection and restoration, and is a must for persons with the functional impairment electrohypersensitivity as for children who are more fragile (cf. Belyaev I, Dean A, Eger H, Hubmann G, Jandrisovits R, Johansson O, Kern M, Kundi M, Lercher P, Mosgöller W, Moshammer H, Müller K, Oberfeld G, Ohnsorge P, Pelzmann P, Scheingraber C, Thill R, "EUROPAEM EMF Guideline 2015 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses", Rev Environ Health 2015; 30: 337–371). In addition, as recently discussed in a think-tank group here in Stockholm, it is very important to constantly educate oneself and participate in the general debate and public discussions to keep the information build-up active. Thus, it is of paramount importance to keep the "kettle boiling", never blindly trusting or accepting given 'facts', but only read and think for yourself and for your loved ones. Only so you can arrive at a genuinely working precautionary principle.

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CONCLUSION
In conclusion, wireless systems, such as Wi-Fi routers or cell towers, and their electromagnetic fields, can not be regarded as safe in schools, but must be deemed highly hazardous and unsafe for the children as well as for the staff.

I encourage governments and local health and educational bodies to adopt a framework of guidelines for public and occupational EMF exposure that reflect the Precautionary Principle. As noted, the Precautionary Principle states when there are indications of possible adverse effects, though they remain uncertain, the risks from doing nothing may be far greater than the risks of taking action to control these exposures. The Precautionary Principle shifts the burden of proof from those suspecting a risk to those who discount it — as some nations have already done. Precautionary strategies should be based on design and performance standards and may not necessarily define numerical thresholds because such thresholds may erroneously be interpreted as levels below which no adverse effect can occur.

Some 100 years back, we learned the hard lessons of ionizing radiation and the need for strict health protections – now we must openly face the possibility that we must take a seat in life's school and learn again. This time it is about non-ionizing radiation.

Based on all of the above, I strongly urge you to reconsider your public stance on the safety of Wi-Fi, cell towers, and similar systems in schools as their non-ionizing radiation emissions very likely are hazardous and unsafe for students, staff and teachers.

With my very best regards
Yours sincerely
Olle Johansson

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January 3, 2016

Dear Montgomery County COO Dr. Andrew Zuckerman, Interim Superintendent Larry Bowers, Board of Education and Office of Technology;

I have been asked to comment on the MCPS Statement Concerning Deployment of Wireless Computing Technologies. I am happy to do so.

The first paragraph in that statement is not relevant to the issue at hand because it is perfectly possible to use wired communication for such education. This document is being produced on a computer on which I only use wired communication, connecting to the internet, connecting to my printer and for other purposes, as well.

The 2nd and 3rd paragraphs of your statement may well be technically correct. However these give us no assurance whatsoever of safety of Wi-Fi fields. The FCC guidelines as are many other such guidelines, are based on the assumption that only heating effects of microwave/lower frequency EMFs can have biological effects. However that assumption has been falsified by thousands of studies published from the 1950s to the present, each showing that non-thermal levels of exposure often produce biological effects. For example, in 1971, the U.S. Office of Naval Medical Research produced a document reporting over 100 different non-thermal effects [1], listing 40 apparent neuropsychiatric changes produced by non-thermal microwave frequency exposures, including 5 central/peripheral nervous system (NS) changes, 9 central NS effects, 4 autonomic system effects, 17 psychological disorders, 4 behavioral changes and 2 misc. effects [1]. It also listed cardiac effects including ECG changes and cardiac necrosis as well as both hypotension and hypertension, and also 8 different endocrine effects.

Changes affecting fertility included tubular degeneration in the testis, decreased spermatogenesis, altered sex ratio, altered menstrual activity, altered fetal development, programmed cell death (what is now known as apoptosis) and decreased lactation. Many other non-thermal changes were also listed for a total of over 100 non-thermal effects. They also provided [1] approximately 2000 citations documenting these various health effects. That was almost 45 years ago and is only the beginning of the evidence for the existence of non-thermal effects. My own recent paper [2] shows that widespread neuropsychiatric effects are caused by non-thermal exposures to many different microwave frequency electromagnetic fields (EMFs).

Tolgskaya and Gordon [3] in 1973 published a long and detailed review of effects of microwave and lower frequency EMFs on experimental animals, mostly rodents. They report that non-thermal exposures impact many tissues, with the nervous system being the most sensitive organ in the body, based on histological studies, followed by the heart and the testis. They also report effects of non-thermal exposures on liver, kidney, endocrine and many other organs. The nervous system effects are very extensive and include changes many changes in cell structure, disfunction of synaptic connections between neurons and programmed cell death and are discussed in Refs. [2,3] and more modern studies reporting extensive effects of such non-thermal EMF exposures on the brain are also cited in [2]. There are also many modern studies showing effects of non-thermal exposures on fertility in animals.

The Raines 1981 National Aeronautics and Space Administration (NASA) report [4] reviewed an extensive literature based on occupational exposures to non-thermal microwave EMFs. Based on multiple studies, Raines [4] reports that 19 neuropsychiatric effects are associated with occupational microwave/ radiofrequency EMFs, as well as cardiac effects, endocrine including neuroendocrine effects and several other effects.

I reviewed many other scientific reviews on this topic, each of which clearly supports the view that there are various non-thermal health impacts of these EMFs [5]. In 2015, 206 international scientists signed a statement sent to the United Nations Secretary General and to member states, stating that international safety guidelines and standards are inadequate to protect human health [6]. Each of these 206 scientists from 40 countries had scientific publications on biological effects of such EMFs and therefore each is well qualified to judge this. ***It can be seen from this statement to the UN, that there is a strong scientific consensus that current safety guidelines and standards are inadequate because they do not take into consideration all of the non-thermal health effects produced by various EMF exposures.***

That scientific consensus also rejects, therefore, the FCC EMF guidelines, guidelines that cannot be defended despite your own attempt to do so in MCPS Statement Concerning Deployment of Wireless Computing Technologies.

It can be seen from the previous paragraphs, that the following non-thermal effects of EMF exposures are well documented:

- Widespread neuropsychiatric effects
- Several types of endocrine (that is hormonal) effects
- Cardiac effects impacting the electrocardiogram (Note: these are often associated with occurrence of sudden cardiac death)
- Male infertility

However, there are many additional types of biological changes produced by non-thermal EMF exposures (reviewed in 5,7] including:

- Oxidative stress
- Changes in calcium fluxes and calcium signaling
- Several types of DNA damage to the cells of the body, including single strand and double strand DNA breaks and 8-OH-guanine in DNA
- Cancer (which is undoubtedly caused, in part, by such DNA damage)
- Female infertility
- Lowered melatonin; sleep disruption
- Therapeutic effects of EMFs when they are highly controlled and focused on a specific part of the body

It can be seen from the above, that each of the things that we most value as individuals and as a species are being attacked by non-thermal microwave frequency EMFs [5.7]:

- **Our Health**
- **Our brain function**
- **The integrity of our genomes**
- **Our ability to produce healthy offspring**

I want to emphasize that the specific health effects listed above are **not** the only things that are likely to be impacted by non-thermal EMF exposures, they are however the best documented such effects.

While it has been clear for many years that there are many non-thermal health effects of microwave frequency EMFs, it has not been clear until about 2 ½ years ago, how these effects are produced by such exposures. I stumbled onto the mechanism in 2012 and published on it in mid-2013. This 2013 paper [8] was honored by being placed on the Global Medical Discovery web site as one of the most important medical papers of 2013. At this writing, it has been cited 61 times according to the Google Scholar database, with over 2/3rds of those citations during 2015. So clearly it is having a substantial and rapidly increasing impact on the scientific literature. I have given 26 professional talks, in part or in whole on EMF effects in 10 different countries over the last 2 1/4 years. So it is clear that there has been a tremendous amount of interest in this research.

What the 2013 study showed [8], was that in 24 different studies (and there are now 2 more that can now be added [2]), effects of low-intensity EMFs, both microwave frequency and lower frequency EMFs could be blocked by calcium channel blockers, drugs that block what are called voltage-gated calcium channels (VGCCs). There were a total of 5 different types of calcium

channel blocker drugs used in these studies, with each type acting on a different site on the VGCCs and each thought to be highly specific for blocking VGCCs. What these studies tell us is that these EMFs act to produce non-thermal effects by activating the VGCCs. Where several effects were studied, when one of them was blocked or greatly lowered, each other effect studied was also blocked or greatly lowered. This tells us that the role of VGCC activation is quite wide – many effects go through that mechanism, possibly even all non-thermal effects in mammals. There are a number of other types of evidence confirming this mechanism of action of microwave frequency EMFs [2,]. Each of the 11 health impacts caused by non-thermal EMF exposures can be explained as being produced by indirect effects of VGCC activation [5,7].

It is now apparent [7] that these EMFs act directly on the voltage sensor of the VGCCs, the part of the VGCC protein that detects electrical changes and can open the channel in response to electrical changes. The voltage sensor (and this is shown on pp. 102-104 in [7]) is predicted, because of its structure and its location in the plasma membrane of the cell, to be extraordinarily sensitive to activation by these EMFs, about 7.2 million times more sensitive than are single charged groups elsewhere in the cell. What this means is that arguments that EMFs produced by particular devices are too weak to produce biological effects, are immediately highly suspect because the actual target, the voltage sensor of the VGCCs is extremely sensitive to these EMFs. **Because heating is mostly produced by forces on these singly charged groups elsewhere in the cell, limiting safety guidelines to heating effects means that these guideline allow exposures that are something like 7.2 million times too high**.

Why then does the FCC stick with these totally unscientific safety guidelines? That is the 64 billion dollar question. The FCC has been shown, in a long detailed document published by Harvard University Center for Ethics, to be a “captured agency”, that is captured by the telecommunications industry that the FCC is supposed to be regulating [9; can be obtained full text from web site listed in 9]. So perhaps the failure of the FCC to follow the extensive science in this important area, can be understood. Of course, what that means is that the FCC is completely failing in its role of protecting the public and it is a major blunder, therefore for either you or any other organization to depend on the FCC guideline as a reliable predictor of impacts of EMFs in humans.

So what is known about health impacts of Wi-Fi EMFs?

Table 1. The following Table summarizes various health impacts of Wi-Fi EMF exposures:

Citation(s)	**Health Effects**
[10,11,12,13,14,15,16]	Sperm/testicular damage, male infertility
[10,15,17,18,19,20]	Oxidative stress
[20]	Calcium overload

[11,12,20]	Apoptosis (programmed cell death)
[17]	Melatonin lowering; sleep disruption
[10,13]	Cellular DNA damage
[21]	MicroRNA expression (brain)
[18]	Disrupts development of teeth
[22]	Cardiac changes, blood pressure disruption; erythrocyte damage; catecholamine elevation
[23,24]	Neuropsych changes including EEG
[25]	Growth stimulation of adipose stem cells (role in obesity?)

Each of the effects reported above in 2 to 7 studies have an extensive literature for their occurring in response to various other microwave frequency EMFs so it should be clear that these observations on Wi-Fi exposures are highly probable to be correct. These include (see Table 1) findings that Wi-Fi exposures produce impacts on the testes leading to lowered male fertility; oxidative stress; intracellular calcium overload; apoptosis (a process that has an important causal role in neurodegenerative diseases); cellular DNA damage; neuropsychiatric changes including EEG changes. Each of these are very serious and oxidative stress has causal roles in many different human diseases; intracellular calcium overload has many different consequences – for example, it has a central role in causing neurodegenerative diseases; cellular DNA damage can cause cancer and produce mutations that impact future generations (if there are any). Other Wi-Fi effects each only documented by a single study are also effects where a variety of other non-thermal microwave EMFs also cause these, as shown by extensive literature on each of them. These include: melatonin lowering and sleep disruption; and the effects reported by Saili et al [22] cardiac changes, blood pressure disruption; erythrocyte damage; catecholamine elevation. So these may well be correct observations as well despite having only a single Wi-Fi specific study for each.

Summary:

1. The EMF safety guidelines supported by the FCC and others assume that only heating effects need be of concern. These assumptions have been known to be false for at least 45 years and there is a scientific consensus on this, that has lead to the petition by 206 highly qualified international scientists to the UN stating that current safety guidelines are inadequate.
2. We now know that low intensity non-thermal exposures work via VGCC activation and that indirect effects of such VGCC activation can produce each of the health effects that have been widely reported to occur in response to such EMF exposures for something like 60 years. These attack:
    a. **Our health**

b. Our brain function
c. The integrity of our genomes
d. Our ability to produce healthy offspring

3. The voltage sensor of the VGCCs is stunningly sensitive to such low intensity EMFs, about 7.2 million times more sensitive than are singly charge groups elsewhere in our cells. The consequence of this is that safety guidelines allow exposures that are very roughly 7.2 million times too high.
4. The FCC has been shown, in a detailed Harvard University study, to be a Captured Agency, captured by the industry that it is supposed to be regulating. This provides an additional reason to be very highly skeptical about all FCC safety guidelines.
5. 15 studies have each shown health effects of Wi-Fi, most of which have also been shown to occur in response to low intensity exposures to other types of microwave frequency EMFs. These are likely to have massive health effects by producing male infertility (female infertility has not been studied in response to Wi-Fi), oxidative stress (involved in dozens of human diseases), cellular DNA damage (possibly leading to both cancer and mutations in future generations), life threatening cardiac effects, cellular apoptosis and also intracellular calcium overload (with both of these possibly leading to neurodegenerative diseases), various neuropsychiatric changes and many others.

It is my view that it is sheer insanity to fail to see the threat to our and to all human civilization by continuing to ignore the threats from such EMFs, starting with Wi-Fi.

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Columbia University, College of Physicians and Surgeons
Department of Physiology and Cellular Biophysics

Board Member
Los Angeles Unified School District,
Board of Education

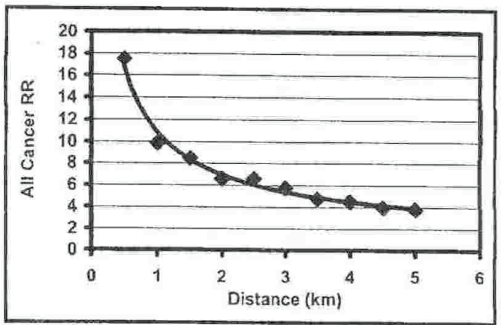
Re: Health effects of cell tower radiation

As an active researcher on biological effects of electromagnetic fields (EMF) for over twenty five years at Columbia University, as well as one of the organizers of the 2007 online Bioinitiative Report on the subject, I am writing in support of a limit on the construction of cell towers in the vicinity of schools.

There is now sufficient scientific data about the biological effects of EMF, and in particular about radiofrequency (RF) radiation, to argue for adoption of precautionary measures. We can state unequivocally that EMF can cause single and double strand DNA breakage at exposure levels that are considered safe under the FCC guidelines in the USA. As I shall illustrate below, there are also epidemiology studies that show an increased risk of cancers associated with exposure to RF. Since we know that an accumulation of changes or mutations in DNA is associated with cancer, there is good reason to believe that the elevated rates of cancers among persons living near RF towers are probably linked to DNA damage caused by EMF. Because of the nature of EMF exposure and the length of time it takes for most cancers to develop, one cannot expect 'conclusive proof' such as the link between helicobacter pylori and gastric ulcer. (That link was recently demonstrated by the Australian doctor who proved a link conclusively by swallowing the bacteria and getting the disease.) However, there is enough evidence of a plausible mechanism to link EMF exposure to increased risk of cancer, and therefore of a need to limit exposure, especially of children.

EMF have been shown to cause other potentially harmful biological effects, such as leakage of the blood brain barrier that can lead to damage of neurons in the brain, increased micronuclei (DNA fragments) in human blood lymphocytes, all at EMF exposures well below the limits in the current FCC guidelines. Probably the most convincing evidence of potential harm comes from living cells themselves when they start to manufacture stress proteins upon exposure to EMF. The stress response occurs with a number of potentially harmful environmental factors, such as elevated temperature, changes in pH, toxic metals, etc. This means that ***when stress protein synthesis is stimulated by radiofrequency or power frequency EMF, the body is telling us in its own language that RF exposure is potentially harmful.***

There have been several attempts to measure the health risks associated with exposure to RF, and I can best summarize the findings with a graph from the study by Dr. Neil Cherry of all childhood cancers around the Sutro Tower in San Francisco between the years 1937 and 1988. Similar studies with similar results were done around broadcasting antennas in Sydney, Australia and Rome, Italy, and there are now studies of effects of cellphones on brain cancer. The Sutro tower contains antennas for broadcasting FM (54.7 kW), TV (616 kW) and UHF (18.3 MW) signals over a fairly wide area, and while the fields are not uniform, and also vary during the day, the fields were measured and average values estimated, so that one could associate the cancer risk with the degree of EMF exposure.



The data in the figure are the risk ratios (RR) for a total of 123 cases of childhood cancer from a population of 50,686 children, and include a 51 cases of leukaemia, 35 cases of brain cancer and 37 cases of lymphatic cancer. It is clear from the results that the risk ratio for all childhood cancers is elevated in the area studied, and while the risk falls off with radial distance from the antennas, as expected, it is still above a risk ratio of 5 even at a distance of 3km where the field was 1μW/cm^2. This figure is what we can expect from prolonged RF exposure. In the Bioinitiative Report, we recommended 0.1μW/cm^2 as a desirable precautionary level based on this and related studies, including recent studies of brain cancer and cellphone exposure.

As I mentioned above, many potentially harmful effects, such as the stress response and DNA strand breaks, occur at nonthermal levels (field strengths that do not cause a temperature increase) and are therefore considered safe. It is obvious that the safety standards must be revised downward to take into account the nonthermal as well as thermal biological responses that occur at much lower intensities. Since we cannot rely on the current standards, it is best to act according to the precautionary principle, the approach advocated by the European Union and the scientists involved in the Bioinitiative report. In light of the current evidence, the precautionary approach appears to be the most reasonable for those who must protect the health and welfare of the public and especially its most vulnerable members, children of school-age.

Sincerely yours,

Martin Blank, Ph.D.
Associate Professor of Physiology and Cellular Biophysics

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MCPS COO Dr. Andrew Zuckerman
MCPS Interim Superintendent Larry Bowers
MCPS Board of Education
MCPS Office of Technology
Montgomery County Schools
Carver Educational Services Center
850 Hungerford Drive
Rockville, MD 20850

December 13, 2015

Dear Montgomery County COO Dr. Andrew Zuckerman, Interim Superintendent Larry Bowers, Board of Education and Office of Technology;

In my capacity as a pediatric occupational therapist, biologist, international speaker, and author on the subject of the impact of technology on child development and learning, I'm writing to you on behalf of students, teachers, and parents requesting you reconsider the use of devices which operate using wireless radiation.

Please find below guiding principles regarding managed balance between technology and healthy activity, as well as information on wireless radiation. More judicious use of educational based technologies is a safe manner, will serve to ensure sustainable futures for all children. Reversion to Ethernet or fiber optic cable devices, until such time as the World Health Organization deems wireless to not be harmful to young children, is recommended.

Guiding principles for the use of educational based technology in school environments.

Minimize Risk and Maximize Safety.

- Wireless radiation has not been proven safe (WHO 2011).
- Recent research indicates wireless radiation causes harmful effects to adult humans (Avendano 2012, Hardell 2013).
- Long term effects of wireless radiation on children are unknown at this time (AAP 2013).
- Children have thinner skulls, more aqueous bodies, and have rapidly developing cells, indicating they are exceedingly more vulnerable to harmful effects from wireless radiation than adults (AAP 2013, C4ST 2015).
- The American Academy of Pediatrics and the Canadian Pediatric Society recommends no more than 1-2 hours total technology use per day, including

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educational technology. Many schools exceed these expert guidelines (AAP 2014).

Weigh Risk vs. Benefit.

- Education technology is not evidence based and is laden with conflict of interest e.g. manufacturers claims are financially motivated, and are not substantiated by university level research.
- Traditional and standardized teaching methods have substantive research support and evidence, yet are being rapidly replaced with education technology.

Ensure adequate foundational skills prior to use of technology.

Children need to balance the following 4 critical factors with technology, to optimize development and learning. Time spent with technology adversely affects these factors.

- *Movement:* stimulates vestibular, proprioceptive and cardiovascular systems.
- *Touch:* stimulates parasympathetic system for lowered cortisol and adrenalin.
- *Human Connection:* activates parasympathetic system; a life sustaining force.
- *Nature:* attention restorative, improves learning, erases effects of technology.
- *See video:* Message to Schools on EdTech

Risks associated with the use of technology by children are as follows:

- *Sedentary nature* of technology use is causally related to the recent rise in obesity/diabetes, developmental delay and learning difficulties (Tremblay 2011, HELP EDI Mapping 2009/13, Ratey 2008, PISA 2012).
- *Isolating factor* of technology use is associated with escalation in social impairments, mental illnesses (including adhd and autism), and self-regulation difficulties (Houtrow 2014).
- *Overstimulation* from technology use is a causal factor in rise in attention deficit, aggression, sleep disturbance, and chronic stress from hyper-arousal of the sympathetic nervous system (Christakis 2004, Gentile 2009, Markman 2010, Bristol University 2010).
- *Neglect* of students by teachers and support staff who are engaged in their own personal technology, is unfortunately common.
- Consequently, the risks associated with using education technology far outweigh the dubious benefits.

When In Doubt, Act With Caution.

- Existing research on harmful effects of wireless radiation on *adults*, indicates taking a cautionary approach when considering same radiation exposure to *children* (AAP 2014).

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- Rapid cell turnover in children creates particular concern regarding potential DNA damage from wireless radiation, and consequent susceptibility to cancer. While rise in cancer incidence is becoming more apparent, rise in rates of cancer in children will not be observable until adulthood.
- Removal of wireless radiation and reversion to Ethernet cabled devices, will ensure immediate and long term safety to all students, teachers, and support staff.
- Defaulting to a remote authority regarding removing wireless radiation from schools, is not acting in the best interests of students and staff, and may not be defensible in a court of law.

Montgomery County's statement that the radiofrequency levels in schools "is compliant" with federal regulations *does not* assure safety to the students in your care. The current proposed technology plan to further increase the use of screens in classrooms on a daily basis, clearly does not support children's healthy development.

The implications of failure of schools to act with caution now regarding wireless radiation and technology, could potentially be horrific in both scope and magnitude, and may constitute neglect of children. Please act now to safeguard your children's future.

Respectfully,

CRowan

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Montgomery County Board of Education
Montgomery County Schools
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January 20, 2016

Dear Montgomery County Board of Education,

Concerned parents in your school district have asked me to write to you regarding the health risks of wireless radiofrequency radiation exposure in the classroom. Based on what I have been told, I want to urge you to halt programs that currently have students use their own phones in ways that expose their eyes and brains to levels of radiation that have never been tested for safety.

I was Founding Director of the Board on Environmental Studies and Toxicology of the U.S. National Research Council, and Founding Director of the Center for Environmental Oncology at the University of Pittsburgh Cancer Institute. President Clinton appointed me to the Chemical Safety and Hazard Investigation Board, and I am former Senior Advisor to the Assistant Secretary for Health in the Department of Health and Human Services. I founded the non-profit Environmental Health Trust in 2007 to provide basic research and education about environmental health hazards. Our scientific team is currently focusing on the health risks of radiofrequency radiation as an important public health issue.

Many people are unaware that cell phones and wireless laptops and tablets function as two-way microwave radios. A typical classroom might have the following scenario: every student has a laptop--which is typically tested for use 8 inches from an adult male body--a cell phone in the pocket--which is also tested at a minimum distance from an adult male body-- and a network transmitter on the ceiling and possibly a cell tower outside next to the sports field. All these devices emit microwave radiation which can be readily absorbed into children's bodies and brains.

Manufacturers specifically recommend that cell phones be used “as tested”—at this little-known minimum distance from the body. Recently, *Consumer Reports* in November advised that people should not keep phones in the pocket—advice that few children or adults appreciate. *These devices have never been tested for safety with children.* Accumulating research indicates that long-term exposure to low levels over long lifetimes could pose a serious risk to our health.

Regarding tested distances for using laptops, the Federal Communications Commission (FCC) states that laptops and computers are "mobile devices are transmitters designed to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons." The body in this instance refers to a large male weighing more than 200 pounds and standing six feet tall.

As the county is preparing to increase student use of Chromebooks, please be aware that the Samsung Chromebook manual states:
"United States of America USA and Canada Safety Requirements and Notices

- Do not touch or move antenna while the unit is transmitting or receiving.
- Do not hold any component containing the radio such that the antenna is very close or touching any exposed parts of the body, especially the face or eyes, while transmitting.
- Regardless of the power levels, care should be taken to minimize human contact during normal operation.
- This device should be used more than 20 cm (8 inches) from the body when wireless devices are on and transmitting.
- FCC Statement for Wireless LAN use: *"While installing and operating this transmitter and antenna combination the radio frequency exposure limit of 1mW/cm2 may be exceeded at distances close to the antenna installed. Therefore, the user must maintain a minimum distance of 20cm from the antenna at all times."*

As one of the leaders in educational policy of this nation, your school district has an opportunity to set an example for school districts nationwide by installing safer technology in classrooms and educating students, teachers and staff about tested distances that devices should be used to reduce radiation. A number of public and private schools have already implemented such policies. Just as we provide children with seat belts and bike helmets, a precautionary approach to wireless is recommended by many scientists and governments worldwide.

For more information about all of these issues, please read cell phone instructions for various models at http://showthefineprint.org. Our newly posted Ebook also details fine print safety instructions in wireless device user manuals.

When children use these devices close to their bodies, they are exceeding these safety instructions, and exposing themselves to radiofrequency (RF) radiation levels which can exceed our government FCC RF radiation exposure limits. The FCC RF exposure limit was designed to protect the public from the thermal (heating) effects of acute exposure to RF energy. The FCC states, "Tissue damage in humans could occur during exposure to high RF levels because of the body's inability to cope with or dissipate the excessive heat that could be generated. Two areas of the body, the eyes and the testes, are particularly vulnerable to RF heating because of the relative lack of available blood flow to dissipate the excess heat load."

CHILDREN ABSORB MORE RADIATION THAN ADULTS

Our recently published research in the IEEE *Spectrum* with investigators at the Federal Universities of Brazil provides new state-of-the-art radiation exposure brain modeling which confirms that substantially higher radiofrequency radiation doses occur in younger children as compared to adults even where products comply with tested guidelines developed for adults.

FCC REGULATIONS ARE OUTDATED

FCC exposure limits were set more than 19 years ago and were based on decades-old research. The Government Accountability Office published a 2012 Report that calls on the FCC to formally reassess their current RF energy (microwave) exposure limits, stating that the "FCC RF energy exposure limit *may not* reflect the latest research." I encourage you to read scientific submissions to FCC Proceeding Number 13-84 at http://bit.ly/1aGxQiq. It is unknown when the FCC will make a ruling, however, *until that time* the current outdated FCC limits are *not reflective* of the current state of science.

FCC REGULATIONS DO NOT PROTECT THE PUBLIC FROM BIOLOGICAL EFFECTS

As the California Medical Association states in their 2014 Resolution calling for updated FCC Regulations, "peer reviewed research has demonstrated adverse biological effects of wireless EMF [electromagnetic fields] including single and double stranded DNA breaks, creation of reactive oxygen species, immune dysfunction, cognitive processing effects, stress protein synthesis in the brain, altered brain development, sleep and memory disturbances, ADHD, abnormal behavior, sperm dysfunction, and brain tumors."

In May 2015, over 200 scientists who have authored more than 2,000 articles on this topic appealed to the United Nations to address "the emerging public health crisis" related to cellphones and other wireless devices, urging that the United Nations Environmental Programme (UNEP) initiate an assessment of alternatives to current exposure standards and practices that could substantially lower human exposures to non-ionizing radiation. These scientists state that "the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, " and are " insufficient to protect public health." They also state that "the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF." Please see their website at https://emfscientist.org.

INCREASED CANCER RISK

Wireless radiofrequency radiation was classified as a Class 2B "Possible Human Carcinogen" by the World Health Organization's International Agency for Research on Cancer in 2011. According to many scientists, evidence *has increased* since 2011, indicating that cell phone and wireless radiation should be classified as a "probable carcinogen." Those exposed at younger ages show four to eight times increased cancer risk. Replicated research just published in Biochemical and Biophysical Research Communications indicates that radiofrequency acts as a *tumor promoter* at low to moderate levels.

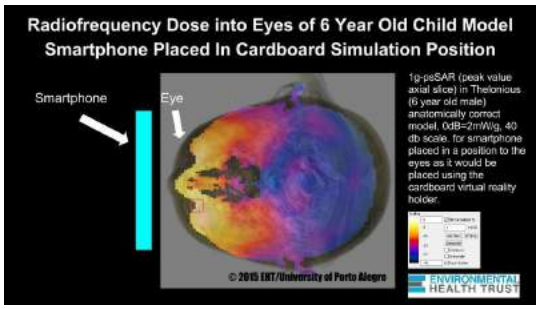
CONCERN FOR PREGNANT STUDENTS AND STAFF

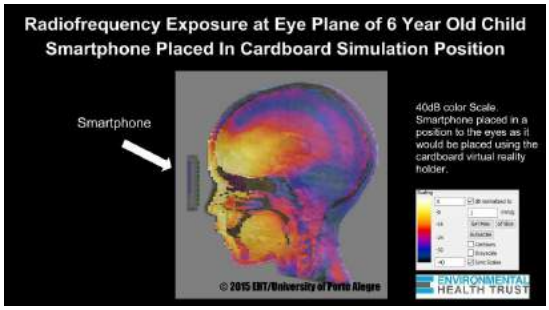
Pregnant students and staff are especially at risk from wireless because the fetus is the most vulnerable to toxic exposures. Several experimental studies are showing irreversible changes after prenatal exposure to cell phone and wireless radiation such as altered brain functioning, decreased brain cells and altered reproductive organ development. More than 100 physicians, scientists and public health professionals joined together to express their concern about the risk that wireless radiation poses to pregnancy and now *urge pregnant women to limit their exposures*. Please read these scientists BabySafe Joint Statement

VIRTUAL TECHNOLOGY RESULTS IN HIGHER EXPOSURES TO THE EYE AND BRAIN

Most recently, I was contacted by a parent in your district about the virtual reality devices now used in MCPS classrooms to go on a virtual "field trip." As indicated by online instructions, this experience involves using smartphones placed directly in front of the child's eyes so that they can directly watch a fascinating video of faraway lands. The smartphone is streaming radiation throughout the classroom from the teacher's iPad for the entire "field trip."

Please be aware that FCC regulations set decades ago did not utilize science that looks at the effects from cell phones on different body tissues such as the eyes. Upon hearing about this issue, I contacted EHT-associated scientists at federal universities of Brazil who do state-of-the-art computer modeling. I asked them to position the phone as it would be in the virtual reality cardboard for use in front of the child's eyes and assess the microwave radiation. The yellow and orange color show the highest exposures.





My colleagues and I are sharing this work with you today because we believe you should have more information about microwave radiation exposures that will take place through this system.

This research image above utilizes a sophisticated computer system that the U.S. Food and Drug Administration (FDA) currently applies to evaluate medical devices. It simulates the radiation absorption into *anatomically correct models*--something that currently used systems for testing phones and devices cannot do. In a study from Memorial Sloan-Kettering Cancer Center, radiation physicist David Gultekin, working with Bell Labs electrical engineer Lothar Moeller, reported that normal working cell phones can create tiny hotspots within brain tissue. Unlike other organs, eyes do not have circulation to effectively carry away heat.

In addition to the impact from the microwave radiation, there could also be impacts to a child's retina from the blue light emitted by the screen. Youths under the age of 20, and especially very young children,

have little or no yellowing of the lens (which helps protect the adult eye). Therefore, blue light (or UV) which enters the eye is unfiltered in children and strikes the retina at full-strength exposing not only the retina, but the lens to possible damage over the long time. Such injury may not be evident until later in time.

In 2010, Andreas Christ and team reported that children's hippocampus and hypothalamus absorbs 1.6–3.1 times higher and the cerebellum absorbs 2.5 times higher microwave radiation compared to adults; children's bone marrow of the skull absorbs 10 times higher microwave radiation than in adults, *and children's eyes absorb much higher microwave radiation than adults.* A recent Deans' Lecture I delivered to University of Melbourne provides an overview on this research.

SIMPLE STEPS WILL PROTECT CHILDREN

Compelling research raises the possibility of very serious harm to children from radiofrequency radiation exposures well below "FCC compliant" levels. Legal does not mean safe. Based on the preliminary work that I share with you here, I urge you to forgo the use of such devices such as virtual reality cardboard as there is no research that has considered their impact on children's eyes. At this time, the smart choice for school decision makers is to act now and reduce radiofrequency wireless exposures. In fact, many countries (over 20) and health authorities worldwide recommend reducing radiofrequency radiation to children.

More recently, the Cyprus Government's National Committee on Environment and Children's Health released a video about reducing wireless and I invite you to watch this excellent example of responsible action at this link https://www.youtube.com/watch?v=H43IKNjTvRM .

I understand that your county has a Bring Your Own Device policy whereby cell phones are not only allowed *in* the classroom but are actively used in the curriculum. As I have been told, students in film class might use their cell phones to take footage to create a movie, and in some math classes they use their cell phones as a calculator. Advice should be routinely provided to any student using a wireless device at school about *how to reduce exposures*. For example, if phones are used on airplane mode, and wireless is turned off on computers then these devices will neither send nor receive microwave radiation.

When powered on, phones undergo short bursts of microwave radiation up to 900 times per minute, *whether or not the phone is being used for talking.* Once teachers and students are educated on how they can simply turn their phone onto airplane mode, then they can use the phone in the classroom *without* being exposed to unnecessary radiofrequency radiation.

Likewise, laptops such as Chromebooks are also emitting constant radiation and at much higher levels when a student is streaming video or using cloud based applications. Laptops can easily be hardwired to ethernet so that students can safely use the internet without radiation emissions. Please review the Best Practices for Low EMF in Schools developed by the Northeast Collaborative For High Performing Schools which details how schools can reduce exposure to radiofrequency fields and still have full internet connectivity.

Along with the recommendation of over 200 scientists (see https://emfscientist.org) and health authorities worldwide, I recommend that the best course of action is to take simple precautions—as many nations already currently advise. *Children's exposures to wireless radiation should be reduced as much as possible.* We have a responsibility to act now to reduce children's exposure to radiofrequency radiation. Children's nervous, immune and reproductive systems are rapidly developing and, along with pregnant women, children deserve an abundance of caution.

As several colleagues and I wrote in a letter to the U.S. Secretary of Education just a few months ago, we recommend your school district do the following:

1. **Raise school community awareness through new educational curriculum:** Students, teachers and their families should be given information on wireless health risks and simple precautionary steps they can take to protect their health. It is important to teach children how to use technology both safely and more responsibly in order to protect their health and wellbeing.

2. **Install a safe communication and information technology infrastructure in schools to meet educational needs:** Solutions exist to reduce exposures to wireless emissions and mitigate the health risk. Low-EMF Best Practices have been developed, allowing educational needs to be met with safer, hard-wired Internet connections, which are also faster and more secure.

Low-EMF Best Practices are the solution that allows for full communication, information access and learning tools use in the classroom while minimizing unnecessary health risks. Your district can thoughtfully integrate safe technology into every classroom while responsibly safeguarding the health of every generation.

I fully understand that this information has not been widely understood. I would be happy to provide or develop an online technical briefing to your senior staff to assist you as you make decisions today that will affect the health of students for the rest of their lives.

Yours respectfully,

Devra Davis, PhD MPH
President and Founder
Environmental Health Trust
Visiting Professor of Medicine
The Hebrew University, Hadassah Medical Center
Associate Editor, Frontiers in Radiation and Health
ehtrust.org

UNIVERSITY AT ALBANY
State University of New York
Institute for Health and the Environment
WHO Collaborating Center in Environmental Health

July 28, 2014

Board of Trustees
Fay School
48 Main Street
Southborough, MA 01772

Re: Advisability of WiFi in schools

Dear Sirs/Madams:

This is concerning potential adverse health effects associated with exposure to radiofrequency/microwave (RF/MW) radiation, specifically that from wireless routers and wireless computers. I am writing to express concern that students at your school are experiencing electrosensitivity symptoms from these technologies.

I am a public health physician who has been involved in issues related to electromagnetic fields (EMFs) for several decades. I served as the Executive Secretary for the New York Powerline Project in the 1980s, a program of research that showed that children living in homes with elevated magnetic fields coming from powerlines suffered from an elevated risk of developing leukemia. I served as Director of the Wadsworth Laboratory of the New York State Department of Health, as well as Dean of the School of Public Health at the University at Albany/SUNY. I have edited two books on effects of EMFs, ranging from low frequency fields to radiofrequency/ microwave radiation, or the kind emitted by WiFi routers, cell phones, neighborhood antennas and wireless computer equipment. I served as the co-editor of the BioInitiative Report 2012 (Bioinitiatve.org), a comprehensive review of the literature showing biological effects at non-thermal levels of exposure, much of which has since been published in the peer-reviewed journal, *Pathophysiology* (attached). Also, I served on the President's Cancer Panel that examined radiation exposures as they relate to cancer risk, in 2009, and a report from that testimony is also attached. Thus, this is a subject which I know well, and one on which I take a public health approach rooted in the fundamental principle of the need to protect against risk of disease, even when one may not have all the information that would be desirable.

There is clear and strong evidence that intensive use of cell phones increases the risk of brain cancer, tumors of the auditory nerve and cancer of the parotid gland, the salivary gland in the cheek by the ear. The evidence for this conclusion is detailed in the attached publications. The WHO's International Agency for Research on Cancer has also classified the radiation from both cell phones and WiFi as a Class 2B "Possible Carcinogen" (2011). WiFi uses similar radio-frequency radiation as cell phones (in the 1.8 to 5.0 GHz range). The difference between a cell phone and a WiFi environment, however, is that while the cell phone is used only intermittently, and at higher power, a WiFi environment is continuous, and transmitting even when not being used. In addition, WiFi transmitters are indoors, where people (and in this case, children) may be very close by, or certainly close to devices using the WiFi, such as wireless computers, iPads and smart boards, the radiation from which can be intolerable to sensitive people.

East Campus, 5 University Place, Room A217, Rensselaer, NY 12144-3429
PH: 518-525-2660 FX: 518-525-2665
www.albany.edu/ihe

Furthermore, commercial routers, like those in schools, operate at much higher wattage than consumer routers. They are designed to penetrate through materials like cement, wood and brick, to handle dozens to hundreds of users, and to reach into outdoor areas, so industrial grade routers are of much greater concern.

An additional consideration to appreciate is that it is not only the power of wireless radiation that causes biological dysregulation, but the frequencies, pulsing, amplitude, and the quantity and kind of information being transmitted that can have effects as well. These 'non-thermal effects' have been shown in thousands of studies to be biologically active, and may be more important than the effects from the power. Thus, while a router may be in the ceiling, or not right next to a student, teacher or administrator, the known biological and health effects, particularly the non-thermal ones, are still very much occurring.

Finally, while acute electrosensitivity symptoms, like the ones I understand your students are experiencing, are of course of great concern (such as cognitive effects impairing attention, memory, energy levels, and concentration; cardiac irregularities, including in children; or, headaches or other symptoms in students wearing braces), the full effects for society from chronic and cumulative exposures are not known at this time. Given what we do know, however, including the DNA effects, I must, as a public health physician, advise minimizing these exposures as much as possible. Indications are that cell phones and wireless technologies may turn out to be a serious public health issue, comparable to tobacco, asbestos, DDT, PCBs, pesticides and lead paint, or possibly worse given the ubiquitous nature of the exposures. While unfortunately we must wait for federal regulation to catch up with the science, the prudent thing to do in the interim would be to exercise precaution at every opportunity.

Computers and the world-wide web have tremendous value in education, but the value also depends on how these are used in numerous respects. As wired internet connections do not pose radiation risk, are readily available, are faster and more secure than WiFi, and are now even available for certain tablets, I highly recommend you factor the risks I have described into your technology planning. At the same time, I would urge you to take the complaints of your students very seriously, and potentially involve the school nurse and teachers in helping to assess the extent of the electrosensitivity problem among students at the school.

An excellent reference on the EMF and electrosensitivity science is "Electrosensitivity and Electrohypersensitivity—A Summary" (2013) authored by M.J. Bevington and available through Electrosensitivy-U.K. (www.es-uk.info/)

If I can be of further help, please do not hesitate to call.

Yours sincerely,

David O Carpenter

David O. Carpenter, M.D.
Director, Institute for Health and the Environment
University at Albany

Enclosures

Martin Blank, PhD
Department of Physiology and Cellular Biophysics
Columbia University
New York, NY 10032

July 25, 2014

Mr. Thomas McKean, President, Board of Trustees
Mr. James Shay, President-Elect, Board of Trustees
Fay School
48 Main Street
Southborough, MA01772

To the Board of Trustees,

It has been brought to my attention that school children have become symptomatic at your school after installation of WiFi. I am writing to express my concern and to encourage you to review the independent science on this matter.

I can say with conviction, in light of the science, and in particular in light of the cellular and DNA science, which has been my focus at Columbia University for several decades, putting radiating antennas in schools (and in close proximity to developing children) is an uninformed choice. Assurances that the antennas are within 'FCC guidelines' is meaningless today, given that it is now widely understood that the methodology used to assess exposure levels only accounts for one type of risk from antennas, the thermal effect from the power, not the other known risks, such as non-thermal frequencies, pulsing, signal characteristics, etc. They fail also to consider multiple simultaneous exposures from a variety of sources in the environment, and cumulative exposures over a lifetime. Compliance with FCC guidelines, thus, unfortunately, is not in any way an assurance of safety today, as the guidelines are fundamentally flawed. Until the guidelines and advisories in the U.S. are updated, the intelligent thing for your Board of Trustees to do is to exercise the Precautionary Principle and hard wire all internet connections.

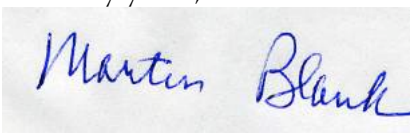
I know this might be disappointing to hear, as I understand you have invested in the WiFi. But there is no amount of money that could justify the added physiological stress from wireless antenna radiation and its many consequences, most in particular for children. Our research has shown that the cellular stress response, a protective reaction that is indicative of cellular damage, occurs at levels that are deemed 'safe'. Many other harmful reactions have been reported, such as the impairment of DNA processes that can account for the observed increased risk of cancer, as well as the potential cognitive decline, and sleep effects that may be due to impairment of the blood brain barrier. The DNA effects are of particular concern for future generations, an area of research that is just beginning to raise alarms. As with other environmental toxic exposures, children are far more vulnerable than adults, and they will have longer lifetimes of exposure.

The science showing reasons for concern about the microwave radiation emitted by antennas is abundant and there will be a day of reckoning. As I explain in my recent book,

Overpowered, The Precautionary Principle instructs us that in the face of serious threats, a lack of scientific 'certainty' never justifies inaction. The changes occurring at the molecular level, and known associations with many diseases, are sufficient at this time to give us pause and to recommend minimizing exposures to these fields, in our homes, schools, neighborhoods and workplaces. There is significant potential for risk, and to very large numbers of people, and the effects are occurring nonetheless whether or not we are noticing them.

I recommend you hardwire the internet connections at your school, and also encourage students to use hard wired connections at home for internet access, as well as for all computer equipment connections and voice communications.

Sincerely yours,



Martin Blank, PhD
mb32@columbia.edu,

Martin Blank, PhD, Special Lecturer and (ret.) Associate Professor, Columbia University, Department of Physiology and Cellular Biophysics. Dr. Blank is a leading expert in the effects of electromagnetic fields on DNA and biology, and Past President of the Bioelectromagnetics Society. He holds two PhDs, in physical chemistry and in colloid science, an interdisciplinary field involving chemistry, physics and nanoscience. Dr. Blank was author of the BioInitiative Report's section on the impact of electromagnetic fields on Stress Proteins; Editor of the journal *Pathophysiology*'s special issue on Electromagnetic Fields (2009); and co-author of "Electromagnetic fields and health: DNA based dosimetry" (2012), which recommends a new way of assessing the biological impact of electromagnetic fields across the spectrum, using DNA. Dr. Blank's book, *"Overpowered—What Science Tells Us About the Dangers of Cell Phones and Other WiFi-Age Devices",* was published in 2014.

Wi-Fi in Schools

Are We Playing It Safe With Our Kids?

"Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes." American Academy of Pediatrics Letter to FCC August 29, 2013 (20)

By Cindy Russell, MD
VP of Community Health, SCCMA

Industry has been quite successful in creating magically useful wireless technologies such as cell phones, Ipads, Wi-Fi, and now wearable tech devices such as Google glasses, we all love. Many of these handy gadgets have now reached the typical classroom across the globe. It has become apparent, however, that there are substantial downsides to being too connected to technology and as safety concerns mount, governments such as France and Israel are backing away from the blind adoption of wireless technology in schools, especially for young children.

These devices are cool and convenient, however there remains nagging questions of overuse and safety as the application of these devices has increased to the point we are literally exposed 24 hours a day to this radiation. Wireless microwaves come from many sources both at work and at home.

An increasing number of physicians, scientists, and parents are concerned about long term health effects from Wi-Fi in schools. (42)(43)(44)(49) As any parent knows, computers now are as ubiquitous in schools as they are at work. From kindergarteners on up kids are required to learn computer skills in order to take core testing online. There is a push to enable students to be connected to the internet 24/7 to take photos, email documents, and research a topic. In schools, wired connections for computers have been rapidly being eliminated to install wireless systems that connect students both indoors and outdoors on campus.

Europe and some schools in the U.S. are taking a different more precautionary approach and going back to the future with wired plug in computers. Studies have also cast doubt on some of the benefits of classroom computers and warned of the new age of "Digital Dementia" which has now crept into Korean youth due to the heavy use of electronic gadgets. (17)(48)

Professors in college are banning computers during lectures and finding students learn more. (38) (39)

CHILDREN ARE MORE VULNERABLE THUS NEED MORE PROTECTION

Children have several organ systems that are immature at birth and are thus much more sensitive to toxic exposures. The human brain, one of the top vital organs, is far from being a finished product in youth. Long-term structural maturation of the nervous system is required for successful development of cognitive, motor, and sensory functions. Neuronal axons – long thin projections from the nerve cell – act as electronic transmission lines. Axons in major pathways of the brain continue to develop throughout childhood and adolescence. Myelin is the insulation surrounding individual nerves protecting it from outside electrical charges. The process of myelination is much faster the first two years but continues into adulthood. (16) Children have thinner skulls (29), their immune systems are undeveloped, their cells are dividing more rapidly, thus, they are more vulnerable to EMF radiation and other carcinogens. They also have a longer cumulative exposure to all toxins including EMF radiation.

CURRENT WIRELESS SAFETY STANDARDS AND MICROWAVING POTATOES

Wireless devices work on high frequency microwaves similar to the microwave you use to cook food with. It is with less power but substantial research (1)(2)(3)(4) demonstrates that even at low power within the current safety standards these microwaves can cause biologic harm to plants, animals, and cellular structures. Current Federal Communications Commission (FCC) standards are based only on heat generated by the device, not on adverse biological effects seen in hundreds of studies and at much lower levels.

Our own CMA supports reassessment of EMF standards. The California Medical Association, in 2014, passed a resolution as follows:

> "Resolved 1:That CMA supports efforts to re-evaluate microwave safety exposure levels associated with wireless communication devices, including consideration

Continued on page 18

of adverse nonthermal biologic and health effects from non-ionizing electromagnetic radiation used in wireless communications and be it further

Resolved 2: That CMA support efforts to implement new safety limits for wireless devices to levels that do not cause human or environmental harm based on scientific research.

ADVERSE EFFECTS DEMONSTRATED IN PEER REVIEWED PUBLISHED RESEARCH (2)

- DNA with single and double stranded breaks
- Leakage of the blood brain barrier (two hours of cell phone exposure causes 7+ days of albumin leakage)
- Stress protein production in the body indicating injury
- Infertility/reproductive harm
- Neurologic harm with direct damage to brain cells
- Lowering of melatonin levels
- Immune dysfunction
- Inflammation/oxidation.

PLAUSIBLE MECHANISM FOUND FOR EMF MICROWAVE EFFECTS

Dr. Martin Pall, Professor Emeritus of Biochemistry, Washington State University has studied how electromagnetic fields impact the cells of our bodies. His 2013 paper on this subject highlights a major biological mechanism of action of EMF microwave radiation on cell structure. His work, along with two dozen prior studies, demonstrated that EMF microwave radiation effects cellular calcium channels and this can be inhibited with calcium channel blockers. "A whole series of biological changes reportedly produced by microwave exposures can now be explained in terms of this new paradigm of EMF actions via Voltage Gated Calcium Channels (VGCC) activation." (14)(15)

EMF AFFECTS ON WILDLIFE: BIRDS, BEES, AND TOMATO PLANTS

Bird researchers in Germany found that their migratory European Robins lost their sense of navigation when in the city. (5) This was found to be due to the EMF radiation interfering with the bird's special internal magnetic compass. They replicated the experiment over seven years before publishing the results in the prestigious journal *Nature*.

John Phillips and others have found that newts, sea turtles, and migratory birds use a magnetic compass to navigate long distances and this can be interrupted by low levels of EMF. (6)(7) A review of effects on cell towers and wireless devices showed that beehives can have rapid colony collapse with exposure to cell phone radiation. (8)

Plants have been shown to have stress response to EMF from wireless devices. (9)(10) (22) In tomatoes exposed for short duration, the stress response seen by exposure to EMF was prevented by administration of calcium counteracting drugs. (11) Even simple high school science experiments document abnormal seed growth near Wi-Fi routers. (19) There appear to be adverse biological effects of this seemingly harmless radiation.

HUMAN ELECTROSENSITIVITY: IS IT REAL?

There is varied opinion about those who state they are sensitive to EMF. Scientific research has not given a definitive answer, nevertheless, many seem to suffer from vague and often disabling symptoms they feel in the presence of EMF. Exposure to EMF radiation in some people reportedly causes headaches, memory problems, fatigue, sleep disorders, depression. This is so significant for some people that they have to live in a very low EMF environment to feel normal. (25)

Sweden recognizes electro-sensitivity as a functional impairment and estimates that about 3% of the population suffers from this. (23)(24) Dr. Magda Havas found in replicated studies that some EMF sensitive individuals heart rates increased with wireless devices turned on in double blind study. (12)(26) Researchers at Louisiana State University, in 2011, studied a self reported EMF sensitive physician and found "In a double-blinded EMF provocation procedure specifically designed to minimize unintentional sensory cues, the subject developed temporal pain, headache, muscle twitching, and skipped heartbeats within 100 s after initiation of EMF exposure ($p < .05$)." They concluded that "EMF hypersensitivity can occur as a bona fide environmentally inducible neurological syndrome." (27)

In May 2011, the International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B).(30)

Genius and Lipp reviewed the current literature on EHS, in 2011, and point to several explanations for this multisystem phenomenon, including toxicant induced loss of tolerance as many with EHS symptoms had high levels of PCB's possibly causing immune dysfunction. Scientific research also identifies an inflammatory response with cytokine production. Another aspect of research points to catecholamine and adrenal gland dysfunction. In addition, heavy metal toxicity has also been proposed as contributing to EHS. (28)

The Austrian Medical Association feels Electrohypersensitivity is a real phenomenon and in 2012 published Guidelines for EMF and Electro-hypersensitivity. They state the primary method of treatment should consist in the prevention or reduction of EMF exposure, taking care to reduce or eliminate all sources of EMF if possible. (32)

GOVERNMENT ACTIONS ON WI-FI IN SCHOOLS

While much of the U.S. is marching forward with Wi-Fi in schools, Europe is changing direction, as indicated by the policies listed below. (45) Internationally there is wide disagreement in standards. The U.S. and Canadian limits are 1000 microwatts/cm2. China and Russia are 10 microwatts/cm2. Belgium is 2.4 microwatts/cm2, and Austria is 0.001 microwatts/cm2. The Bioinitiative Report 2012 recommendation for "No Observable Effect" is 0.0003 microwatts/cm2. Cosmic background EMF we evolved with is <0.00000000001 microwatts/cm2. (2)

COUNCIL OF EUROPE PARLIAMENT ASSEMBLY 2011 EMF MICROWAVE POLICY : "THE POTENTIAL DANGERS OF ELECTROMAGNETIC FIELDS AND THEIR EFFECT ON THE ENVIRONMENT"

The report notes "other non-ionizing frequencies, whether from ex-

tremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications, and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects, and animals, as well as the human body, even when exposed to levels that are below the official threshold values."

The Council calls for a number of measures to protect humans and the environment, especially from high-frequency electromagnetic fields. One of the recommendations is to "take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumors". (37)

IN FRANCE: A NEW NATIONAL LAW BANS WI-FI IN NURSERY SCHOOLS

In January 2015, France passed a landmark law that calls for precaution with wireless devices for children and the general public. (34)(35) It calls for:

1. Wi-Fi banned in nursery schools.
2. Wi-Fi routers should be turned off in school when not in use.
3. Schools are informed when new tech equipment is installed.
4. Citizens will have access to environmental cell tower radiation measurements near homes.
5. There will be continued research conducted into health effects of wireless communications.
6. Information on reducing exposure to EMF radiation is mandatory in the contents of the cell phone package.
7. Wi-Fi hotspots are labeled.

ISRAELI MINISTRY OF EDUCATION ISSUE GUIDELINES TO LIMIT WI-FI IN SCHOOLS

On August 27, 2013, the Israeli Ministry of Education issued new guidelines regarding Wi-Fi use in schools. (33) The guidelines will:

1. Stop the installation of wireless networks in classrooms in kindergarten.
2. Limit the use of Wi-Fi between first and third grades. In the first grade, students will be limited to use Wi-Fi to study for one hour per day and no more than three days per week. Between the first and third grades, students will be limited to use Wi-Fi up to two hours per day for no more than four days per week.
3. To limit unnecessary exposure teachers will be required to turn off mobile phones and Wi-Fi routers when they are not in use for educational purposes.
4. All Wi-Fi equipment be tested for compliance with safety limits before and after installation in an Israeli school.
5. Desktop computers and power supplies be kept at least 20 cm from students.

2012 THE RUSSIAN COMMITTEE ON NON-IONIZING RADIATION PROTECTION OFFICIALLY RECOMMENDED THAT WI-FI NOT BE USED IN SCHOOLS.

2011 THE RUSSIAN COMMITTEE ON NON-IONIZING RADIATION PROTECTION (RNCNIRP) RELEASED THEIR RESOLUTION ENTITLED "ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECTS ON CHILDREN AND TEENAGERS."

According to the opinion of the Russian National Committee on Non-Ionizing Radiation Protection, the following health hazards are likely to be faced by the children mobile phone users in the nearest future: disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to the stress, increased epileptic readiness. (36)

Expected (possible) remote health risks: brain tumors, tumors of acoustical and vestibular nerves (in the age of 25-30 years), Alzheimer's

Continued on page 20

disease, "got dementia", depressive syndrome, and the other types of degeneration of the nervous structures of the brain (in the age of 50 to 60).

PLAYING IT SAFE FOR OUR KIDS

A healthy and safe learning environment is a cornerstone of education. Current FCC standards are obsolete and inappropriate as they are based only on heat effects, not biological effects. They give us a false sense of security. There may be higher EMF levels at school than at home as routers are more powerful. Cumulative Effects on DNA or cell structures are not taken into consideration in any safety standard. Because of the long-term exposure to EMF microwave radiation this generation is experiencing, they will be at higher risk for potential health problems. We will not know what happens to our progeny's DNA until our grandchildren are born.

Considering there has been a more precautionary approach internationally to microwave radiation exposure and the trend is toward less exposure in schools, especially to vulnerable populations such as children, it makes sense to re-evaluate our wireless schools. We buckle our seat belts and wear a helmet when we ride bikes even though we don't know if we will get in an accident. Although not all the issues of wireless microwaves are understood, there is enough science to understand it acts as a toxicant at even low levels that fall within current safety standards. We also know that decades of research precedes meaningful regulation in the area of toxins, thus the only reasonable approach is precautionary.

In addition, we need to be thoughtful about how much our kids should use computers and what this is doing not only to them, but to our society as a whole. We get starry eyed with every new wireless gadget, however, in "Alone Together" Sherry Turkle expertly addresses the rise in isolation, loneliness, lack of privacy, and increasing pressure on students in this age of invasive technology. Her thorough and non-judgmental scientific investigation of the psychological effects of computers makes us aware that we need to take care that we do not replace real human connection with a "virtual reality" that will redirect us in an unhealthy direction.

As physicians and parents, we understand that decisions we make today may have far reaching consequences in the future for our kids. Let's play it safe for them right now.

RECOMMENDATIONS FOR SCHOOLS

1. **Wired internet connections** like we used to have are the safest and possibly cheapest option – all the benefits of the internet without the risk.
2. **Wireless devices**, but with an on/off switch in each room so teachers can use only when needed for educational purposes.
3. **Limit Wi-Fi** use, especially in younger grades.
4. **Cell phones stay off and in the backpacks during class** and on the campus during school hours.
5. **Have EMF and electrical measurements done by one or more qualified, experienced consultants before and after any installation**. Understand you may need to increase your knowledge of low and high frequency electromagnetic fields and limits to accurately interpret the reports. The Bioinitiative Report is a very useful compendium that has recommendations for safer levels.
6. **Support efforts by governments to provide independent standardized transparent research to define safe limits in all the different wireless frequencies used commercially**. This could lead to less EMF emissions and safer wireless devices.

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STEPHEN T. SINATRA M.D., F.A.C.C.
F.A.C.N., C.N.S., C.B.T.,
Integrative Metabolic Cardiology

July 16, 2014

Chairman and Trustees
Fay School
48 Main Street
Southborough, MA 01772

RE: Wi-Fi in Schools

Dear Chairman and Trustees:

I am writing this letter on behalf of concerned parents of children who are attending schools with Wi-Fi technology. I'm a cardiologist and co-founder of Doctors for Safer Schools, an organization dedicated to informing teachers, parents and superintendents about the uncertainty and possible environmental health hazards of Wi-Fi technologies.

The heart is a delicate and complex electromagnetic organ that can be adversely affected by exogenous signals from wireless technology and microwave radiation. For this reason it is unwise to expose students and teachers to Wi-Fi radiation for internet access, especially when safer alternative wired options are available. Children are particularly vulnerable to this radiation and the incidents of cardiovascular events including sudden cardiac arrest, seems to be increasing, especially among young athletes (up to the age of 19). In some cases this is due to undetected heart defects, blunt trauma to the heart in contact sports, and heat stress during strenuous exercise, but in instances these irregularities may be exacerbated by or due to microwave signals interfering with the autonomic nervous system that regulates the heart.

I know this because I am a board certified cardiologist and have been a Fellow of the American College of Cardiology since 1977. At the Manchester Memorial Hospital in Connecticut, I served in several roles, including Chief of Cardiology, Director of Cardiac Rehabilitation, and Director of Medical Education.

In both Canada and the United States a large number of students are complaining that they feel unwell in classrooms that have Wi-Fi technology. These complaints have been investigated and what emerges is the following:

1. Symptoms common among these students include headaches, dizziness, nausea, feeling faint, pulsing sensations or pressure in the head, chest pain or pressure, difficulty

The Optimum Health Building • 257 East Center Street • Manchester, CT 06040 • TELEPHONE: 860-647-9729 • FAX: 860-643-2531
www.opthealth.com

concentrating, weakness, fatigue, and a racing or irregular heart accompanied by feelings of anxiety. These symptoms may seem diverse but they indicate autonomic dystonia or dysfunction of the autonomic nervous system.

2. Symptoms do not appear in parts of the school that do not have this technology (Wi-Fi-free portables) and they do not appear in homes that do not have wireless technology.

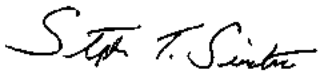
3. We know that the heart is sensitive to and can be adversely affected by the same frequency used for Wi-Fi (2.4 GHz) at levels a fraction of federal guidelines (less than 1%) and at levels that have been recorded in two Ontario schools with Wi-Fi technology.

4. The incidence of sudden cardiac arrests (SCA) among young athletes is increasing and doctors don't know why. In one small Ontario community, the number of students experiencing SCA is disturbingly high. Whether WiFi and nearby cell phone antennas exacerbate SCA needs to be investigated further before students are subjected to these fields.

In conclusion it is unwise to install wireless technology (WiFi) in schools. We do not know what the long-term effects of low-level microwave radiation are on students and teachers. The safety of this technology on children has not been tested and I would advise that you follow the precautionary principle that states the following:
"*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*"
(Rio Conference 1992).

The principle implies that we have a social responsibility to protect the public from exposure to harm, when scientific investigations have found a plausible risk. That "plausible risk" exists for microwave radiation at very low levels. These protections can be relaxed only if further scientific findings emerge that provide sound evidence that no harm will result. In some legal systems the application of the precautionary principle has been made a statutory requirement.

Sincerely,



Stephen T. Sinatra, M.D., F.A.C.C., F.A.C.N., C.N.S

Karolinska Institutet
Department of Neuroscience
Experimental Dermatology Unit

Stockholm, July 24, 2014

Mr. Thomas McKean, President, Board of Trustees
Mr. James Shay, President-Elect, Board of Trustees
Fay School
48 Main Street
Southborough, MA 01772

Ladies and Gentlemen,

It has been brought to my attention that children in your school are physically being impacted by radiation from WiFi antennas, and that some of the student's reactions have been severe. I was concerned to learn this. It is unwise to chronically expose children to this type of radiation, as their bodies are more sensitive than adults and the radiation has been shown to impair not just physiological functioning but cognitive function and learning.

Radiation of the kind emitted by WiFi transmitters impacts attention, memory, perception, learning capacity, energy, emotions and social skills. There is also diminished reaction time, decreased motor function, increased distraction, hyperactivity, and inability to focus on complex and long-term tasks. In some situations, children experience cardiac difficulties. In one Canadian school district, incidence of cardiac arrest in children was 40x the expected rate, and defibrillators have had to be placed at each school. Online time, particularly multi-tasking in young children, has been linked with a chronically distracted view of the world preventing learning critical social, emotional and relational skills. There is a physiological as well as psychological addiction taking place. I am sure, that as stewards of the lives of the children in your charge, you would not wish any of these outcomes.

Given the large and growing body of science indicating biological and health effects from the radiation emitted by antennas, it would be most imprudent at this time to permit wireless antennas on—or inside—your property. Understand the FCC exposure guidelines only protect against the acute power density, or acute thermal, effects, and they do nothing to protect against the other aspects of the radiation's risk, such the frequencies, amplitude, pulsing, intensity, polarity and biologically disruptive information content. Thus, until the FCC establishes guidelines for the non-thermal effects, any reliance by your school on current FCC guidelines, based solely on *thermal effects* would necessarily be incomplete. I urge a school of your caliber to be a leader on this issue, and appreciate that two wrongs do not make a right.

I enclose for your review the transcript of the Seletun Scientific Statement laying out the key concerns on this topic. If I can be of further help, please, do not hesitate to be in touch.

Yours truly,

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CC: cheemf@lists.healthandenvironment.org
Sent: 2/8/2013 2:21:54 P.M. Pacific Standard Time
Subj: [cheemf] Adoption of Wi-Fi in Los Angeles USD classrooms

TO: Los Angeles Unified School District (LAUSD)

FROM: Joel M. Moskowitz, Ph.D.
Director, Center for Family and Community Health
School of Public Health
University of California, Berkeley

RE: Adoption of Wi-Fi in Classrooms

DATE: February 8, 2013

Based upon my review of the research of the health effects associated with exposure to radiofrequency (RF) electromagnetic radiation (EMR), especially microwave radiation, I feel compelled to register my concern that adoption of Wi-Fi in LAUSD classrooms is likely to put at risk the health of many students and employees in the District.

In December, Dr. Gayle Nicoll of URS Corporation asked me to serve as an expert reviewer for a report that URS prepared for the LAUSD regarding the adoption of Wi-Fi in classrooms. Since Ms. Nicoll could not assure me that URS has no conflicts of interest, I turned down her request and sent her references to recent studies about Wi-Fi radiation. I cc:ed Board members and key staff as I was concerned about the health risks of unnecessarily subjecting 660,000 children to 13,000 hours of Wi-Fi microwave radiation during their K-12 school years.

Although I have not seen the URS report, I imagine it is based on the FCC's outmoded 1996 safety standards which only protect the public from the **thermal risk of RF EMR exposure** (i.e., from heating of tissue). For the past three years, in numerous media interviews I have been calling on the FCC to strengthen its standards and testing procedures to protect the public and workers from the low-intensity, **non-thermal risks of RF EMR exposure** that have been reported in hundreds, if not thousands, of research studies. These include increased risk of neurological and cardiovascular problems, sperm damage and male infertility, reproductive health risks, and cancer.

The **precautionary principle** should be applied to this critical policy decision. This principle, developed at a U.N. environmental conference in 1992 states that in the absence of scientific consensus if an action has a suspected risk of causing harm, the burden of proof it is not harmful falls on those taking the action, and all reasonable measures to reduce the risk must be taken.

Internet access can be provided to students through wires or optical fiber without installing Wi-Fi in the classrooms.

For further information, please see my **Electromagnetic Radiation Safety web site** at http://saferemr.blogspot.com where I have archived news releases and links to recent reports by major scientific groups and political agencies.

Sincerely,

Joel M. Moskowitz, Ph.D.

==========

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December 1, 2015

Montgomery County Schools
Carver Educational Services Center
850 Hungerford Drive
Rockville, MD 20850

Attention: Dr. Andrew Zuckerman, Chief Operating Officer
MCPS Board of Education Members

This letter of comment has been prepared after reviewing the *Montgomery County Public Schools Radiofrequency (RF) Summary Monitoring Report* dated July 2015 produced by AECOM Environment.

1) The instrument cited as being used for the peak measurements in section 7, a Narda SRM-3006, is not suitable to measure the very short (1 millisecond) spikes typically found in WiFi 802.11n communication. As stated on page 7-1, each data sweep takes 550 milliseconds, making the instrument unsuitable for reliably logging the short bursts typical in 802.11n WiFi communications. Palit et al conclude that 50% of the uplink traffic will be in bursts shorter than 2 milliseconds. The peak levels of those packets will not be reliably logged by a device with a 550 millisecond sweep time.

Palit et al, 2012. Anatomy of WiFi Access Traffic of Smartphones and Implications for Energy Saving Techniques. International Journal of Energy, Information and Communications, Vol. 3, Issue 1.

2) Even the average-level tests seem inconsistent with engineering reality. Figure 7.1 shows a background noise level mostly flat between 2.4GHz and 5.8Ghz. That noise (typically -70dBm) is generally consistent with the internal thermal noise in a quality wide-band measuring instrument. Two tiny peaks out of that noise are represented to be the "*average electric field generated at one foot away from an AP in use at Beverly Farms Elementary School*." Even with just the 802.11n beacon-frame idling, the peak field a foot away from an access point should be a million times higher than the levels of figure 7.1. Why do we just see a blip on the chart? Clearly some unusual 'averaging' has occurred, yet the parameters of that averaging, and the potential clinical implications of that averaging, are not noted in the annotation to the Figures. Further, Figure 7.2 shows a background noise level some 10dB higher than figure 7.1, something that would be very unusual in measurements at these Gigahertz frequencies.

3) The RF exposure estimates are additionally inadequate because, in reality, there is no way to meet the distancing that AECOM's report bases it's measurements on for an individual student. In normal use, kids hover over devices. They hug them to the body. They put them in their laps at lunchtime, on the couch and in bed doing homework. It is entirely unrealistic to expect teachers and parents to guarantee that students always keep their Chromebooks at some arbitrary distance during use.

4) The report concludes with classroom RF measurement comparisons to an outdated 2007 BioInitiative Report recommendation of 0.1 uW/cm2. (Section 7). Graphics need to be re-drawn with comparisons to the 2012 recommended BioInitiative level, and do so not only for a 12" spacing, but also for the one-inch distance measured from the Chromebook (Figure 7-3 and 7-4). Using an arbitrary 12" distance to report and compare to either the 2007 or 2012 BioInitiative recommendations will seriously underestimate RF exposures since students don't always (or even typically) maintain a foot of distance. Their 'leaning in' and having to place their faces close to the device is common usage, and is unavoidable.

5) The methodology is not specific as to the number of operating devices and clustering of students at work – which is necessary to characterize exposures from a room full of operational wireless devices. Figure 2.1 shows multiple wireless devices connected to one wireless router. Measuring one or several Chromebooks rather than one Chromebook for each of the 25-35 students plus router isn't how a normal classroom operates. It **does not** produce RF measurements of a typical class using many wireless devices at once, so this is a fundamental flaw. It will underestimate RF exposures.

6) There is also a comment to be made here about the setup – how does this methodology reasonably reflect how smaller or younger children with short arms and torsos actually use tablets? What RF exposures they can expect to receive? The likely consequence to the measurements is greater exposure. Unless the students are using chopsticks instead of their fingers, or are using wired keyboards that increase the distance to the wireless device, RF exposures will be worse for the younger or smaller-stature students.

7) This Report appears to legitimize MCSD's use of wireless in the classroom by asserting compliance with the 2007 BioInitiative Report recommendation, yet the report does not mention the significant revision of that threshold in the years between 2007 and 2012. Both BioInitiative Reports clearly state that their recommendations are interim and 'that they may have to go lower.' Recent studies of students reporting headache, irritability, concentration and behavior problems at levels as low as 0.003-0.006 uW/cm2, indicate that neither BioInitiative Report threshold may be low enough to assure safety. As the co-editor of the BioInitiative Reports, and a founding member of the BioInitiative Working Group, the way in which our work has been invoked is not consistent with the findings of the BioInitiative Reports overall. The conclusions of this report cannot be said to give a positive assertion of safety because of the degree of uncertainty over whether the testing equipment was adequate (we believe it was not); the lack of comparison data; and the failure to measure RF exposures at realistic distances from the student(s).

8) Correct BioInitiative citations are:

BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation at

www.bioinitiative.org, December 31, 2012.

BioInitiative Working Group, Cindy Sage and David O. Carpenter, Editors. BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF) at www.bioinitiative.org, August 31, 2007

CONCLUSION

The data in this report cannot therefore be used to infer safety, or lack of safety, of children in any of the tested locations.

Respectfully submitted,

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Sage Associates
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Prof. Trevor Marshall, PhD
Director, Autoimmunity Research Foundation,
Senior Member IEEE,
Founding chair (retired) IEEE EMBS (Buenaventura Chapter)
Fellow, European Association for Predictive, Preventive and Personalised Medicine (Brussels)
International Expert Council, Community of Practice: Preventative Medicine (Moscow)
trevor.m@trevormarshall.com

September 22, 2014

On behalf of the BioInitative Working Group, we are writing to express our concern about the views expressed by CEOs from Google, Dell, Apple, Adobe, eBay, Facebook, the George Lucas Educational Foundation and others to the FCC supporting wireless technologies in schools.

Your letter to the FCC dated July 7, 2014 titled Education Superhighway, states:

> *"Today, we are writing to you to urge swift bi-partisan action at your July 11, 2014 meeting to adopt the E-Rate modernization proposal set forth by Chairman Wheeler."*
> *"By responsibly investing $2 billion of unused funds and providing predictable ongoing support for Wi-Fi, the plan will make dramatic progress in bringing high-speed connectivity to our classrooms."*

No one denies that bringing high-speed connectivity to our classrooms is important. But it can be a wired connection and does not have to be WiFi. It does not reflect well on the ethics of your corporations to encourage the FCC to provide $2 billion dollars for new wireless classroom infrastructure and devices for school children, knowing that wireless emissions have been classified as a Possible Human Carcinogen by the World Health Organization's International Agency for Research on Cancer (2011). To promote wireless technologies in schools is to deliberately and knowingly disregard current health warnings from international science and public health experts.

Saturating schools with wireless technology will likely create unnecessary liability for municipalities and result in a loss of public trust and confidence in the corporations that push their wireless products with a blind eye toward health concerns.

Epidemiological studies show links between radiofrequency radiation (RFR) exposure and cancers, neurological disorders, hormonal changes, symptoms of electrical hypersensitivity (EHS) and more. Laboratory studies show that RFR exposure increases risk of cancer, abnormal sperm, learning and memory deficits, and heart irregularities. Fetal exposures in both animal and human studies result in altered brain development in the young offspring, with disruption in learning, memory and behavior. The brain development of a fetus can be impaired by in-utero exposure to a pregnant woman. The evidence for these statements is based on hundreds of published, peer-reviewed scientific studies that report adverse effects at levels much lower than current FCC public safety limits. WiFi is schools, in contrast to wired internet connections, will increase risk of neurologic impairment and long-term risk of cancer in students. Corporations cannot avoid responsibility simply by asserting compliance with existing legal, but outdated and inadequate FCC public safety limits.

Today, corporations that deal with educational technology should be looking forward and helping school administrators and municipal leaders to access safe, wired solutions. Your corporations can reasonably foresee and offer alternatives to potentially hazardous exposures to wireless radiation by choosing to support wired educational technologies.

Thank you for your attention to this letter.

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David O. Carpenter, MD, Tel: 518-525-2660 Email: dcarpenter@albany.edu
Co-Editors, BioInitiative 2012 Report
For the BioInitiative Working Group

Copies: CEOs signing Education Superhighway letter to the FCC
Federal Communications Commission
The White House, President Obama
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American Academy of Environmental Medicine

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May 13, 2013

Open Letter to the Superintendents
of the School Districts of the United States

The American Academy of Environmental Medicine (AAEM) strongly supports the use of wired Internet connections.

The AAEM comprises Medical Doctors, Osteopaths, and PhD researchers focusing on the effects of environmental agents on human health. For forty years the Academy has trained Physicians to treat the most difficult patients who are often overlooked by our medical system, because the cause of their illness, rather than being caused by an infection or traditionally understood cause, is related to more basic underlying causes such as chemical, toxic metal, food or radiation exposures.

In May 2011 the World Health Organization elevated exposure to wireless radiation, including WiFi, into the Class 2b list of Carcinogens.

There is consistent emerging science that shows people, especially children who are more vulnerable due to developing brains, and thinner skulls, are affected by the increasing exposure to wireless radiation. In September 2010, the Journal of the American Society for Reproductive Medicine-Fertility and Sterility, reported that only four hours of exposure to a standard laptop using WiFi caused DNA damage to human sperm.

In December 2012 the American Academy of Pediatrics- representing 60,000 pediatricians, wrote to Congress requesting it update the safety levels of microwave radiation exposure especially for children and pregnant women.

In a school setting, children are exposed to WiFi for an unprecedented period of time, for their entire childhood. Some of these signals will be much more powerful than is received at home, due to the need for the signals to go through walls, and serve multiple computers simultaneously. The school signals are dozens of times more powerful than the café and restaurant systems.

To install this system in your school district risks a widespread public health hazard that the medical system is not yet prepared to address. Statistics show that you can expect to see an immediate reaction in 3% and delayed effects in 30%, including teachers.

It is better to exercise caution and substitute with a safe alternate such as a wired connection, which is not classified as a possible Carcinogen. While more research is being conducted children must be protected. Wired technology is not only safer, it also stronger and more secure.

While the debate ensues about the dangers of WiFi, cell phone towers and cell phones, it is the doctors who must deal with the after affects. Until we can determine why some get sick and others do not, and some are debilitated for indeterminate amounts of time, we implore you to not take the risk, with the health of so many children who have entrusted you to keep them safe while at school.

Respectfully,

The Executive Committee of the American Academy of Environmental Medicine

Message to Schools and Colleges about Wireless Devices and Health

If wireless devices, such as Wi-Fi, are used in your schools and colleges, then the health of your students, your faculty, and your staff can be at risk. This is a difficult problem but an addressable one if you act.

Background: Wireless devices transmit information using radiofrequency/microwave radiation. The international biomedical research community has been studying the biological impact of such radiation for decades, but more intensely in recent years. Thousands of peer-reviewed studies published in biomedical research journals have contributed to our understanding of this impact. So many serious biological effects have been found that immediate responsive action is warranted. Further, these biological effects are occurring at levels of radiation far lower than earlier understood. Simply stated, a worldwide health crisis is emerging and is becoming a hallmark of the 21st Century. The international biomedical research community is trying to warn us; but we, in the USA, are not yet listening. I hope this message will help to change that.

As a scientist, I urge you to look into the **health impact of the radiofrequency/microwave radiation** produced by wireless devices. Examples of wireless devices of concern in our environment are Wi-Fi in all of its forms; cell phones and cell towers (especially those located on school grounds); cordless phones; wireless computers, whether desktop, laptop, or tablet versions; wireless baby monitors; wireless smart electricity meters; emerging wireless smart appliances; and microwave ovens (because they always leak radiation).

This crisis is the consequence of many factors. Here are some of them:

- All living things are bioelectrical in nature. That is why electrocardiograms and electroencephalograms work. They, of course, measure the tiny electrical signals that operate the heart and the brain. The critical tasks performed by these tiny electrical signals, and so many other electrical signals in all living things, can be disrupted by radiofrequency/microwave radiation.

- The levels of manmade radiofrequency/microwave radiation in our environment are increasing exponentially and already exceed, by many orders of magnitude, the levels at which all life on Earth evolved. Simply stated, we are drowning in a rising sea of manmade radiofrequency/microwave radiation.

- The invisible nature of radiofrequency/microwave radiation leaves the public and the decision-makers unaware of the rising levels of radiation around them.

- The genuine usefulness of wireless devices promotes denial of the risks.

- The intense advertising, the economic power, and the political power of profitable wireless industries enable them to dominate the public dialogue and to hold sway over government regulators and legislators.

- Current Federal standards for limiting the exposure of the public to radiofrequency/microwave radiation are outdated and overly permissive. Those standards are based on thermal heating alone. In effect, the Government claims that if you are not cooked too much by the radiation, then you are fine. Those Federal standards ignore the many biological effects that occur at much lower levels of radiation, leaving the public unprotected.

- Federal and state governments are advocating unlimited expansion of wireless technology, and are even co-funding such expansion and mandating the acceptance of wireless technology by the public. Such

actions reflect a widespread lack of understanding of, or willful blindness to, the underlying science and its consequences for public health.

- Some of the more serious consequences of exposure to radiofrequency/microwave radiation (such as DNA damage, cancer, and infertility) are especially nefarious because they give no early warning signs.

- Other consequences of exposure do give early warning signs (such as sleep disruption, headaches, fatigue, ringing in the ears, memory loss, dizziness, heart arrhythmia, and many others); but those signs are too often dismissed because they can have other causes as well, complicating identification of the true cause.

- The absence of routine training of physicians in the biological effects of radiofrequency/microwave radiation makes it difficult for physicians to identify the causes and to provide responsive guidance.

- Even aware individuals cannot control their exposure in any environment shared with others, because the radiation around them, much like second-hand smoke, is forced on them by unaware individuals. Only governments can fully solve this problem, but they are currently part of the problem. For now the public will have to protect itself, and that will require public education and action.

Fortunately, many of the services that wireless devices offer can be realized with much safer wired devices. The wired devices achieve connectivity with fiber-optic, coaxial, or Ethernet cables. The wired devices are faster, more reliable, and more cyber secure. They are, however, less mobile, often less convenient, and somewhat more expensive to install. But those drawbacks pale in comparison to the benefits of good health.

Simply stated, schools and colleges can protect their students, staff, and faculty from the health risks posed by wireless devices, including Wi-Fi, by converting to safe wired connectivity. If your institution lacks the resources to convert now, do consider shutting down your wireless devices anyway and converting as soon as you can. You can advance learning without leaving a trail of illness behind you, some of which can be lifelong.

As a suggested starting place for exploring the concerns about the radiation from wireless devices, I have appended an “Annotated List of References” and an “Annotated List of Videos”. Please view, especially, video (1) called “Wi-Fi in Schools, the Facts”, made in Australia, on page 6.

Regards,

Ronald M. Powell, Ph.D.
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Montgomery Village, MD 20886-4007
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My background

I am a retired U.S. Government scientist (Ph.D., Applied Physics, Harvard University, 1975). During my Government career, I worked for the Executive Office of the President, the National Science Foundation, and the National Institute of Standards and Technology. For those organizations, respectively, I addressed Federal research and development program evaluation, energy policy research, and measurement development in support of the electronics and electrical-equipment industries and the biomedical research community. I currently interact with other scientists and with physicians around the world on the impact of the environment – including the radiofrequency/microwave environment – on human health.

ANNOTATED LIST OF REFERENCES

The international biomedical research community has conducted thousands of studies seeking to identify the biological effects of exposure to both low frequency and radiofrequency electromagnetic fields, extending into the microwave region. So many serious biological effects have been found from such fields, at levels earlier thought to be low enough to be safe, that immediate action is needed to alert and protect the public.

The most massive review of this biomedical literature is the 1479-page BioInitiative 2012 Report which considered about ***1800*** biomedical research publications, most issued in the previous five years. The BioInitiative 2012 Report was prepared by an international body of 29 experts, heavy in Ph.D.s and M.D.s, from 10 countries, including the USA which contributed the most experts (10). The review concludes that "The continued rollout of wireless technologies and devices puts global public health at risk from unrestricted wireless commerce unless new, and far lower*[,]* exposure limits and strong precautionary warnings for their use are implemented."

> BioInitiative Working Group, Cindy Sage, M.A. and David O. Carpenter, M.D., Editors, BioInitiative Report: A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Radiation, December 31, 2012
> http://www.bioinitiative.org

A group of six doctors in Oregon, led by Paul Dart, M.D., released, in June 2013, a 74-page review of ***279*** biomedical research publications. This review makes the health case against "cell phones, base stations, Wi-Fi, Smart Meters and other RF *[radiofrequency]* or ELF *[extremely low frequency]* -emitting devices". The review notes that "The current levels of exposure need to be reduced rather than increased further. The FCC *[Federal Communications Commission]* must especially protect vulnerable groups in the population including children and teenagers, pregnant women, men of reproductive age, individuals with compromised immune systems, seniors, and workers." This review is posted on the website of the FCC at the link entitled "Health Effects of RF - Research Review (87)".

> Biological and Health Effects of Microwave Radio Frequency Transmissions, A Review of the Research Literature, A Report to the Staff and Directors of the Eugene Water and Electric Board, June 4, 2013
> http://apps.fcc.gov/ecfs/comment/view?id=6017465430

Michael Bevington, in 2013, published a book that summarizes the findings of ***1828*** international biomedical research publications. The book describes the symptoms caused by exposure to electromagnetic radiation, the many diseases associated with such exposure, and the relative risk levels associated with specific sources of electromagnetic radiation. The citations of papers include the PMID index numbers for easy location on the PubMed.gov website of the National Institutes of Health. This website provides the largest index to the biomedical research literature in the world.

> Electromagnetic Sensitivity and Electromagnetic Hypersensitivity: A Summary by Michael Bevington
> NEW EDITION: March 2013
> http://www.es-uk.info

About 200 scientists from 39 countries around the world submitted an international appeal to the United Nations and to the World Health Organization in May 2015. These scientists seek improved protection of the public from harm from the radiation produced by many wireless sources, including "cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors" among others.

Together, these scientists have published over 2000 peer-reviewed research papers on this subject.

https://www.emfscientist.org/index.php/emf-scientist-appeal

The International Agency for Research on Cancer, of the World Health Organization, has already classified radiofrequency electromagnetic fields as a Class 2B carcinogen ("possible carcinogen"), based primarily on the increased risk of brain cancer. That decision was made in 2011. Since then, the research supporting a higher classification of risk ("probable carcinogen", or even "known carcinogen") has continued to build.

http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

The American Academy of Environmental Medicine (AAEM), which trains physicians in preparation for Board Certification in Environmental Medicine, states: "The AAEM strongly supports the use of wired Internet connections, and encourages avoidance of radiofrequency such as from WiFi, cellular and mobile phones and towers, and 'smart meters'." AAEM further states that "The peer reviewed, scientific literature demonstrates the correlation between RF *[radiofrequency]* exposure and neurological, cardiac, and pulmonary disease as well as reproductive and developmental disorders, immune dysfunction, cancer and other health conditions. The evidence is irrefutable." The AAEM concludes: "To install WiFi in schools plus public spaces risks a widespread public health hazard that the medical system is not yet prepared to address."

AAEM, Wireless Radiofrequency Radiation in Schools, November 14, 2013
http://www.aaemonline.org/pdf/WiredSchools.pdf

The American Academy of Pediatrics (AAP), whose 60,000 doctors care for our children, supports the development of more restrictive standards for radiofrequency radiation exposure that would better protect the public, particularly the children. The AAP, in a letter to the Federal Communications Commission (FCC) and the Food and Drug Administration (FDA), dated August 29, 2013, states that "Children are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation. Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes."

http://apps.fcc.gov/ecfs/document/view?id=7520941318

The U.S. Government bears a major responsibility for the exponential growth in the levels of radiation from wireless devices in the environment. In 1996, the U.S. Congress passed, and the President signed, the Telecommunications Act of 1996. Under pressure from the cell phone industries, this law included this provision: "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities *[cell towers]* on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the *[Federal Communications]* Commission's regulations concerning such emissions." Because the Federal Communications Commission's regulations on radiation exposure are so permissive, this provision prevents state and local governments from protecting their people from radiation from cell towers, based on health concerns.

Telecommunications Act of 1996
https://transition.fcc.gov/Reports/tcom1996.pdf

The Federal Communications Commission (FCC) has acted in partnership with the wireless industries by permitting wireless radiation levels far higher than the biomedical research literature indicates are necessary to protect human health. The success of the wireless industries in capturing the FCC, the committees in the U.S. Congress that oversee the FCC, and the Executive Branch is detailed in a new monograph from the Center for Ethics at Harvard University. As an example of that capture, the President recently appointed, as head of the FCC, the former head of the CTIA – The Wireless Association, which is the major lobbying organization for the wireless industry. This, of course, is the infamous "revolving door".

> Norm Alster, Captured Agency: How the Federal Communications Commission is Dominated by the Industries It Presumably Regulates (2015)
> http://ethics.harvard.edu/news/new-e-books-edmond-j-safra-research-lab

Further, the U.S. Government's "American Recovery and Investment Act of 2009" provided funding that was used to motivate the installation of wireless smart meters (also called the "Advanced Metering Infrastructure" or "AMI") by offering cost sharing, in the form of grants, to the utilities that would adopt such meters.

> https://www.smartgrid.gov/recovery_act/overview/smart_grid_investment_grant_program.html

Many states then extended the impact of the above Act by *mandating* the acceptance of wireless smart meters by the public. These meters contain microwave transmitters/receivers and are placed either on, or inside, every home and many businesses. A California court-ordered document indicates that each smart meter broadcasts bursts of radiation, on average about 10,000 times per day and up to a maximum of about 190,000 times per day. Such bursts flood neighborhoods with radiation, day and night, throughout the year.

> http://emfsafetynetwork.org/wp-content/uploads/2011/11/PGERFDataOpt-outalternatives_11-1-11-3pm.pdf

Increasingly, the public is becoming aware of the threat that wireless radiation poses to health. The initial opposition focuses primarily on *mandated* sources of exposure, especially when the individuals exposed include the unborn and young children as they are among the most vulnerable. Thus, the strongest initial opposition is surfacing for cell towers, especially on school grounds; for Wi-Fi in schools and colleges; and for wireless smart meters placed on, or inside, homes and businesses. Most states now have opposition groups, and some states have even 10 or 20 such groups. These groups are pursuing relief through state regulatory bodies, through state legislatures, and through the courts. Below is a sampling of the hundreds of U.S. websites that reflect the nature and scope of the opposition to the unbridled expansion of wireless technology. Such websites seek to educate the public and decision-makers, and thus to promote responsive action, based on the underlying science.

> The BabySafe Project
> http://www.babysafeproject.org/the-science/
>
> National Association for Children and Safe Technology
> http://www.nacst.org/
>
> Stop Smart Meter's listing of groups in the USA and other countries opposed to wireless smart meters
> http://stopsmartmeters.org/frequently-asked-questions/contacts-database/
>
> Smart Grid Awareness, a Website by SkyVision Solutions, Consumer Protection Advocate
> http://smartgridawareness.org

ANNOTATED LIST OF VIDEOS

There are hundreds of videos on the Internet that address the impact of wireless radiation on health. Here are just a few that provide an especially good introduction to this topic. An Internet search will surface many more.

(1) An introduction to the health risks posed by Wi-Fi in schools

Wi-Fi in Schools, the Facts (September 9, 2013) (18 minutes)
Produced by Wi-Fi in Schools Australia.
https://www.youtube.com/watch?v=QQryZbxlqXI&feature=youtu.be

(2) Wide ranging overview of the impact of electromagnetic radiation on human health, particularly at microwave frequencies, with a special emphasis on children and the school environment

Electromagnetic Radiation Health for Children 2014 (70 minutes)
Presented by Dr. Erica Mallery-Blythe, a UK physician.
https://www.youtube.com/watch?v=sNFdZVeXw7M

(3) Documentary on the wireless industry's efforts to suppress public awareness of the health effects of wireless radiation

Microwaves, Science & Lies (2014) (90 minutes)
Produced by Jean Heches and Nancy de Meritens of France.
https://vimeo.com/ondemand/17755/89417454

(4) Samples of video testimony by individuals harmed by the radiation from wireless devices

Cell Phones Cause Cancer (October 17, 2012) (9 minutes)
Presented by Jimmy Gonzalez, Esq.
https://www.youtube.com/watch?v=DIlOVJd0lA8

Woman suffers acute radiation exposure from a bank of smart meters (January 21, 2015) (3 minutes).
Produced by Maryland Smart Meter Awareness.
https://www.youtube.com/watch?v=F9QZuWPw6Y0&feature=youtu.be

Man experiences adverse health effects from exposure to a smart meter (March 7, 2013) (3 minutes).
Presented by Garic Schoen of Gaithersburg, MD.
Produced by Maryland Smart Meter Awareness.
http://marylandsmartmeterawareness.org/smart-meter-news/maryland-ms-resident-testimony-to-economic-matters-committee-re-hb1038-on-march-14-2013/

Individuals with high sensitivity to the radiation from wireless devices search for increasingly rare safe electromagnetic environments.
Searching for a Golden Cage (May 8, 2014) (13 minutes)
Produced by Nadav Neuhaus.
http://time.com/golden-cage/

IDEA

IRISH DOCTORS' ENVIRONMENTAL ASSOCIATION
CUMANN COMHSHAOIL DHOCTÚIRÍ NA HEIREANN

7th January, 2013

Dear Principal,

The Irish Doctors Environmental Association (IDEA) has very serious concerns in relation to the ubiquitous use of Wi-Fi in Irish schools, and alerts you to the warnings of many leading international scientists and medical doctors who believe Wi-Fi is harmful to health, especially children's health.
http://wifiinschools.org.uk/resources/safeschools2012.pdf
Wi-Fi is an unregulated technology and there is absolutely no evidence that it is safe.

Since May 31st, 2011, radiofrequency electromagnetic fields (as in Wi-Fi) have been classified by the World Health Organisation as 'possibly carcinogenic' to humans. The IDEA unequivocally supports the Council of Europe, The European Environmental Agency and The International Commission for Electromagnetic Safety (ICEMS) in urging the adoption of the Precautionary Principle to protect human health.
Warnings by Scientists and Doctors:
http://www.iemfa.org/index.php/appeals

The Precautionary Principal has already been adopted by a number of Governments and agencies internationally.
Governments & organisations banning and warning against Wi-Fi:
http://www.cellphonetaskforce.org/?page_id128

While we fully support the promotion of technology in education we urge you to use wired technologies for your own safety and that of your pupils and staff. The tragedy of avoidable illness is only superseded by the knowledge that it could have been avoided.

Yours sincerely

Elizabeth Cullen M.B. B.Ch. B.A.O. M.Sc. Ph. D 045-485215

p.p. Philip Michael
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April 9, 2014

Via email: rec@harlanglaw.dk

Dear members of The Committee on Radiation Protection/Komitéen for Strålebeskyttelse:

My name is Frank Clegg and I am the CEO of Canadians for Safe Technology, C4ST, a volunteer based, national organization which promotes the safe use of wireless technology.

In my previous role as President of Microsoft Canada, I witnessed the incredible benefits that technology can provide. I also witnessed the potential harmful effects if technology is not implemented safely. Though wireless technologies afford schools various advantages, this solution cannot overshadow the evidence which demonstrates cause for concern. I request that you consider the following important facts.

The Canadian Teachers' Federation (CTF) is a national alliance of provincial and territorial teacher organizations that represent nearly 200,000 elementary and secondary school teachers across Canada. In their submission to the public consultation of the Royal Society of Canada, Oct. 28, 2013, they submitted the following recommendations. (Safety Code 6 is Health Canada's guideline regarding the limits of radiation from wireless devices).
Recommendations...
... That Safety Code 6 include a recommendation for prudent use of Wi-Fi whenever possible including the recommendation to limit consistent exposure in schools by turning off wireless access points when not in use. ...
That Safety Code 6 exposure thresholds be based upon both thermal and biological effects of exposure to Wi-Fi.
... That the Expert Panel recommend an education program regarding the relative safety of Wi-Fi exposure and that appropriate resources be developed to educate the public regarding ways to avoid potential exposure risks of Wi-Fi access points and devices.

As reported by CBC News on Aug. 17, 2013, http://www.cbc.ca/news/canada/toronto/story/2013/08/17/toronto-cell-phone-ban.html "The Elementary Teachers' Federation of Ontario has updated its policy position on the student use of personal electronic devices, preferring for them to be turned off and put away unless a teacher says otherwise. That policy, which was amended at the union's annual general meeting, informs ETFO in its discussions with the government and school boards on related issues. A portion of that policy now states that such devices, which include cellphones, should "be stored and turned off during the instructional day unless their use is directly authorized by staff." In a separate resolution, ETFO voted to study the effects of non-ionizing electromagnetic radiation, the potentially harmful radiation emitted by cellphones. A report is due on the matter in February."

In a letter to the Peel Region, April 22, 2013, The American Academy of Environmental Medicine stated "To install this widespread wireless internet access system in Peel District schools risks a widespread public health hazard that the medical system is not yet prepared to address. Statistics show that you can expect to see an immediate reaction in 3% and delayed effects in 30%, including teachers."

In 2012, the BC Confederation of Parent Advisory Councils passed resolution 18 which states: "BCCPAC call on Boards of Education to cease to install Wi-Fi and other wireless networks in schools where other networking technology is feasible." http://www.bccpac.bc.ca/resolutions/wi-fi-classrooms-committee-report

In May 2011, the World Health Organization (WHO) announced that the radiation emitted from wireless devices, including Wi-Fi, is a Class 2B carcinogen, which falls into the same category as lead and DDT.

You may already be aware that some schools and libraries in France and Switzerland have already removed Wi-Fi due to the suspected harmful health effects.

The Council of Europe, which includes 47 countries, adopted resolution 1815 which suggests in member countries "give preference to wired Internet connections, and strictly regulate(s) the use of mobile phones by schoolchildren on school premises."

The European Parliament (EU) resolutions 2008/2211(INI) & 2007/2252(INI,) state: "wireless technology (mobile phones, Wi-Fi / WiMAX, Bluetooth, DECT landline telephones) emits EMFs that may have adverse effects on human health... particularly to young people whose brains are still developing... **the limits on exposure to electromagnetic fields which have been set for the general public are obsolete."** (emphasis in original)

Other countries such as Israel, Russia, Switzerland, Frankfurt, Bavaria, and Salzburg have followed suit making the difficult decision to use hard wired connections as well. Recently, France passed a law recommending hard wired technology in schools.

The Austrian Medical Chamber shares that “WiFi may lead to concentration difficulties and memory problems in certain individuals.” The Austrian Medical Association recommends Wi-Fi free school environments.

The International Society of Doctors for the Environment (ISDE) and Irish Doctors Environmental Association (IDEA) advises to “Avoid Wi-Fi in home or work if possible, particularly in schools or hospitals. Use wired technology whenever possible” sharing that: “Because of the potentially increased risks for the fetus, infants and young children due to their thinner more permeable skulls and developing systems, particularly the immune and neurological systems, based on the precautionary principal and on the mounting evidence for harm at the sub-cellular level, we recommend that EMR exposure should be kept to a minimum.”

The American Academy of Pediatrics (AAP) - 60,000 Pediatricians and Pediatric Surgeons calls for caution as well stating that "The differences in bone density and the amount of fluid in a child’s brain compared to an adult’s brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults... the current exposure limits may not reflect the latest research on RF energy" and lends support to removing Wi-Fi from schools as well.

As stewards of the public trust, I urge you to ensure the safest possible learning environment for the students in your care and to set an example for school districts by removing Wi-Fi and adopting “Best Practices” which limit the use of other wireless technologies.

Sincerely,

Frank Clegg
CEO,
Canadians for Safe Technology (C4ST)
frank@c4st.org

cc: Susanne Hansen, sh.klodskov@gmail.com

UNIVERSITY AT ALBANY
State University of New York
Institute for Health and the Environment
and
Department of Environmental Health Sciences
School of Public Health

28 February 2011

Chairman and Trustees
Kawartha Pine Ridge District School Board
Education Centre
1994 Fisher Drive
Peterborough, Ontario K9J7A1

Dear Sirs/Madams:

This is concerning potential adverse health effects associated with exposure to radiofrequency (RF) radiation, specifically that from wireless routers. I am a public health physician who has been involved in issues related to electromagnetic fields (EMFs) for a number of years. I served as the Executive Secretary for the New York Powerline Project in the 1980s, a program of research which showed that children living in homes with elevated magnetic fields coming from powerlines suffered from an elevated risk of developing leukemia. I have edited two books on effects of EMFs, including RF radiation. I served as the co-editor of the Bioinitiative Report (www.bioinitiative.org), a comprehensive review of the literature on this subject. The public health chapter from this report was subsequently published in a peer reviewed journal, and that is attached. Also I testified before the President's Cancer Panel on this subject in 2009, and a publication coming from that testimony is also attached. Thus this is a subject which I know well, and one on which I take a public health approach that has as a fundamental principle the need to protect against risk of disease even when one does not have all the information that would be desirable.

There is clear and strong evidence that intensive use of cell phones increases the risk of brain cancer, tumors of the auditory nerve and cancer of the parotid gland, the salivary gland in the cheek by the ear. The evidence for this conclusion is detailed in the attached publications. WiFi uses similar radiofrequency radiation (1.8 to 5.0 GHz), although the intensity of exposure in the immediate environment is much lower than what one gets from holding a cell phone close to your head. The difference between a cell phone and a WiFi environment, however, is that while the cell phone is used only intermittently a WiFi environment is continuous. In addition WiFi transmitters are indoors, where people (and in this case, children) may be very close to them. There is evidence from Scandinavian studies of cell phone usage that children who use cell phones are about five times more likely to develop brain cancer than if use starts as an adult. Thus it is especially important to protect children.

To my knowledge there has not been any health investigation of individuals living or working in WiFi environments as compared to others who are not. However, because the radiation is the same as those for cell phones, there is every reason to assume that the health effects would be the same, varying only in relation to the total dose of radiation. Wired facilities do not generate any RF radiation. While there is not specific proof that WiFi increases risk of cancer, there is certainly no evidence that it is safe. I urge you to not put WiFi in any school. Children should not be put at increased risk of developing cancer.

Yours sincerely,

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1. Regarding: Measurements related problems in the MCPS Wi-Fi Report

We have analysed the measurement report and would like to note the following:

- In the **Comparison-table 2.2.** the MCPS provides only average values, no peak values. In cell phone technologies (like GSM) the difference between average and peak value is 2-fold. **In Wireless local area technologies like Wi-Fi, the difference between average value and peak value is up to 100-fold** (Ferro & Potorti, 2005). Note that in the table 2.2. by the MCPS only average values are presented. Later you provide **in the chapter 7.2.2 Maximum, Instantaneous Power Density, which needs attention since these levels occasionally exceeded in your school measurements allowable EMC-levels (EN60601-1 → 3 V/m) for medical instruments** (Robinson *et al*., 2003).

- **Almost all MCPS measurements were done in the near field of the devices under 3 wavelengths.** The wavelength for 2,4 GHz is 12,5 cm and for 5 GHz is 6 cm. That means that the near field will be <37,5 cm for 2,4 GHz and <18 cm for 5 GHz. In order to assess power density exposure in near field one needs to measure both electric and magnetic field components.

- The MCPS has not provided **information about Wi-Fi technology, namely it's beacon signal**. This signal, officially **SSID (Service Set IDentifier), is created by the access point (AP) by sending constantly SSID 10 times in a second , at 10 Hz** (Ferro and Poporti, 2005). **Mobile industry has patented technology to avoid this constant SSID sending for health reasons** (Swisscom, 2004). This SSID sending at 10 Hz is an additional risk-factor and it should be mentioned. Our brain operates in alpha, beta and gamma bands. This Wi-Fi beacon overlaps the alpha band. Low-frequency EMFs (including low-frequency pulses) have an effect on evoked potentials of the brain (Carrubba *et al*., 2008).

- **Because of the risk of this 10 Hz Beacon signal of Wi-Fi, The European Academy for Environmental Medicine has assigned very strict precautionary RF-levels for Wi-Fi** (Belyaev et al., 2015). Please, pay attention to Wi-Fi RF power density peak-levels in the next picture.

RF source Max Peak/Peak Hold	Daytime exposure	Nighttime exposure	Sensitive populations[1)]
Radio broadcast (FM)	10,000 µW/m²	1000 µW/m²	100 µW/m²
TETRA	1000 µW/m²	100 µW/m²	10 µW/m²
DVBT	1000 µW/m²	100 µW/m²	10 µW/m²
GSM (2G) 900/1800 MHz	100 µW/m²	10 µW/m²	1 µW/m²
DECT (cordless phone)	100 µW/m²	10 µW/m²	1 µW/m²
UMTS (3G)	100 µW/m²	10 µW/m²	1 µW/m²
LTE (4G)	100 µW/m²	10 µW/m²	1 µW/m²
GPRS (2.5G) with PTCCH* (8.33 Hz pulsing)	10 µW/m²	1 µW/m²	0.1 µW/m²
DAB+ (10.4 Hz pulsing)	10 µW/m²	1 µW/m²	0.1 µW/m²
Wi-Fi 2.4/5.6 GHz (10 Hz pulsing)	10 µW/m²	1 µW/m²	0.1 µW/m²

Picture. Precautionary levels for RF-radiation. **For Wi-Fi less than 10 μW/m² (peak value), which is 0,001 μW/cm² (peak value).** By the **European Academy for Environmental Medicine** (Belyaev *et al*., 2015, p. 356)

- **We would like to draw attention to** long-term exposure related health risks.

Radiofrequency radiation from Wi-Fi devices causes fertility problems as shown by several in vivo and in vitro studies (see for example Atasoy *et al*., 2013, Avendaño *et al*,. 2012, Dasdag *et al*., 2015a, Shokri *et al*., 2015).

Additionally, **RF-radiation from Wi-Fi access points (AP) causes oxidative stress in cells which leads to several disorders** (see for example Nazıroğlu *et al*., 2012, Aynali *et al*., 2013, Salah *et al*., 2013). The overall detrimental impact of RF radiation induced oxidative stress is summarised in the review of Yakymenko *et al*. (2015).

2. Regarding: The IARC classification of RF-EMF as Group 2B, i.e., 'possibly' carcinogenic to humans and the MCPS Report's inaccurate interpretation

The classification of radiofrequency electromagnetic fields (RF-EMF) as Group 2B, i.e., 'possibly' carcinogenic to humans,was made by 30 scientists from 14 countries at a meeting 2011 for the International Agency for Research on Cancer (IARC), World Health Organization (IARC 2011, Baan et al. 2012). **The working group mainly based their classification on one cohort study** (Schüz et al., 2006) **and five case-control studies** (Muscat et al., 2000, Inskip et al., 2001, Auvinen et al.,2002, The Interphone study group, 2010, Hardell et al., 2011).

They also reviewed more than 40 studies that assessed the carcinogenicity of RF-EMF in rodents, including seven 2-year cancer bioassays and also many studies with endpoints relevant to mechanisms of carcinogenesis, including genotoxicity, effects on immune function, gene and protein expression, cell signaling, oxidative stress, and apoptosis (Baan et al., 2011).

The referred INTERPHONE study (The Interphone study group, 2010), in the MCPS radiation report, was one of the case-control studies. **The Interphone study was a multicentre study of mobile phone use and brain tumours, including malignant tumours in the brain as glioma and benign tumours as acoustic neuroma and meningioma**. The pooled analysis included 2708 glioma cases and 2972 controls (participation rates 64% and 53%, respectively). In the Interphone study a regular user of mobile phones had an average of at least one call per week for a period of ≥6 months. **This very low user group was compared to several other groups of low users compared to nowadays more extensive use of mobile phones.** The highest group of users, ≥1640 hours was divided in three sub groups depending on how many years they had used a mobile phone. For the shortest time span on 1-4 years only 23 of the glioma cases and 8 of the controls had used their mobile phones for more than 1640 hours. If any of these 23 persons with a brain cancer or any of the 8 controls had used their mobile phones for only one year they would have used it at least in average for four and a half hours a day during a year. If they instead had talked in their mobile phones during four years it would be for an average of a little more than an hour a day.
For the group of users between 5 and 9 years, 84 cases and 73 controls, the use per day would be at least between 54 minutes and 30 minutes. **For the long user group of 10 years or more, 93 cases and 73 controls, they talked in their mobile phones for 27 minutes a day or less for more than 10 years of use.**
For the main part of cases their use of mobile phones had been for a lot less than four hours a day. Today when most people use only their mobile phone and landline phones both at home and at work are becoming scarce, an amount of 4 hours or more wireless telephone use / day for salesman, telephone operators and so on is not uncommon.
In the Interphone study there was an statistical significant increased risk for a malignant brain tumour of 1.4 times (odds ratio, OR, 1.4, 95% CI 1.03-1.89) only for the highest user group of a total on more than 1640 hours.
Hardell et al. (2011) in Sweden found that **cases who had used a mobile phone for more than 1 year had an increased risk for glioma of 1.3** (OR 1.3, 95% Cl 1.1-1.6).

The **risk increased with increasing time since first use and with total call time, reaching 3.2 times** (OR 3,2, Cl 2.0-5.1) **for more than 2000 hours of use**. Use of the mobile phone on the same side of the head as the tumour was associated with higher risk.

Since 2011 several other studies have been published which are strengthening the possible association between RF-EMF and cancer. Using the **Bradford Hill viewpoints for evaluating strengths of evidence of the risk for brain tumours associated with use of mobile and cordless phones the classification should be upgraded to group 1 carcinogen, i.e., "the agent is carcinogenic to humans"** (Hardell & Carlberg, 2013).

New case-control studies have verified Hardell's studies (Coureau et al., 2014) and up to 20 years of mobile phone use have found even higher risk for brain tumours (Hardell & Carlberg, 2015).

A newly published study has found a tumor promotion effect on mice from exposure to radiofrequency electromagnetic fields below exposure limits for humans (Lerchl *et al*., 2015). RF-EMFs do not cause direct DNA damage. On the contrary **numerous studies have shown generation of reactive oxygen species (ROS) that can cause oxidative damage of DNA. This is a well-known mechanism in carcinogenesis for many agents.** The broad biological potential of ROS and other free radicals makes radiofrequency radiation a potentially hazardous factor for human health, not only cancer risk but also other health effects (Yakymenko *et al*., 2015).

The IARC classification of RF-EMF as Group 2B, possibly carcinogenic to humans, doesn't only include exposure from mobile phones near the ear. **The classification includes all sources of RF-EMFs.** The exposure from mobile phone base stations, Wi-Fi access points, smart phones, laptops and tablets can be long term, sometimes around the clock both at home and at school. **This constant exposure to lower levels of exposure may be as deleterious to health as higher exposure during short time** (Fragopoulou et al., 2012, Dasdag et al., 2015b). This **risk may be accentuated for children because their probable longer use of wireless devices** (Morgan et al., 2014). **Children are also growing and have more immature cells which can be more sensible to RF-EMF** (Markova et al., 2010)

In conclusion, long term health effects from RF EMFs are still under investigation and a significant amount of troublesome scientific evidence has surfaced. By using wireless technologies at close range, long term health risks cannot be excluded. Therefore, we recommend schools to use wired technologies.

Respectfully submitted

Sincerely,

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24 March 2014

Open letter by British medical doctors: Health and safety of Wi-Fi and mobile phones

We wish to highlight our concern over the safety of exposure to microwave radiation from wireless technology, particularly for vulnerable groups like children, pregnant women, the elderly and those with compromised health.

There is growing concern that chronic (long-term) exposure to radiofrequency/microwave radiation from wireless technologies causes damage, particularly genetic damage, cognitive damage, cancer and decreased fertility. There is now substantial evidence of a link between mobile phone use and brain cancer. This was recognised by the International Agency for Research on Cancer (IARC)'s 30-strong panel of scientists, which in 2011 classed radiofrequency radiation as "possibly carcinogenic".

Additionally, doctors are encountering a significant and growing number of people presenting with **a range of acute (short-term) symptoms from wireless radiation, including headaches, palpitations, rashes, fatigue, sleep disturbance, allergies and memory and concentration problems.**

International medical agencies have recognised the evidence of harm (see appended list) but these rulings may take many years to be reflected in public health policy. This controversy is a common characteristic of scientific understanding when environmental exposures are new.

New technologies and substances often come with scientific conflict, which can continue for several decades before consensus is achieved. Commercial pressures often delay the acceptance of health risks, even when scientific evidence is compelling. In the case of tobacco, asbestos, x-rays and leaded petrol, for example, it took many decades before damage was established and accepted by health agencies and, during those decades, millions of people suffered ill health and death as a result of the delay. Now, despite evidence of harm, wireless technology is being rolled out widely.

We urge health agencies and the public to act immediately to reduce exposure to radiofrequency/ microwave radiation. This is especially important for children, who are physiologically more vulnerable to this exposure, and for whom adults have a safeguarding responsibility. **Children's health should be put ahead of convenience and commercial benefits. Children should not use mobile phones except in an emergency, and WiFi should be replaced with wired alternatives in schools and other settings where children spend considerable time.**

Yours faithfully,

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Appendix – International Rulings

1. In 2011 the **World Health Organization's scientific panel, the International Agency for Research on Cancer (IARC),** reviewed all the evidence on carcinogenesis (cancer-causing) and categorised electromagnetic radiation from mobile phones and Wi-Fi as **Possibly Carcinogenic (Class 2B).**

See http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

2. **The Council of Europe has called for member states to take measures to reduce exposure to electromagnetic fields and give preference to wired internet connections for children, particularly in schools and classrooms.**

The Parliamentary Assembly stated that "the Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco."

See http://assembly.coe.int/mainf.asp?link=/documents/adoptedtext/ta11/eres1815.htm

3. **The BioInitiative Report**, updated in 2012 by 29 scientists, states that **biological effects are clearly established and occur at very low levels of exposure to electromagnetic fields and radiofrequency radiation** from just minutes of exposure to mobile phone masts (cell towers), WI-FI, and wireless utility 'smart' meters.

See http://www.bioinitiative.org/conclusions

4. **The American Academy of Environmental Medicine** stated in a 2012 Position Paper that "**Multiple studies correlate RF exposure with diseases such as cancer, neurological disease, reproductive disorders, immune dysfunction, and electromagnetic hypersensitivity."**

See http://aaemonline.org/emf_rf_position.html

6. **International Society of Doctors for the environment (ISDE) and Irish Doctors' Environmental Association (IDEA)** state that "**there is sufficient scientific evidence to warrant more stringent controls** on the level and distribution of electromagnetic radiation [EMR]. The joint statement and recommendations are part of a call by medical and scientific experts for safe technologies in schools."

See http://www.env-health.org/news/members-news/article/isde-idea-statement-on

5. The Safe Schools Report 2012 lists statements by **other doctors and medical associations** raising concerns over children's exposure to electromagnetic fields from Wi-Fi and other wireless technology.

See http://wifiinschools.org.uk/resources/safeschools2012.pdf

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July 10, 2009.

Open Letter to Parents, Teachers, & School Boards Regarding Wi-Fi Networks in Schools and Cell Phone Antennas near School Property

I am a scientist who does research on the health effects of electromagnetic radiation and I am becoming increasingly concerned that a growing number of schools are installing WiFi networks and are making their school grounds available for cell phone antennas.

You will be told by both the federal government (Federal Communication Commission in the US; Health Canada and Industry Canada in Canada) as well as by the Wi-Fi provider that this technology is **safe** provided that exposures to radio frequency radiation remain below federal guidelines.

This information is **outdated** and **incorrect** based on the growing number of scientific publications that are reporting adverse health and biological effects below our "short-term, thermal-based" guidelines (see www.bioiniative.org) and the growing number of scientific and medical organizations that are asking for stricter guidelines to be enforced.

For these reasons it is irresponsible to introduce Wi-Fi microwave radiation into a school environment where young children and school employees spend hours each day.

FACT:

1. **GUIDELINES: Guidelines for microwave radiation (which is what is used in Wi-Fi) range 5 orders of magnitude in countries around the world.** The lowest guidelines are in Salzburg Austria and now in Liechtenstein. The guideline in these countries is 0.1 microW/cm^2. See short video (http://videos.next-up.org/SfTv/Liechtenstein/AdoptsTheStandardOf06VmBioInitiative/09112008.html). In Switzerland the guideline is 1 and in both Canada and the US it is 1000 microW/cm^2!

   Why do Canada and the US have guidelines that are so much higher than other countries? Our guidelines are based on a short-term (6-minute in Canada and 30-minute in US) heating effect. It is assumed that if this radiation does not heat your tissue it is "safe". This is NOT correct. Effects are documented at intensities well below those that are able to heat body tissue. See attached report: *Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network* (2007). These biological effects include increased permeability of the blood brain barrier, increased calcium flux, increase in cancer and DNA breaks, induced stress proteins, and nerve damage. Exposure to this energy is associated with altered white blood cells in school children; childhood leukemia; impaired motor function, reaction time, and memory; headaches, dizziness, fatigue, weakness, and insomnia.

2. **ELECTRO-HYPER-SENSITIVITY:** A growing population is adversely affected by these electromagnetic frequencies. The illness is referred to as "electro-hyper-sensitivity" (EHS) and is recognized as a disability in Sweden. The World Health Organization defines EHS as:

   ". . . a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs). . . EHS is a real and sometimes a debilitating problem for the affected persons, while the level of EMF in their neighborhood is no greater than is encountered in normal living environments. Their exposures are generally several orders of magnitude under the limits in internationally accepted standards. "

   Health Canada acknowledges in their Safety Code 6 guideline that some people are more sensitive to this form of

energy but they have yet to address this by revising their guidelines.

Symptoms of EHS include sleep disturbance, fatigue, pain, nausea, skin disorders, problems with eyes and ears (tinnitus), dizziness, etc. It is estimated that 3% of the population are severely affected and another 35% have moderate symptoms. Prolonged exposure may be related to sensitivity and for this reason it is imperative that children's exposure to microwave radiation (Wi-Fi and mobile phones) be minimized as much as possible.

3. **CHILDREN'S SENSITIVITY:** Children are more sensitive to environmental contaminants and that includes microwave radiation. The Stewart Report (2000) recommended that children not use cell phones except for emergencies. The cell phone exposes your head to microwave radiation. A wireless computer (Wi-Fi) exposes your entire upper body and if you have the computer on your lap it exposes your reproductive organs as well. Certainly this is not desirable, especially for younger children and teenagers. For this reason we need to discourage the use of wireless technology by children, especially in elementary schools. That does not mean that students cannot go on the Internet. It simply means that access to the Internet needs to be through wires rather than through the air (wireless, Wi-Fi).

4. **REMOVAL OF WI-FI:** Most people do not want to live near either cell phone antennas or Wi-Fi antennas because of health concerns. Yet when Wi-Fi (wireless routers) are used inside buildings it is similar to the antenna being inside the building rather than outside and is potentially much worse with respect to exposure since you are closer to the source of emission.

   Libraries in France are removing Wi-Fi because of concern from both the scientific community and their employees and patrons.

   The Vancouver School Board (VSB) passed a resolution in January 2005 that prohibits construction of cellular antennas within 1000 feet (305 m) from school property.

   Palm Beach, Florida, Los Angeles, California, and New Zealand have all prohibited cell phone base stations and antennas near schools due to safety concerns. The decision not to place cell antennas near schools is based on the likelihood that children are more susceptible to this form of radiation. **Clearly if we do not want antennas "near" schools", we certainly do not want antennas "inside" schools!** The safest route is to have wired internet access rather than wireless. While this is the more costly alternative in the short-term it is the least costly alternative in the long run if we factor in the cost of ill health of both teachers and students.

5. **ADVISORIES:** Advisories to limit cell phone use have been issued by the various countries and organizations including the UK (2000), Germany (2007), France, Russia, India, Belgium (2008) as well as the Toronto Board of Health and the Pittsburgh Cancer Institute (July 2008). While these advisories relate to cell phone use, they apply to Wi-Fi exposure as well since both use microwave radiation. If anything, Wi-Fi computers expose more of the body to this radiation than do cell phones.

6. **PRECAUTIONARY PRINCIPLE**: Even those who do not "accept" the science showing adverse biological effects of microwave exposure should recognize the need to be careful with the health of children. For this reason we have the Precautionary Principle, which states:

   In order to protect the environment, the precautionary approach shall be widely applied by States according to their capability. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.

   In this case "States" refers to the School Board and those who make decisions about the health of children.

The two most important environments in a child's life are the home (especially the bedroom) and the school. For this reason it is imperative that these environments remain as safe as possible. **If we are to err, please let us err on the side of caution.**

Respectfully submitted,
Dr. Magda Havas,
Associate Professor
Trent University
July 10, 2009

Shallow Minds:
How the Internet and Wi–Fi in Schools Can Affect Learning

By Cindy Lee Russell, MD
VP-Community Health, Santa Clara County Medical Association

Most of us cannot live without our computers, text messaging, e-mail, and immediate access to the vast cloud of information, especially kids and teenagers who have grown up in the age of the Internet. In fact, more schools are integrating computers at younger ages, even in kindergarten. Forty-nine states are phasing out cursive handwriting altogether. What effects does it have, however, on learning, brain development, cognition, and brain health? Studies have shown some interesting ways that technology is rewiring and shaping our brain, which may not be "all good."

A growing body of scientific evidence suggests that the Internet, with its distractions and interruptions, is turning us into scattered, superficial thinkers. What does that portend for our kids?

Multitasking and Internet Addiction

Nicholas Carr explains, in his book "The Shallows," that we are changing the way we process information. "Dozens of studies by psychologists, neurobiologists, educators, and Web designers point to the same conclusion: When we go online, we enter an environment that promotes cursory reading, hurried and distracted thinking, and superficial learning….The Net delivers precisely the kind of sensory and cognitive stimuli-repetitive, intensive, interactive, addictive, that have been shown to result in strong and rapid alterations in brain circuits and functions."

Researchers from Stanford, in 2009, gave a battery of cognitive tests to a group of heavy and light media Internet multitaskers. They found that the heavy multitaskers were much more easily distracted by "irrelevant environmental stimuli" and had less control over their working memory. In addition, they were much less able to focus on a particular task. Professor Clifford Nass, who led the research, stated intensive multitaskers are "suckers for irrelevancy. Everything distracts them." (5)

"Teaching is a human experience. Technology is a distraction when we need literacy, numeracy, and critical thinking." Paul Thomas, author and associate professor of education at Furman University

Law School Professors Ban Laptops in Classrooms

Several years ago, professors who were irritated with students surfing the Web and hiding behind laptop screens began banning the use of the Internet or laptops in the classroom. Laptops have been banned in classes at Harvard Law School, Yale, George Washington University, University of Virginia, and South Texas College of Law, to mention a few. (4)(15) A 2006 study by Carrie Fried backed up the policies, demonstrating that students who used laptops in

class spent considerable time multitasking. They more importantly found that the level of laptop use was negatively related to several measures of student learning. (3)

A 2012 survey by Elon University, the Pew Internet, and American Life Project asked over 1,000 leaders in the U.S. their thoughts about cognition in our millennial generation. They were asked to consider how the Internet and its environment are changing, for better or worse. Overall, the survey found that multitasking is the new norm and that hyper-connectivity may be leading to a lack of patience and concentration. The "always on" ethos may be encouraging a culture of expectation and instant gratification.

Brain Maturation, Learning, Memory, and Intelligence

The maturation of intelligence requires quiet, deep thought, and time. Established research findings in cognitive science leads to the conclusion that laptop use, especially with Wi-Fi access, could interfere with learning.

The hippocampus, which lies under the cortex, is intimately involved in long-term memory storage. Initial experiences are stored and stabilized in the hippocampus and then later transferred to the cortex. Removal of the hippocampus does not affect long-term memories, but prevents new memories from forming.

Learning depends on the ability to transfer information from our working memory to long-term memory and weave this into other acquired knowledge. There is a bottleneck in the passage of working memory to long-term memory. We have a limited ability as humans to capture and process information. The Internet provides too many choices and too much information at once. Excess distracting information creates "overload," preventing long-term memorization and important information is lost. No one disagrees that we need to protect our memories. As author Nicholas Carr highlights, personal memory is not just for the individual to function, but it shapes and sustains our collective cultural memory.

Brain Drain:

Adverse Neurologic and Health Effects of Wireless Microwave Communications

A growing body of peer reviewed research is showing neurologic damage to fetal brain and other systems from Wi-Fi and other microwave wireless sources. In a prior article, "Why-Fi: Is Wireless Communication Hazardous to Your Health?" in the Sept/Oct 2010 SCCMA *Bulletin*, the full range of effects of EMF from our cell phones and wireless devices was discussed. New basic science research in the last three years is confirming these findings. Initially, the Bioinitiative report of 2007 reviewed the biological effects of low level EMF. It found that there was clear evidence of adverse effects to living systems at current environmental exposures and at doses well below the threshold of the International Commission of Non-Ionizing Radiation Protection (ICNIRP) safety guidelines. Current microwave safety limits are based solely on the heating of tissue and do not take into account research showing negative biological effects on DNA, cancer, protein synthesis, skin tissue changes, sperm motility and viability, cognitive functioning, and disruption of the blood brain barrier.

Current Research on Cognition and Wireless Communication

Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice. *Scientific Reports*. March 2012.

Aldad et al noted that neurobehavioral disorders are increasingly prevalent in children with 3%-7% of school-aged children diagnosed with attention deficit hyperactivity disorder (ADHD). The etiology is unclear, however, an association between prenatal cellular telephone use and hyperactivity in children has been postulated by others. To test this, he exposed pregnant mice to cell phone radiation throughout gestation (days 1-17), with a sham cell phone control group. He found that the exposed group had dose responsive impaired neurologic transmission in the prefrontal cortex and that the mice exposed in utero were hyperactive and had impaired memory. He concluded "that these behavioral changes were due to altered neuronal developmental programming."(3)

Microwave Radiation Induced Oxidative Stress, Cognitive Impairment, and Inflammation in Brain of Fischer Rats. Megha. 2012.

Megha evaluated the intensity of oxidative stress, cognitive impairment, and brain inflammation in rats exposed to typical cell phone microwave radiation. They were subjected to 900 and 1,800 MHz EMF for two hours a day, for 30 days. They state, "Significant impairment in cognitive function and induction of oxidative stress in brain tissues of microwave exposed rats were observed, in comparison with sham exposed groups… Results of the present study indicated that increased oxidative stress due to microwave exposure may contribute to cognitive impairment and inflammation in brain."

Effect of Low Level Microwave Radiation Exposure on Cognitive Function and Oxidative Stress in Rats. Deshmukh. 2013.

The author highlights the exponential increase in wireless communication devices we are exposed to. He evaluated the effects of cell phone radiation on oxidation in tissues, in addition to cognition in rats. They subjected rats to 900 MHz EMF for two hours per day, five days a week, for 30 days, with an unexposed control group. "Results showed significant impairment in cognitive function and increase in oxidative stress, as evidenced by the increase in levels of MDA (a marker of lipid peroxidation) and protein carbonyl (a marker of protein oxidation) and unaltered GSH content in blood. Thus, the study demonstrated that low level MW radiation had significant effect on cognitive function and was also capable of leading to oxidative stress."

The Internet Can Damage Teenage Brains

A large radiologic study from China, published July 2011, looked at structural brain changes in Internet-addicted teenagers. It is estimated that 24 million teenagers are addicted to the Internet in China. The researchers found a consistent atrophy of grey matter in parts of the brain and shrinkage of the surface of the brain in those addicted to the Internet. The effects were worse the longer the addiction. In addition, the study revealed changes in white matter of the brain, which

function to transmit messages in the brain to the grey matter. They concluded these structural abnormalities were most likely associated with functional impairments in cognitive control.

"It strikes me as a terrible shame that our society requires photos of brains shrinking in order to take seriously the common-sense assumption that long hours in front of screens is not good for our children's health. Dr Aric Sigman, Fellow of the Royal Society of Medicine

WHO Classifies EMF as a Carcinogen

In 2011, The WHO/International Agency for Research on Cancer (IARC) classified radiofrequency electromagnetic fields as "possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer1, associated with wireless phone use."

France Bans Wi-Fi in Schools, But Replaces With Ethernet

The French National Assembly, March 2013, passed an amendment to ban Wi-Fi in their schools until it's proven "safe for human consumption." They instead agreed to install far safer, wired Ethernet cable connections.

The Council of Europe has called for a ban on Wi-Fi use in schools and also recommends a wired alternative.

In Austria, the Austrian Medical Society has also issued a policy statement asking for a ban of Wi-Fi in schools.

The U.K. has a useful frequently-updated website on Wi-Fi in schools, which provides much scientific research. http://www.wifiinschools.org.uk/ Still the controversy persists.

The Cost of a Virtual World

There are a host of concerns with classroom technology, and the virtual world it creates, that have not been explored in the rush to "modernize" education and prevent our kids from becoming "computer illiterate," despite the fact that computers are designed for ease of use. These issues range from distraction in the classroom, impairment of cognitive development and long-term memory, deficiency in learning social skills, Internet addiction, cyber bullying, access to inappropriate content, eye fatigue, and security risks to online learning networks. In addition, the sheer cost of computers and continuous upgrades is likely to break many school budgets. We have not mentioned the issue of toxic e-waste, another growing public health problem.

Common Sense

We will not get rid of the Internet or computers. We should not ignore, however, the enlarging body of science that points to real threats to public health and, especially, our children's safety and well-being. The best approach is precautionary. Reduce the risk by reducing the microwave emissions. It is our obligation as physicians and parents to protect our children. They are the

future and our legacy.

1. Remove wireless devices (white boards and routers) in schools in favor of wired connections and fiberoptic.
2. If there is Wi-Fi, then give teachers the authority to turn it off when not in use or if they feel it is not necessary.
3. Ban cell towers near or on schools.
4. Limit screen time on computers.
5. Limit or ban cell phone use in the class.
6. Limit or ban cell phone use at home.
7. Do not allow laptops to be placed on laps.
8. Undertake independent scientific studies on Wi-Fi and computer use that look at acute and long-term health effects.
9. Train teachers how to recognize symptoms of EMF reactions.
10. Conduct meetings with parents and teachers to address this issue in each school.

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Minimize health risks from electronic devices

Published in the September 2016 NJEA Review
by Adrienne Markowitz and Eileen Senn

Desktops, laptops, tablets, eBook readers, printers, projectors, smart boards, smart TVs, cellphones, cordless phones and wireless networks (WiFi) have become ubiquitous in schools. At their best, they are powerful tools for education. At their worst, they threaten the physical and mental health of teachers, paraeducators, secretaries, librarians and other school staff members and students who spend numerous hours using the devices.

Physical health risks from electronic devices include pain and tingling from repetitive strain injuries to the hands and wrists; pain in the neck, shoulders and back; dry, burning, itchy eyes, blurred vision and headaches; altered sleep patterns and next-day fatigue from exposure to blue screen light; distracted driving; and various health problems from exposure to radiation.

Mental health risks arise from stress due to raised expectations for multitasking, productivity and proficiency with devices; dealing with malfunctioning devices; student and colleague distraction from and addiction to devices; and intrusion of devices into nonwork time.

WiFi devices emit radiation

Radio frequency (RF) electromagnetic frequency (EMF) radiation is sent and/or received by the antennae of phones, routers and other wireless devices. RF radiation is capable of causing cancer, reproductive, neurological and ocular effects. The amount of radiation exposure received depends on the amount of time exposed and distance from the source. Radiation levels fall off exponentially with distance from antennae. If you double the distance, the radiation is four times less. If you triple the distance, it is nine times less, and so on. Children and developing fetuses are particularly at risk because their bodies are still growing. People with implanted medical devices are at risk for device interference.

Hazards and solutions

The most straightforward ways to minimize health risks are to use electronic devices in moderation and to maximize your distance from them. There are also specific solutions to specific hazards listed below.

Local associations should work with their UniServ field representative to negotiate solutions that are in the control of district administrators such as providing training and ergonomic equipment and hard-wiring devices. Individuals should take steps within their control, such as:

For repetitive strain injuries

- Use voice control/speech recognition.
- Use ergonomic alternatives to traditional mice and keyboards.
- Use as many fingers as possible when typing and both thumbs when texting.

For neck, shoulder and back pain

- Ensure an ergonomic workstation.
- When using a hand-held device, support it and the forearms.
- Avoid bending the head down or jutting it forward.
- Take frequent, short breaks from the device.
- Ensure good posture and change positions frequently.
- Stand and do stretching exercises.

For eye pain, blurred vision and headaches

- Use sufficient, but not excessive, lighting.
- Use assistive technology built into Apple, Android and Windows devices.
- Enlarge and darken the cursor and pointer.
- Enlarge the font; magnify the text.
- Use text-to-speech instead of reading.
- Use special computer glasses.
- Relax the eyes on a minibreak.

For altered sleep patterns and next-day fatigue

- Stop using devices at least one hour before bedtime.

For distracted driving

- Use hands-free devices, preferably speakerphones.
- Pull over and park.
- Let someone else drive.

For radiation exposure

- Keep devices away from the body and bedroom.
- Carry phones in briefcases, etc., not on the body.
- Put devices on desks, not laps.
- Hard wire all devices that connect to the internet.
- Hard wire all fixed devices such as printers, projectors and boards.
- Use hard-wired phones instead of cell or cordless phones.
- Text rather than call.
- Keep conversations short or talk in person.
- Put devices in airplane mode, which suspends EMF transmission by the device, thereby disabling Bluetooth, GPS, phone calls, and WiFi.
- Use speaker phone or ear buds instead of holding the phone next your head.
- Take off Bluetooth devices when not using them.

For stress

- Training in device use, assistive technology.
- Easy access to user manuals.
- Easily available technical support.

Cell phones and cancer

The National Toxicology Program (NTP) is conducting the largest set of laboratory rodent studies to date on cellphone RF radiation. The studies cost $25 million and are designed to mimic human exposure. They are based on the cellphone

frequencies and modulations currently in use in the United States. The NTP studies are designed to look at effects in all parts of the body.

On May 27, 2016, NTP released a report with partial results of the studies. They found increased occurrence of rare brain tumors called gliomas and increases in nerve tumors called schwannoma of the heart in male rats. The released results are partial because more rat studies and all of the mouse studies will be forthcoming by 2017. The cells that became cancerous in the rats were the same types of cells as those that have been reported to develop into tumors in human cellphone users.

The EMF produced by cellphones was classified as possibly carcinogenic to humans by the World Health Organization in 2011. They found that long-term use of a cell phone might lead to two different types of tumors, gliomas and acoustic neuroma, a tumor of the auditory nerve.

For more information

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COUNCIL OF EUROPE
CONSEIL DE L'EUROPE

Resolution 1815 (2011)[1]
Final version

The potential dangers of electromagnetic fields and their effect on the environment

Parliamentary Assembly

1. The Parliamentary Assembly has repeatedly stressed the importance of states' commitment to preserving the environment and environmental health, as set out in many charters, conventions, declarations and protocols since the United Nations Conference on the Human Environment and the Stockholm Declaration (Stockholm, 1972). The Assembly refers to its past work in this field, namely Recommendation 1863 (2009) on environment and health: better prevention of environment-related health hazards, Recommendation 1947 (2010) on noise and light pollution, and more generally, Recommendation 1885 (2009) on drafting an additional protocol to the European Convention on Human Rights concerning the right to a healthy environment and Recommendation 1430 (1999) on access to information, public participation in environmental decision-making and access to justice – implementation of the Árhus Convention.

2. The potential health effects of the very low frequency of electromagnetic fields surrounding power lines and electrical devices are the subject of ongoing research and a significant amount of public debate. According to the World Health Organization, electromagnetic fields of all frequencies represent one of the most common and fastest growing environmental influences, about which anxiety and speculation are spreading. All populations are now exposed in varying degrees to electromagnetic fields, the levels of which will continue to increase as technology advances.

3. Mobile telephony has become commonplace around the world. This wireless technology relies upon an extensive network of fixed antennae, or base stations, relaying information with radio-frequency signals. Over 1.4 million base stations exist worldwide and the number is increasing significantly with the introduction of third generation technology. Other wireless networks that allow high-speed Internet access and services, such as wireless local area networks, are also increasingly common in homes, offices and many public areas (airports, schools, residential and urban areas). As the number of base stations and local wireless networks increases, so does the radio-frequency exposure of the population.

4. While electrical and electromagnetic fields in certain frequency bands have wholly beneficial effects which are applied in medicine, other non-ionising frequencies, whether from extremely low frequencies, power lines or certain high frequency waves used in the fields of radar, telecommunications and mobile telephony, appear to have more or less potentially harmful, non-thermal, biological effects on plants, insects and animals as well as the human body, even when exposed to levels that are below the official threshold values.

5. As regards standards or threshold values for emissions of electromagnetic fields of all types and frequencies, the Assembly strongly recommends that the ALARA (as low as reasonably achievable) principle is applied, covering both the so-called thermal effects and the athermic or biological effects of electromagnetic emissions or radiation. Moreover, the precautionary principle should be applied when scientific evaluation does not allow the risk to be determined with sufficient certainty. Given the context of growing exposure of the population, in particular that of vulnerable groups such as young people and children, there could be extremely high human and economic costs if early warnings are neglected.

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1. Text adopted by the Standing Committee, acting on behalf of the Assembly, on 27 May 2011 (see Doc. 12608, report of the Committee on the Environment, Agriculture and Local and Regional Affairs, rapporteur: Mr Huss).

6. The Assembly regrets that, despite calls for the respect of the precautionary principle and despite all the recommendations, declarations and a number of statutory and legislative advances, there is still a lack of reaction to known or emerging environmental and health risks and virtually systematic delays in adopting and implementing effective preventive measures. Waiting for high levels of scientific and clinical proof before taking action to prevent well-known risks can lead to very high health and economic costs, as was the case with asbestos, leaded petrol and tobacco.

7. Moreover, the Assembly notes that the problem of electromagnetic fields or waves and their potential consequences for the environment and health has clear parallels with other current issues, such as the licensing of medication, chemicals, pesticides, heavy metals or genetically modified organisms. It therefore highlights that the issue of independence and credibility of scientific expertise is crucial to accomplish a transparent and balanced assessment of potential negative impacts on the environment and human health.

8. In light of the above considerations, the Assembly recommends that the member states of the Council of Europe:

8.1. in general terms:

8.1.1. take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours;

8.1.2. reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation;

8.1.3. put in place information and awareness-raising campaigns on the risks of potentially harmful long-term biological effects on the environment and on human health, especially targeting children, teenagers and young people of reproductive age;

8.1.4. pay particular attention to “electrosensitive” people who suffer from a syndrome of intolerance to electromagnetic fields and introduce special measures to protect them, including the creation of wave-free areas not covered by the wireless network;

8.1.5. in order to reduce costs, save energy, and protect the environment and human health, step up research on new types of antenna, mobile phone and DECT-type device, and encourage research to develop telecommunication based on other technologies which are just as efficient but whose effects are less negative on the environment and health;

8.2. concerning the private use of mobile phones, DECT wireless phones, WiFi, WLAN and WIMAX for computers and other wireless devices such as baby monitors:

8.2.1. set preventive thresholds for levels of long-term exposure to microwaves in all indoor areas, in accordance with the precautionary principle, not exceeding 0.6 volts per metre, and in the medium term to reduce it to 0.2 volts per metre;

8.2.2. undertake appropriate risk-assessment procedures for all new types of device prior to licensing;

8.2.3. introduce clear labelling indicating the presence of microwaves or electromagnetic fields, the transmitting power or the specific absorption rate (SAR) of the device and any health risks connected with its use;

8.2.4. raise awareness on potential health risks of DECT wireless telephones, baby monitors and other domestic appliances which emit continuous pulse waves, if all electrical equipment is left permanently on standby, and recommend the use of wired, fixed telephones at home or, failing that, models which do not permanently emit pulse waves;

8.3. concerning the protection of children:

8.3.1. develop within different ministries (education, environment and health) targeted information campaigns aimed at teachers, parents and children to alert them to the specific risks of early, ill-considered and prolonged use of mobiles and other devices emitting microwaves;

8.3.2. for children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises;

8.4. concerning the planning of electric power lines and relay antenna base stations:

8.4.1. introduce town planning measures to keep high-voltage power lines and other electric installations at a safe distance from dwellings;

8.4.2. apply strict safety standards for the health impact of electrical systems in new dwellings;

8.4.3. reduce threshold values for relay antennae in accordance with the ALARA principle and install systems for comprehensive and continuous monitoring of all antennae;

8.4.4. determine the sites of any new GSM, UMTS, WiFi or WIMAX antennae not solely according to the operators' interests but in consultation with local and regional government authorities, local residents and associations of concerned citizens;

8.5. concerning risk assessment and precautions:

8.5.1. make risk assessment more prevention oriented;

8.5.2. improve risk-assessment standards and quality by creating a standard risk scale, making the indication of the risk level mandatory, commissioning several risk hypotheses to be studied and considering compatibility with real-life conditions;

8.5.3. pay heed to and protect "early warning" scientists;

8.5.4. formulate a human-rights-oriented definition of the precautionary and ALARA principles;

8.5.5. increase public funding of independent research, in particular through grants from industry and taxation of products that are the subject of public research studies to evaluate health risks;

8.5.6. create independent commissions for the allocation of public funds;

8.5.7. make the transparency of lobby groups mandatory;

8.5.8. promote pluralist and contradictory debates between all stakeholders, including civil society (Århus Convention).

Neurological - Children; A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication. Environ Health Perspect. (Foerster et al); 2018

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A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication

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Background: The potential impact of microwave radiofrequency electromagnetic fields (RF-EMF) emitted by wireless communication devices on neurocognitive functions of adolescents is controversial. In a previous analysis, we found changes in figural memory scores associated with a higher cumulative RF-EMF brain dose in adolescents.

Objective: We aimed to follow-up our previous results using a new study population, dose estimation, and approach to controlling for confounding from media usage itself.

Methods: RF-EMF brain dose for each participant was modeled. Multivariable linear regression models were fitted on verbal and figural memory score changes over 1 y and on estimated cumulative brain dose and RF-EMF related and unrelated media usage ($n = 669$–676). Because of the hemispheric lateralization of memory, we conducted a laterality analysis for phone call ear preference. To control for the confounding of media use behaviors, a stratified analysis for different media usage groups was also conducted.

Results: We found decreased figural memory scores in association with an interquartile range (IQR) increase in estimated cumulative RF-EMF brain dose scores: −0.22 (95% CI: −0.47, 0.03; IQR: 953 mJ/kg per day) in the whole sample, −0.39 (95% CI: −0.67, −0.10; IQR: 953 mJ/kg per day) in right-side users ($n = 532$), and −0.26 (95% CI: −0.42, −0.10; IQR: 341 mJ/kg per day) when recorded network operator data were used for RF-EMF dose estimation ($n = 274$). Media usage unrelated to RF-EMF did not show significant associations or consistent patterns, with the exception of consistent (nonsignificant) positive associations between data traffic duration and verbal memory.

Conclusions: Our findings for a cohort of Swiss adolescents require confirmation in other populations but suggest a potential adverse effect of RF-EMF brain dose on cognitive functions that involve brain regions mostly exposed during mobile phone use. https://doi.org/10.1289/EHP2427

Introduction

The rapid evolution of information and communication technologies (ICTs) during the past 20 y has caused an increase in man-made exposure to radiofrequency electromagnetic fields (RF-EMFs). However, the health effects of RF-EMFs are still unknown. Neurological functions are of special concern given that the brain is heavily exposed while calling with a mobile or cordless phone (Joseph et al. 2010). Present-day adolescents will likely have higher cumulative lifetime exposure to RF-EMF, and the developing brain might be particularly susceptible to RF-EMF–induced alterations up to 15 y of age (Kheifets et al. 2005; Luciana et al. 2005; Schüz 2005). In this age group, memory functions are particularly important because proper encoding, processing, and retrieval of information are required for learning. However, to date studies addressing this topic have produced inconsistent results.

Controlled-exposure studies in animals and humans have found limited evidence for both positive and negative effects of RF-EMF on memory performance and related neural processes (Bouji et al. 2012; Deshmukh et al. 2015; Hao et al. 2013; Jeong et al. 2015; Klose et al. 2014; Son et al. 2016). Among the few epidemio-logical studies, the Australian Mobile Radiofrequency Phone Exposed Users' Study (MoRPhEUS) cohort of 317 adolescents with a median age of 13 y observed faster but less accurate responses in working memory and associative learning tasks for frequent mobile phone users (Abramson et al. 2009). The same result was observed in relation to the number of text messages (SMS), which involve only marginal RF-EMF exposure. This may suggest that aspects other than RF-EMFs are the underlying cause of this association. A longitudinal analysis of the MoRPhEUS data indicated associations between mobile phone use and changes in response times for some cognitive tasks over a 1-y period, but the authors proposed regression to the mean as a potential explanation because associations were inconsistent and increase in exposure was mainly seen in those who had fewer calls and SMS at baseline (Thomas et al. 2010).

In the following Examination of Psychological Outcomes in Students using Radiofrequency dEvices (ExPOSURE) study by the same research group as MoRPhEUS, 617 primary school children were investigated and little evidence for cognitive effects due to RF-EMF was found (Redmayne et al. 2013). However, the number of calls was generally very low in these young children (8–11 y of age): a median of 2.5 and 2 calls per week for mobile phones and cordless phones, respectively, among those children using these devices.

In both studies, the RF-EMF exposure was assessed via self-reported number of calls, which usually yields an overestimation of the actual use by adolescents (Aydin et al. 2011). Further, personal exposure to RF-EMF is dependent on other factors such as the call duration, the distance of the device from the body (Joseph et al. 2010; Kühn and Kuster 2013), and the network used for calling. For instance, the global system for mobile communications standard (GSM) produces about 100–500 times higher exposure than the universal mobile telecommunication system (UMTS) (Gati et al. 2009; Persson et al. 2012). Furthermore, using mobile phone calls as a proxy for RF-EMF exposure ignores confounding by the media-related lifestyle impacting individuals' cognition, behavior, and emotion (Kuss et al. 2014; Kuss and Griffiths 2011, 2012; Roser et al. 2016). The present Health Effects Related to Mobile phone usE in adolescentS (HERMES) cohort was the first study in

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adolescents that used individually modeled RF-EMF doses and operator-recorded mobile phone use to investigate potential effects of RF-EMF exposure on cognitive functions (Roser et al. 2015). With this approach, cumulative RF-EMF brain dose was associated with a significant decrease in figural memory performance over a 1-y period (Schoeni et al. 2015), with a stronger decrease observed in right-side users.

The present study aims to follow-up our previous results using an approximate doubling of sample size. Further, we have updated the individual RF-EMF dose model using more recent information on adolescents' brain specific absorption rates (SARs) for different exposure scenarios and by calibrating self-reported call duration on objective operator-recorded call duration. In addition, the present study applies a new approach to control for confounding due to device usage in epidemiological RF-EMF studies.

Materials and Methods

Data of the prospective HERMES cohort study were collected in two independent sampling waves. The first wave of baseline investigations commenced in June 2012 among a cohort of seventh- through ninth-grade students from 24 secondary schools in Central Switzerland. A second wave commenced in April 2014 that included a new group of seventh- through ninth-grade students from 22 secondary schools. Of the 22 schools, 2 had already taken part in the first wave, 18 were newly recruited from Central Switzerland, and 2 were newly recruited from the Basel canton. Follow-up investigations were conducted approximately 1 y after each baseline until April 2016. Participating adolescents were recruited through an initial telephone contact by the head of the school and a subsequent informational visit in their respective classes by the study managers. Participation was voluntary and the informed consent of both adolescents and a parent was compulsory.

The data were collected during school lessons and consisted of completing a paper questionnaire to assess the adolescents' mobile phone and media usage as well as their psychological and somatic health and socioeconomic factors. Computerized cognitive testing was performed immediately afterward. Additionally, a subsample of 148 volunteers from both study waves was recruited to conduct personal RF-EMF measurements as described in detail for the first study wave ($n = 90$) by Roser et al. (2017). These participants were intentionally sampled depending on their place of residence and school in order to be representative of the entire far-field exposure range of the complete study sample. Participants were required to carry a portable measurement device (exposimeter) with an integrated Global Positioning System (GPS) for 3 consecutive days. Simultaneously, a time–activity app on a smartphone in flight mode had to be filled in to later link the RF-EMF records to a particular activity or place.

Ethical approval for conducting the study was received from the ethical committee of the canton of Lucerne, Switzerland, on 9 May 2012 (EKLU 12025 and EKBB 80/12).

Outcome Assessment: Memory Performance

Cognitive performance was measured using a standardized computerized testing system consisting of the figural and verbal memory subtest of the Intelligenz-Struktur-Test (IST) (Liepmann et al. 2007). For the verbal memory task, participants were given 1 min to memorize five sets of two to five words grouped by their common higher semantic category (e.g., city: Amsterdam, Rome, Hamburg, Madrid, York). The target words were presented by starting with a different letter each time. Immediately after the presenting phase, participants were given a letter and they had to recall the word starting with that letter and report the higher semantic category to which it belonged. This was repeated for 11 words, producing a maximum score of 11 points for the verbal memory task. For the figural memory task, participants were given 1 min to memorize 13 pairs of abstract figures, and immediately afterward one item per pair was shown and participants were asked to choose the correct counterpart out of five possible options. The matching task was repeated for 13 symbols, resulting in a maximum score of 13 points. For each of the two tests, 2 min were given to complete the matching task. Each student started with the verbal memory task.

For the statistical analyses, the difference between the continuous test score values at follow-up minus the baseline values were used as outcome. The coefficient of the outcome–exposure association corresponds directly to the change in score: A positive coefficient thus indicates an improvement in memory between baseline and follow-up in relation to the exposure of interest, whereas a negative association indicates a decrease in memory. In the age group of our study, without considering any exposure, one would generally expect an increase in verbal memory and an increase or little change in figural memory between baseline and follow-up. However, memory development during adolescence may vary largely interindividually (Luciana et al. 2005; Schneider and Pressley 2013).

Exposure: Mobile Phone and General Media Use

The detailed usage of mobile phones and other wireless communication devices was assessed via questionnaire. Questions focused on the average amount and type of mobile phone and media usage per day. Exposures of primary interest were those expected to produce relatively high RF-EMF exposure: specifically, the daily duration and number of calls on mobile and cordless phones. In addition, we asked whether students preferentially held mobile phones on the right or left side of their heads when making calls or whether they had no preference. Further, participants were asked about headset use while calling, which is an important factor for RF exposure because exposure to the body decreases rapidly with increasing distance from the device (Lauer et al. 2013). We also asked about activities that might be correlated with phone use but that would be expected to result in relatively low RF-EMF exposures, including the number of text messages sent per day, daily duration of data traffic on the student's mobile phone, daily duration of gaming on electronic devices, the frequency of social network use, and whether the student's mobile phone was left on or turned off at night. In addition, we used the brief MPPUS-10 scale to assess problematic mobile phone use in the students (Foerster et al. 2015).

For the self-reported usage measures included in the linear regression analysis (daily frequency of text messages, daily duration of mobile phone data traffic, daily duration of gaming, and daily duration of cordless phone use), we calculated the cumulative usage by taking the mean difference between baseline and follow-up, and interpreting this value as usage per day.

Detailed data records of daily quantitative mobile phone use from the 6 months preceding the baseline examination date until the follow-up investigations were obtained from the Swiss mobile phone network operators [Swisscom, Sunrise, and Salt (formerly known as Orange)] if adolescents and one of their parents had given additional written informed consent. These participants are subsequently referred to herein as the operator sample. The operator records included the number and duration of calls, number of text messages sent per day, and the daily volume of data traffic. In addition, the identity of the network (UMTS or GSM) used to start each phone call was obtained from the operators Swisscom and Salt, whereas the third operator, Sunrise, did not provide this information. The daily cumulative mobile phone call duration was calculated by summing up all recorded call durations between baseline and follow-up and dividing this sum by the recorded days between baseline and follow-up to obtain daily usage.

A comparison of self-reported mobile phone use with operator-recorded use indicated severe overestimation of self-reported mobile phone use. To avoid bias, we calibrated self-reported mobile phone call duration for participants without operator records. The calibration equation was derived from the operator sample using a multilevel linear regression model that was clustered by schools with average operator-recorded mobile phone call duration per day as dependent variable and the following predictors to be found relevant (likelihood ratio test for the nonclustered model including or excluding the predictor): age, gender, daily frequency of mobile phone calls at follow-up, daily frequency of text messages at follow-up, daily duration of mobile phone data traffic at follow-up, and daily duration of cordless phone calls at follow-up as well as the difference in daily duration of mobile phone calls between follow-up and baseline (see Table S1). Subsequently, the predicted values from the calibration model were used as estimated daily call duration for the participants without operator data. A similar model was constructed to predict the proportion of calls made on the UMTS network, with the following predictors to be found relevant: the place of residence (urban vs. rural—the UMTS proportion was usually lower in rural areas), UMTS exposure (as a proportion of total downlink) at place of residence obtained by geospatial propagation model (see below), and the number of smartphones at the home as well as the duration of mobile data traffic—all of which were indicators of a higher UMTS proportion. The proportion of GSM network was assumed to be $1-\text{proportion(UMTS)}$. The distinction between both networks used was important in determining RF-EMF exposure because, compared with calls executed on the UMTS network, calls on the GSM network have been associated with irradiation levels heightened by a factor of 100–500 (Gati et al. 2009; Persson et al. 2012). For the participants for whom operator-recorded data was available, the objectively recorded data (cumulative call duration and, if applicable, network proportion) was used for all further analysis, including the RF-dose estimation.

Individual Cumulative RF-EMF Brain Dose

Individual RF-EMF brain dose was calculated using an updated dosimetric model described in detail by Roser et al. (2015) that considers RF-EMF exposure-relevant behaviors and circumstances from near- and far-field sources. Near field refers to the use of RF-EMF–emitting devices close to the body (e.g., mobile phones, wireless Internet), whereas far field refers to the surrounding environmental RF-EMF exposure (e.g., from fixed-site transmitters, W-LAN access points, people using mobile phones nearby).

The first step in dose modeling consists of simulating SARs of the brain gray matter for each exposure-relevant behavior and circumstance [for details see "1. Numeric simulations of brain gray matter specific absorption rates (SAR)" in the Supplemental Material]. SAR is a quantity that indicates the rate at which RF-EMF is absorbed in a certain mass or volume of tissue. SAR values are determined using numeric simulations based on two adolescent human body models from the phantom "virtual population," an 11-y-old girl (Billie) and a 14-y-old boy (Louis) (Gosselin et al. 2014). For near-field sources, SARs were simulated for three scenarios (positions of the emitting device with relation to the body): (*a*) device held close to the ear, (*b*) device kept in the pocket of trousers, and (*c*) device held at a distance of 20 cm to the ear (headset scenario).

SAR values were transformed to dose values by multiplying the SAR with relevant exposure durations (see Table S1). The following near-field exposures were considered in the model: daily duration of mobile phone use (separated by 2G/3G and headset use); daily duration of mobile phone data traffic (separated by transfer via WiFi and mobile phone network); daily duration of cordless phone calls (considering the phone's eco mode if applicable); daily duration of WiFi use on laptop, PC, and tablet; and daily duration of carrying the participant's own mobile phone close to body (e.g., in a pocket). The average output power of these devices was derived from the literature [for details see "1. Numeric simulations of brain gray matter specific absorption rates (SAR)" in the Supplemental Material].

The far-field dose modeling included exposure from mobile phone base stations (downlink) broadcasting (radio and TV), WiFi, DECT (Digital Enhanced Cordless Telecommunications base stations at the home), and far-field exposure from the mobile phones of other nearby people (uplink). Downlink and broadcasting exposure at home and at school was modeled for each participant by means of the geospatial NISMap software (Bürgi et al. 2010).The model is based on accurate operation parameters of all stationary mobile phone and broadcast transmitters and the three-dimensional building and topography model of the study area. Semi-empirical propagation algorithms such as COST-Walfisch-Ikegami (Cichon and Kürner 1999) were used to predict RF-EMF exposure at the receptor points, taking into account, for example, the shielding effects of buildings and topography. Duration of exposure at school was assumed to be 35 h per week in order to eventually obtain the average downlink and broadcasting exposure.

WiFi, uplink, and DECT cannot be modeled by NISMap. Thus, for WiFi and uplink factors, predicting exposure to these sources were identified by linear regression from personal measurement data available from 148 study participants (see Table S1). Relevant predictors for 24-h personal WiFi exposure were the mobile phone operator, presence of WiFi at school, the daily duration of mobile data traffic, and the study wave (2012–2014 vs. 2014–2016). Predictors of uplink were the mobile phone operator, mobile phone status at night (on vs. off), the number of smartphones at the home, the time spent in public transport (train and bus), and the study wave. Because no valuable predictors for DECT could be identified, it was assumed to be the mean DECT exposure as derived from personal measurements in 148 participants. These 24-h far-field exposure values were then transformed to SAR values of the brain gray matter using plane-wave-simulations in the Finite-Different Time-Domain-based simulation software SEMCAD-X, version 16 from SPEAG, Zürich, Switzerland (see Table S2). In a final step, the individual RF-EMF brain gray matter dose for each participant was calculated by summing up the contributions of all different near- and far-field exposure scenarios.

Statistical Analysis

All analyses were conducted for the complete sample as well as separately for the two subsamples investigated during 2012–2014 and 2014–2016, respectively. Following the protocol used in our previous analysis, three different types of exposure variable were considered: (*a*) cumulative RF-EMF brain dose, (*b*) cumulative wireless device use related to RF-EMF exposure (cordless phone calls and mobile phone calls), and (*c*) cumulative wireless device use not or only marginally related to RF-EMF exposure (duration of data traffic, duration of gaming, number of text messages sent). Outcome variables were changes in figural and verbal memory score (follow-up minus baseline) over 1 y.

Separate linear exposure–response models were used to estimate associations between each outcome (the change in verbal or figural memory scores from baseline to follow-up, respectively) and each primary exposure variable (modeled as a continuous variable). All models were adjusted for age, gender, nationality (Swiss, Swiss and other, other), school level [in ascending order according to the school system in Switzerland based on academic expectations: secondary school level C, secondary school level B, secondary school level A, college preparatory high school],

frequency of physical activity at follow-up (defined as working out for at least 40 min: ≤1 to 3 times per month, 1 time per week, 2–3 times per week, 4–6 times per week, daily), days of alcohol consumption per month at follow-up (none, ≤1 time per month, 2–4 times per month, 2–3 times per week), change in height between baseline and follow-up (as a proxy for developmental speed between both time points), duration between baseline and follow-up in months, and education of parents (training school, college preparatory high school, college or higher education, university).

In the second step, a laterality analysis of RF-EMF brain dose (head laterality was not considered in the RF-EMF dose model) was conducted given that the figural memory involves mainly the right hemisphere, whereas verbal memory processing is more left sided (Golby et al. 2001; Nagel et al. 2013). Because most of the study participants indicated they held their phone on the right side of their head, we dichotomized the participants into right-side users vs. left-side users and users with no preference (combined). Laterality analyses were performed using data for the entire sample and were repeated after restriction to the operator sample. To facilitate comparisons among the different exposure variables, all effect estimates are expressed as the difference in test scores associated with an interquartile range (IQR) increase in exposure.

Missing values in the confounder variables were either imputed via linear regression (17 missing values at follow-up for alcohol consumption were predicted by age, gender, school class, and school level; 14 missing values at baseline and 12 missing values at follow-up for information on height were predicted by weight, age, and gender) or by imputation, replacing the missing values with the most common category (i.e., 2 missing values at follow-up for frequency of physical activity were replaced by the most common category "2–3 times per week", and 167 missing values for educational level of the parents were replaced by the most common category "Training school"). Statistical analyses were carried out using STATA (version 14; StataCorp).

To evaluate residual confounding from unmeasured factors related to communication device use, we performed stratified analyses across five subgroups representing five different media usage profiles derived by means of latent class analysis of 11 media use variables from the baseline questionnaire data (Foerster and Röösli 2017). The following five classes were identified: Low Use, Medium Use, Call Preference, Gaming, and High Social Use (see Figure S1).

We performed separate linear regression models restricted to students in each of the five media usage groups and estimated differences in each outcome with an IQR increase (defined for the population as a whole) in cumulative RF-EMF brain dose. Next, we performed random effects meta-analyses to derive a summary estimate for each outcome in each subgroup and assessed heterogeneity using the I^2 statistic (Higgins et al. 2003). We assumed that physical effects of RF-EMF would have a similar impact across media use subgroups, independent of any psychological or cognitive effects of media use; therefore, evidence of heterogeneity among the five group-specific estimates would be consistent with uncontrolled psychobehavioral confounding.

Results

In total, 895 adolescents between 12 and 17 y of age were enrolled in the baseline investigation of the HERMES study. The first sampling wave included 439 [mean age ± standard deviation (SD): 14.0 ± 0.85)] students recruited from 57 classes in 24 schools. During the second wave, 456 students (14.1 ± 0.86 y of age) from 44 classes and 22 schools were recruited. A total of 843 participants (96.8% of wave-1 students, $n = 425$; and 91.7% of wave-2 students, $n = 418$) took part in the follow-up investigation 1 y later (Table 1). The average time between baseline and follow-up was 12.5 months. Of these students, 827 (98.1%) owned a mobile phone. The sample included more girls ($n = 457$, 56.4%) than boys ($n = 368$, 43.6%). Objectively recorded operator data for at least 6 months between baseline and follow-up were available for 322 participants (38.8%).

Outcome and Exposure Distributions

Due to technical problems with the computerized testing system, completed tests for both time points were available for only 676 (80.2%) of the participants for verbal memory and 670 (79.5%) for figural memory, respectively (Table 2). While the verbal memory score increased from baseline to follow-up (mean unit increase ± SD = 1.1 ± 3.0), figural memory score did not increase in general (mean increase of 0.2 ± 3.2). The intraclass correlation coefficient (ICC) within individuals was 0.76 for the verbal score, and 0.81 for the figural memory score.

The mean duration of self-reported mobile phone call time was 17.2 ± 27.6 min/d, in contrast with a mean operator-recorded time of 3.2 ± 13.3 min/d. After calibration based on multilevel regression of the subgroup with operator data, the estimated mean mobile phone call time for the sample as a whole was 10.6 ± 13.7 min/d. Mean self-reported cordless phone call duration was 6.2 ± 6.6 min/d (operator data were not available for calibration of cordless phone use). For media exposures associated with low RF-EMF, average daily durations were 56.7 ± 34.3 min/d for mobile phone data traffic and 43.0 ± 56.9 min/d for gaming, and the mean number of text messages sent per day was 35 ± 21.

The estimated mean cumulative RF-EMF brain dose for the population as a whole was 858 ± 1,027 mJ/kg per day when estimated using calibrated mobile phone call durations (mean 10.6 min/d) (Table 2). In the operator data sample ($n = 322$), the estimated mean cumulative RF-EMF brain dose based on recorded call durations (mean 3.2 min/d) was 469 ± 814 mJ/kg per day.

On average, the daily cumulative call duration accounted for 80.3% of the estimated cumulative RF-EMF brain dose in the population as a whole (see Table S3). The proportion for calls executed on the GSM network was much higher (79.8%) compared with the UMTS network (0. 5%). In comparison, when using only data from the operator data sample ($n = 322$), duration of mobile phone use accounted for 66% of estimated cumulative RF-EMF dose (data not shown).

Estimated cumulative RF-EMF brain doses varied among the five media use groups, primarily due to differences in mobile phone call duration (Table 2; see also Figure S1). For example, the Call Preference group ($n = 119$), which had calibrated daily mobile phone and cordless call duration estimates of 15.9 ± 11.9 and 10.8 ± 9.6 min/d, respectively, had a mean estimated daily RF-EMF brain dose of 1,214 ± 1,259 mJ/kg per day, compared with 551 ± 1,029 mJ/kg per day for the Low Use group ($n = 198$), mean calibrated mobile and cordless phone call duration estimates of 5.9 ± 7.7 and 6.0 ± 5.6 min/d, respectively.

Associations between Changes in Memory Performance and RF-EMF Dose and Media Usage

In the population as a whole, none of the exposure variables were significantly associated ($p < 0.05$) with changes in verbal memory scores (Table 3, Figure 1). However, there was a nonsignificant association with the cumulative duration of data traffic and the increase in verbal memory score [score change per IQR: 0.34; 95% confidence interval (CI): −0.05, 0.72; IQR: 55.4 min/d], which was consistent over both study waves (Figure 2).

Table 1. Distributions among different sociodemographic and lifestyle variables for all participants taking part in the follow-up investigations and the five media use groups separately.

Characteristic	Total [*n* (%)][a]	Gamer [*n* (%)][a]	Media use[b] [*n* (%)][a]	Low use [*n* (%)][a]	Call preference [*n* (%)][a]	High social use [*n* (%)][a]
n (total)	843 (100)	97 (12)	223 (26)	207 (25)	119 (14)	197 (23)
Age [y (min–max)]	14.0 (10.3–17.0)	14.1 (12.2–16.4)	13.9 (10.4–17.0)	13.8 (11.8–15.8)	14.3 (12.3–16.6)	14.1 (12.5–16.1)
Sex						
Female	475 (56.4)	96 (99.0)	102 (45.7)	90 (43.5)	32 (26.9)	48 (24.4)
Male	368 (43.6)	1 (1.0)	121 (54.3)	117 (56.5)	87 (73.1)	149 (75.6)
Sample						
Sample 1 (2012–2013)	425 (50.4)	40 (41.2)	51 (22.9)	191 (92.3)	118 (99.2)	25 (12.7)
Sample 2 (2014–2015)	418 (49.6)	57 (58.8)	172 (77.1)	16 (7.7)	1 (0.8)	172 (87.3)
Nationality						
Swiss	646 (76.6)	75 (77.3)	175 (78.5)	174 (84.1)	89 (74.8)	133 (67.5)
Swiss and foreign	120 (14.2)	11 (11.3)	31 (13.9)	25 (12.1)	19 (16)	34 (17.3)
Foreign	77 (9.2)	11 (11.3)	17 (7.6)	8 (3.9)	11 (9.2)	30 (15.2)
School level[c]						
Secondary school level C	151 (17.9)	23 (23.7)	30 (13.5)	22 (10.6)	34 (28.6)	42 (21.3)
Secondary school level B	242 (28.7)	36 (37.1)	69 (30.9)	43 (20.8)	30 (25.2)	64 (32.5)
Secondary school level A	272 (32.3)	20 (20.6)	68 (30.5)	80 (38.7)	41 (34.5)	63 (32)
High school level	178 (21.1)	18 (18.6 %)	56 (25.1)	62 (30)	14 (11.8)	28 (14.2)
Highest education of the parents[d]						
Training school	496 (58.8)	58 (59.8)	129 (57.9)	88 (42.5)	73 (61.3)	148 (75.1)
College preparatory high school	50 (5.9)	6 (6.2)	15 (6.7)	14 (6.8)	4 (3.4)	11 (5.6)
College of higher education	235 (27.9)	22 (22.7)	63 (28.3)	81 (39.1)	37 (31.1)	32 (16.2)
University	62 (7.4)	11 (11.3)	16 (7.2)	24 (11.6)	5 (4.2)	6 (3.1)
Physically active (FUP)[e]						
≤1 to 3 times per month	128 (15.2)	11 (11.3)	30 (13.5)	28 (13.5)	19 (16)	40 (20.4)
1 time per week	170 (20.2)	16 (16.5)	39 (17.5)	43 (20.8)	31 (26.1)	41 (20.9)
2–3 times per week	316 (37.4)	40 (41.2)	81 (36.3)	83 (40.1)	43 (36.1)	68 (34.7)
4–6 times per week	159 (18.9)	21 (21.7)	48 (21.5)	36 (17.4)	18 (15.1)	36 (18.4)
Daily	70 (8.3)	9 (9.3)	25 (11.2)	17 (8.2)	8 (6.7)	11 (5.6)
Number of days with alcohol consumption (FUP)[f]						
None	469 (55.6)	47 (48.5)	138 (61.9)	142 (68.6)	48 (40.3)	94 (47.7)
≤1 time per month	200 (23.7)	28 (28.9)	51 (22.9)	41 (19.8)	35 (29.4)	45 (22.8)
2–4 times per month	139 (16.5)	13 (13.4)	32 (14.4)	19 (9.2)	29 (24.4)	46 (23.4)
2–3 times per week	35 (4.2)	9 (9.3)	2 (0.9)	5 (2.4)	7 (5.9)	12 (6.1)
Change in height (cm ± SD) (follow-up–baseline)[g]	3.7 ± 6.7	5.8 ± 4.1	4.4 ± 4.4	4.4 ± 4.8	1.2 ± 13.7	2.5 ± 3.9

Note: FUP, follow-up; max, maximum value; min, minimum value; SD, standard deviation.
[a]Numbers are *n* (%) unless notes otherwise.
[b]Media use groups determined by latent class analysis on 11 qualitatively different media use variables as described in Foerster and Röösli (2017).
[c]According to the school system in Switzerland, school levels imply differing academic expectations (in ascending order: secondary school level C, secondary school level B, secondary school level A, college preparatory high school); 167 missing values for educational level of the parents replaced by the most common category "Training school."
[d]Highest level of education achieved by at least one of the parents.
[e]Physical activity defined as working out at least 40 min with perspiration; two values missing at follow-up for frequency of physical activity were replaced by the most common category "2–3 times per week."
[f]Seventeen values missing at follow-up for alcohol consumption were imputed via linear regression imputation predicted by age, gender, school class, and school level.
[g]Fourteen values missing at baseline and 12 values missing at follow-up for information on height were predicted by weight, age, and gender.

Changes in figural memory score were negatively correlated with cordless phone calls and, in tendency, with the duration of mobile phone calls and the cumulative RF-EMF brain dose (Figure 2). The association with RF-EMF brain dose was nonsignificant in the full sample (−0.22 (95% CI: −0.47, 0.03; IQR: 953 mJ/kg per day) and significant in the operator data sample (−0.26 (95% CI: −0.42, −0.10; IQR: 341 mJ/kg per day). When analyzing the two subsamples separately, for both study waves, nonsignificant negative effect estimates for the RF-EMF dose were seen, although the magnitude of this effect was greater for the second ($n = 288$) compared with the first wave ($n = 375$) but with a wider confidence interval for the second wave (first wave: −0.14 (95% CI: −0.42, 0.14); second wave: (−0.58 (95% CI: −1.17, 0.01); IQR: 953 mJ/kg per day). No association was observed with variables that were only marginally related to RF-EMF exposure (cumulative duration of data traffic, cumulative gaming duration, and cumulative number of text messages).

The association between figural memory score and cumulative brain dose became significant when analysis was restricted to users with right-side preference (full sample: $n = 532$; operator sample: $n = 217$) in the laterality analysis (full sample: −0.38; 95% CI: −0.67, −0.09; IQR: 953 mJ/kg per day; operator sample: −0.29 (95% CI: −0.46, −0.11; IQR: 341 mJ/kg per day) (Figure 3). When restricted to left-side/no-preference users, the effect estimates were, in general, imprecise due to the small sample size (full sample: $n = 137$; operator sample: $n = 57$). However, a significant negative association was found for verbal memory in the operator sample (−0.51; 95% CI: −0.89, −0.13; IQR: 341 mJ/kg per day).

Meta-Analysis over Media Use Groups

The pooled random effects estimate for the association between cumulative brain dose and figural memory score over the five media use groups (−0.39; 95% CI: −0.69, −0.09; IQR: 953 mJ/kg per day) was consistent with the main analysis, and did not support heterogeneity among the groups ($I^2 = 0.0\%$). The pooled effect for verbal memory score was 0.02 (−0.24, 0.31; IQR: 953 mJ/kg per day; $I^2 = 0.0\%$) (see Figure S2).

Discussion

In the present study, an IQR increase in estimated cumulative RF-EMF brain dose was associated with a nonsignificant decrease in figural memory score, but was not associated with verbal memory

Table 2. Descriptive statistics for all different exposure variables used in linear regression models for the whole sample and the five media use groups separately.

Variable	Total			Low use			Media use[a]			Gaming			Call preference			High social use		
	n	mean ± SD	IQR[b]	*n*	mean ± SD	IQR	*n*	mean ± SD	IQR	*n*	mean ± SD	IQR	*n*	mean ± SD	IQR	*n*	mean ± SD	IQR
Whole sample																		
Verbal memory score[c]																		
Baseline	751	4.9 ± 2.8	4.0	196	5.3 ± 2.7	3.5	191	4.8 ± 2.7	4.0	88	4.8 ± 2.8	3.5	110	4.8 ± 2.8	4.0	166	4.6 ± 3.0	5.0
Follow-up	738	5.9 ± 2.7	4.0	187	6.5 ± 2.6	5.0	193	5.9 ± 2.8	4.0	84	5.5 ± 2.7	4.0	110	5.8 ± 2.8	4.0	164	5.6 ± 2.8	4.0
Difference (follow-up–baseline)	676	1.1 ± 3.0	4.0	180	1.3 ± 2.9	4.0	168	1.0 ± 3.0	4.0	78	0.8 ± 2.7	3.0	106	1.2 ± 2.9	4.0	144	1.2 ± 3.3	4.5
Figural memory score[a]																		
Baseline	740	7.8 ± 2.8	4.0	195	8.5 ± 2.5	3.0	189	7.3 ± 2.8	4.0	86	6.9 ± 2.7	4.0	110	8.1 ± 2.7	4.0	160	7.6 ± 3.1	4.0
Follow-up	742	7.9 ± 3.3	6.0	189	8.5 ± 3.2	5.0	194	8.0 ± 3.2	5.0	85	6.8 ± 3.5	6.0	110	7.5 ± 3.3	5.0	164	7.7 ± 3.5	6.0
Difference (follow-up–baseline)	670	0.2 ± 3.2	4.0	180	0.1 ± 2.8	4.0	168	0.7 ± 3.0	4.0	77	−0.3 ± 3.6	6.0	106	−0.5 ± 3.2	5.0	139	0.5 ± 3.6	5.0
Usage related to EMF exposure to the head																		
Cordless phone calls [min/d]	843	6.2 ± 6.6	5.1	207	6.0 ± 5.6	5.1	223	4.7 ± 4.1	4.0	97	4.0 ± 3.6	2.3	119	10.8 ± 9.6	11.3	197	6.5 ± 7.6	5.1
Mobile phone calls [min/d][d]	843	10.6 ± 13.7	12.6	207	5.9 ± 7.7	7.4	223	9.0 ± 12.8	10.2	97	9.9 ± 12.3	15.7	119	15.9 ± 11.9	13.2	197	14.4 ± 18.4	15.3
Mobile phone calls, self-reported [min/d]	843	17.2 ± 27.6	16.3	207	7.3 ± 10.9	7.0	223	11.4 ± 19.1	9.9	97	13.8 ± 34.5	9.4	119	31.1 ± 35.8	27.5	197	26.7 ± 32.1	27.4
Usage marginally related to EMF exposure to the head																		
Data traffic [min/d]	843	56.7 ± 34.3	55.4	207	27.6 ± 25.2	35.5	223	51.3 ± 28.3	43.4	97	59.2 ± 30.5	44.7	119	66.7 ± 26.5	41.4	197	86.1 ± 27.3	44.8
Gaming [min/d]	843	43.0 ± 56.9	55.7	207	38.6 ± 48.6	51.3	223	20.9 ± 33.9	29.3	97	116.1 ± 63.2	63.6	119	49.6 ± 62.0	56.8	197	32.7 ± 50.2	40.0
Texts sent [number/d]	843	35 ± 21	40	207	15 ± 12	17	223	32 ± 18	30	97	36 ± 20	35	119	43 ± 17	24	197	54 ± 12	13
Cumulative brain dose [mJ/kg per day][e]	830	858 ± 1,027	953	198	551 ± 1,029	471	221	753 ± 824	800	97	806 ± 956	997	118	1,214 ± 1,259	1,391	196	1,098 ± 1,003	1,110
Sample with operator data																		
Duration mobile phone calls [min/d]	322	3.2 ± 13.3	1.8	116	1.1 ± 2.9	0.8	63	4.2 ± 4.1	1.7	30	1.7 ± 3.1	1.2	65	2.8 ± 3.8	2.7	48	8.8 ± 29.2	8.0
Cumulative brain dose [mJ/kg per day][e]	318	469 ± 814	341	115	357 ± 918	187	61	465 ± 638	324	30	344 ± 694	152	65	620 ± 793	517	47	607 ± 842	443

Note: EMF, electromagnetic field; IQR, interquartile range; SD, standard deviation.

[a]Media use groups were determined by latent class analysis on 11 qualitatively different media use variables as described in Foerster and Röösli (2017).

[b]User-group–specific IQRs are displayed for descriptive purposes. For reporting user-group–specific IQRs (see Figure S2), the whole population IQR was used.

[c]Due to technical problems with the computerized testing system, completed tests for both time points were only available for a reduced number of participants.

[d]Adjusted via multilevel linear regression estimates calibrated on the objectively recorded duration of calls obtained by mobile phone operators. Models were clustered over schools and the following predictors were selected from the self-reported questionnaire data: age, gender, daily frequency of mobile phone calls at follow-up, daily frequency of text messages at follow-up, daily duration of mobile phone data traffic at follow-up, daily duration of cordless phone calls at follow-up, difference in daily duration of mobile phone calls between follow-up and baseline.

[e]Cumulative brain dose derived based on the following cumulative exposure variables. Near-field bands (if not indicated otherwise, taken from the questionnaire): daily duration of mobile phone calls (for the whole sample: calibrated via operator data; for the operator sample: operator recorded), network proportions of UMTS and GSM (for the whole sample: calibrated via operator data and far-field UMTS proportion; for the operator sample: operator recorded), proportion of headset use, daily duration of cordless phone calls, daily duration of mobile phone data traffic on WiFi and 3G, daily duration of WiFi use via laptop, PC, and tablet, daily duration of mobile phone held close to body; far-field bands: Uplink from surrounding mobile phones and Wifi (modeled via linear regression estimation based on questionnaire and personal measurements), downlink GSM900, downlink GSM1800, downlink UMTS, radio/broadcast, TV [(determined by geospatial propagation modeling using the NISMap software (Bürgi et al. 2010)], DECT (mean of the measurements).

Table 3. Results of adjusted linear exposure models for the whole sample and the two subsamples (2012–2014 and 2014–2016).

Exposure	n	IQR	Whole sample [adjusted[a] (95% CI)]	n	Sample 2012–2014 [adjusted[a] (95% CI)]	n	Sample 2014–2016 [adjusted[a] (95% CI)]
Whole sample							
Usage related to EMF exposure to the head							
Verbal memory							
Cordless phone calls [min/d]	676	5.1	−0.02 (−0.20, 0.15)	375	−0.05 (−0.26, 0.15)	301	−0.10 (−0.46, 0.25)
Mobile phone calls [min/d][b]	676	12.6	−0.01 (−0.29, 0.27)	375	0.08 (−0.31, 0.46)	301	−0.15 (−0.57, 0.26)
Figural memory							
Cordless phone calls [min/d]	670	5.1	−0.23 (−0.42, −0.04)	381	−0.23 (−0.45, −0.02)	289	−0.21 (−0.64, 0.22)
Mobile phone calls [min/d][b]	670	12.6	−0.21 (−0.51, 0.09)	381	0.01 (−0.40, 0.41)	289	−0.44 (−0.90, 0.02)
Cumulative brain dose [mJ/kg per day][c]							
Verbal memory	675	953	0.02 (−0.22, 0.26)	372	0.01 (−0.26, 0.27)	293	0.03 (−0.52, 0.58)
Figural memory	669	953	−0.22 (−0.47, 0.03)	381	−0.14 (−0.42, 0.14)	288	−0.58 (−1.17, 0.01)
Usage marginally related to EMF exposure to the head							
Verbal memory							
Data traffic [min/d]	676	55.4	0.34 (−0.05, 0.72)	375	0.48 (−0.04, 1.00)	301	0.33 (−0.28, 0.94)
Gaming [min/d]	676	55.7	−0.03 (−0.30, 0.25)	375	0.04 (−0.33, 0.40)	301	−0.16 (−0.59, 0.27)
Texts sent (units/d)	676	40	0.16 (−0.31, 0.63)	375	0.40 (−0.21, 1.02)	301	0.00 (−0.75, 0.75)
Figural memory							
Data traffic [min/d]	670	55.4	−0.05 (−0.46, 0.37)	381	0.18 (−0.37, 0.73)	289	−0.47 (−1.14, 0.21)
Gaming [min/d]	670	55.7	−0.12 (−0.41, 0.17)	381	0.02 (−0.36, 0.41)	289	−0.36 (−0.83, 0.12)
Texts sent (units/d)	670	40	0.04 (−0.45, 0.54)	381	0.20 (−0.45, 0.84)	289	−0.22 (−1.05, 0.62)
Sample with operator data							
Verbal memory							
Mobile phone calls [min/d]	277	1.8	−0.01 (−0.10, 0.08)	210	0.15 (−0.06, 0.37)	67	−0.01 (−0.13, 0.11)
Cumulative brain dose [mJ/kg per day][c]	273	341	0.02 (−0.14, 0.18)	209	0.05 (−0.12, 0.21)	64	−0.30 (−1.04, 0.44)
Figural memory							
Mobile phone calls [min/d]	278	1.8	−0.03 (−0.12, 0.06)	212	−0.18 (−0.39, 0.04)	66	0.03 (−0.11, 0.16)
Cumulative brain dose [mJ/kg per day][c]	274	341	−0.26 (−0.42, −0.10)	211	−0.25 (−0.41, −0.09)	63	−0.35 (−1.20, 0.50)

Note: Coefficients relate to change score per IQR of exposure shown in the column "IQR." CI, confidence interval; EMF, electromagnetic field.
[a]All models adjusted for age, gender, school level, education of the parents, alcohol consumption at follow-up, physical activity at follow-up, change in height (follow-up–baseline) and time between baseline and follow-up.
[b]Self-reported use calibrated with the objectively recorded duration of calls as described in Table S1.
[c]Cumulative brain dose derived based on the following cumulative exposure variables. Near-field bands (if not indicated otherwise, taken from the questionnaire): daily duration of mobile phone calls (for the whole sample: calibrated via operator data; for the operator sample: operator recorded), network proportions of UMTS and GSM (for the whole sample: calibrated via operator data and far-field UMTS proportion; for the operator sample: operator recorded), proportion of headset use, daily duration of cordless phone calls, daily duration of mobile phone data traffic on WiFi and 3G, daily duration of WiFi use via laptop, PC, and tablet, daily duration of mobile phone held close to body; far-field bands [if not indicated otherwise, exposure was determined by geospatial propagation modeling using the NISMap software (Bürgi et al. 2010)]: Uplink from surrounding mobile phones (modeled via linear regression estimation based on questionnaire and personal measurements), downlink GSM900, downlink GSM1800, downlink UMTS, WiFi (modeled via linear regression estimation based on questionnaire and personal measurements), radio/broadcast, TV, DECT.

score. This inverse association of cumulative RF-EMF brain dose was consistently seen in the full sample analysis and the subgroup analysis of the two study waves (2012–2014 vs. 2014–2016), media usage groups, and the operator sample although the strength of the association differed somewhat. The association was stronger in the second than in the first wave (however, with a wider confidence interval) and statistically significant in the operator sample, but not in the whole sample with self-reported exposure (after calibration using operator data). A significant decrease in figural memory score with cumulative brain dose was further seen in laterality analysis for right-side users of both the full sample and the operator sample only. In left-side users, in contrast, we found a significant decrease in verbal memory score for the operator sample. However, there was no such association for the full sample and estimates for the left-side users were in general imprecise due to the small sample size and also less consistent. The more consistent association of right-side users with a decrease for figural memory and the decrease for verbal memory score seen in left-side users of the operator sample might be related to the lateralization of memory processes (Golby et al. 2001) and requires further study.

Regarding wireless media usage not related to high RF-EMF exposure, a nonsignificant positive association for cumulative duration of mobile phone data traffic and verbal memory score change was observed, whereas the coefficients for text messages and gaming were generally small. It is conceivable that a positive significant association of verbal memory and data traffic could cover a potential negative RF-EMF effect on verbal memory if data traffic and RF-EMF dose are highly correlated. To control for this, we post hoc calculated the Spearman's correlation and fitted a regression model on verbal memory including both variables and adjusted for the same confounding variables as before. Spearman's correlation was weak ($\rho = 0.25$), and the linear regression estimates for neither RF-EMF dose nor duration of data traffic changed majorly in the mutually adjusted model (data not shown).

Strengths and Limitations

The present study is unique in its approach to overcoming the main challenges in epidemiological research on RF-EMF. We estimated individual RF-EMF brain doses for the population as a whole using objectively recorded operator data from a subset of participants to calibrate self-reported call duration and thus reduce misclassification. The operator-recorded data allowed us to estimate the very exposure-relevant proportion of calls on the GSM and UMTS networks (Erdreich et al. 2007; Gati et al. 2009). In our sample, the respective brain dose contributions were 79.8% (GSM) and 0.5% (UMTS) (see Table S2).

The modeling allowed addressing the associations with mobile phone use and RF-EMF brain dose separately to evaluate potential residual confounding of lifestyle and media use related to wireless device use itself. These factors might act on human health, cognition, and behavior independently from a potential biological radiation effect (Kuss et al. 2014; Kuss and Griffiths 2011, 2012; Roser et al. 2016). To control for such confounding, we adjusted our analysis for age, gender, school level, parents' education, alcohol consumption, and physical activity at follow-up, and the time and change in height between baseline and

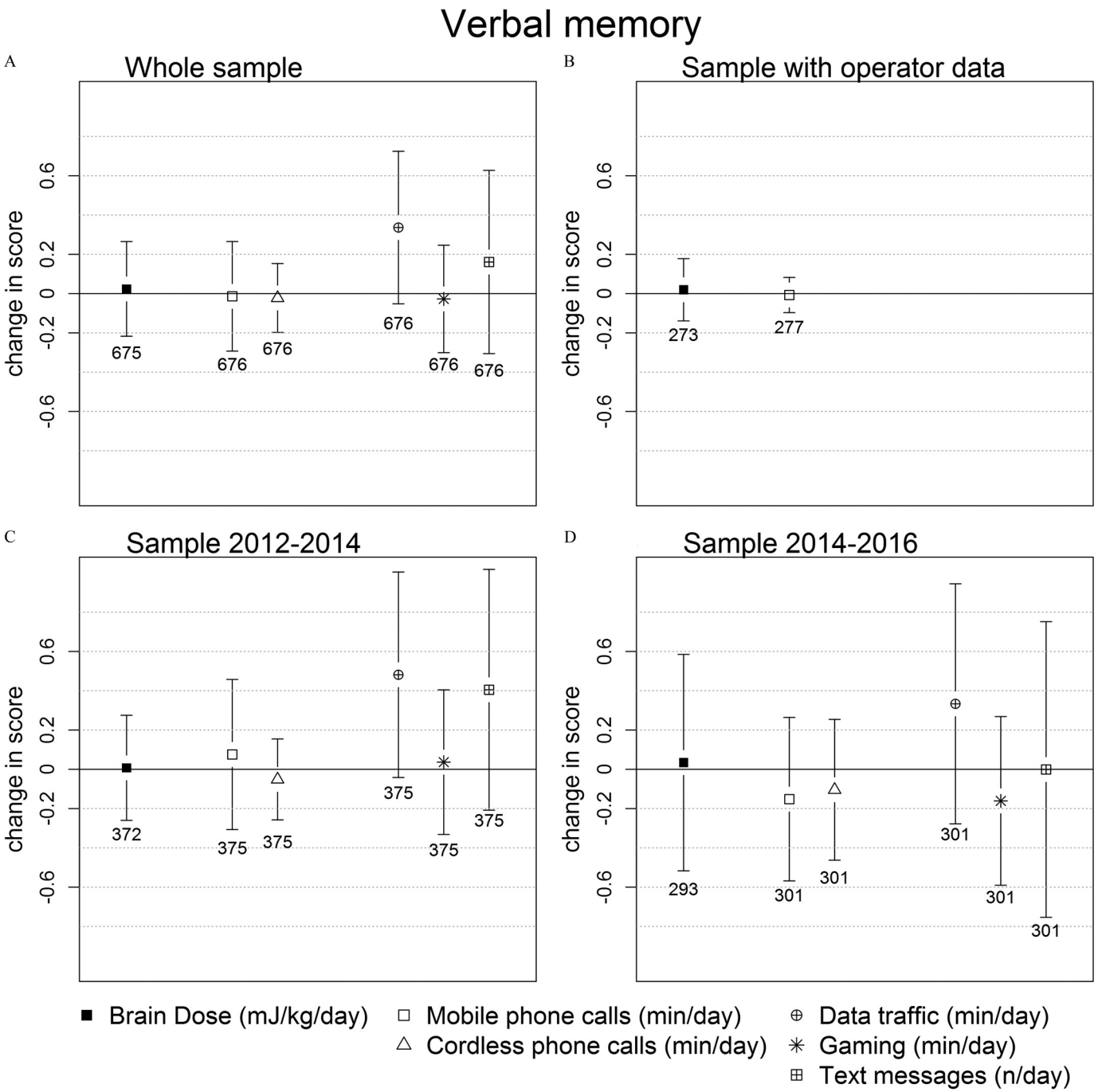

Figure 1. Results of linear exposure–response models for change in verbal memory scores (follow-up–baseline): estimates relate to change in memory score for (*A*) the whole sample per interquartile range (IQR) of exposure of the whole sample; (*B*) the operator sample per IQR of operator sample; (*C*) the sample 2012–2013 per IQR of exposure of the whole sample; and (*D*) the sample 2014–2015 per IQR of exposure of the whole sample. IQRs of the whole sample: brain dose, 953 mJ/kg per day; mobile phone calls, 12.6 min/d; cordless phone calls, 5.1 min/d; data traffic, 55.4 min/d; gaming, 55.7 min/d; and text messages, 40 per day. IQRs of the operator data, brain dose: 341 mJ/kg per day; and mobile phone calls, 1.8 min/d. All models were adjusted for age, gender, baseline score, nationality, school level, physical activity, alcohol, and education of parents and change in height and time between baseline and follow-up investigation. Number of observations for each calculation is indicated below each estimate.

follow-up. In addition, we estimated associations with media exposures associated with low RF-EMF exposures (minutes of gaming, minutes of mobile phone data traffic, and numbers of texts sent each day) to assess the potential impact of media use unrelated to RF-EMF.

In addition, we applied a new approach to control for residual confounding by stratifying the analysis for the RF-EMF brain dose over independent patterns of media use. Separate estimates for students classified according to the five media use patterns were similar among the groups for both verbal and figural memory, with I^2 statistics indicating little or no heterogeneity, and pooled estimates were consistent with estimates based on the main analysis. This pattern does not support major bias from uncontrolled confounding and is compatible with associations due to biophysical effects of RF-EMF, rather than effects of media use unrelated to RF-EMF. However, sample sizes within the five media use groups were small, and residual confounding cannot be ruled out based on this analysis.

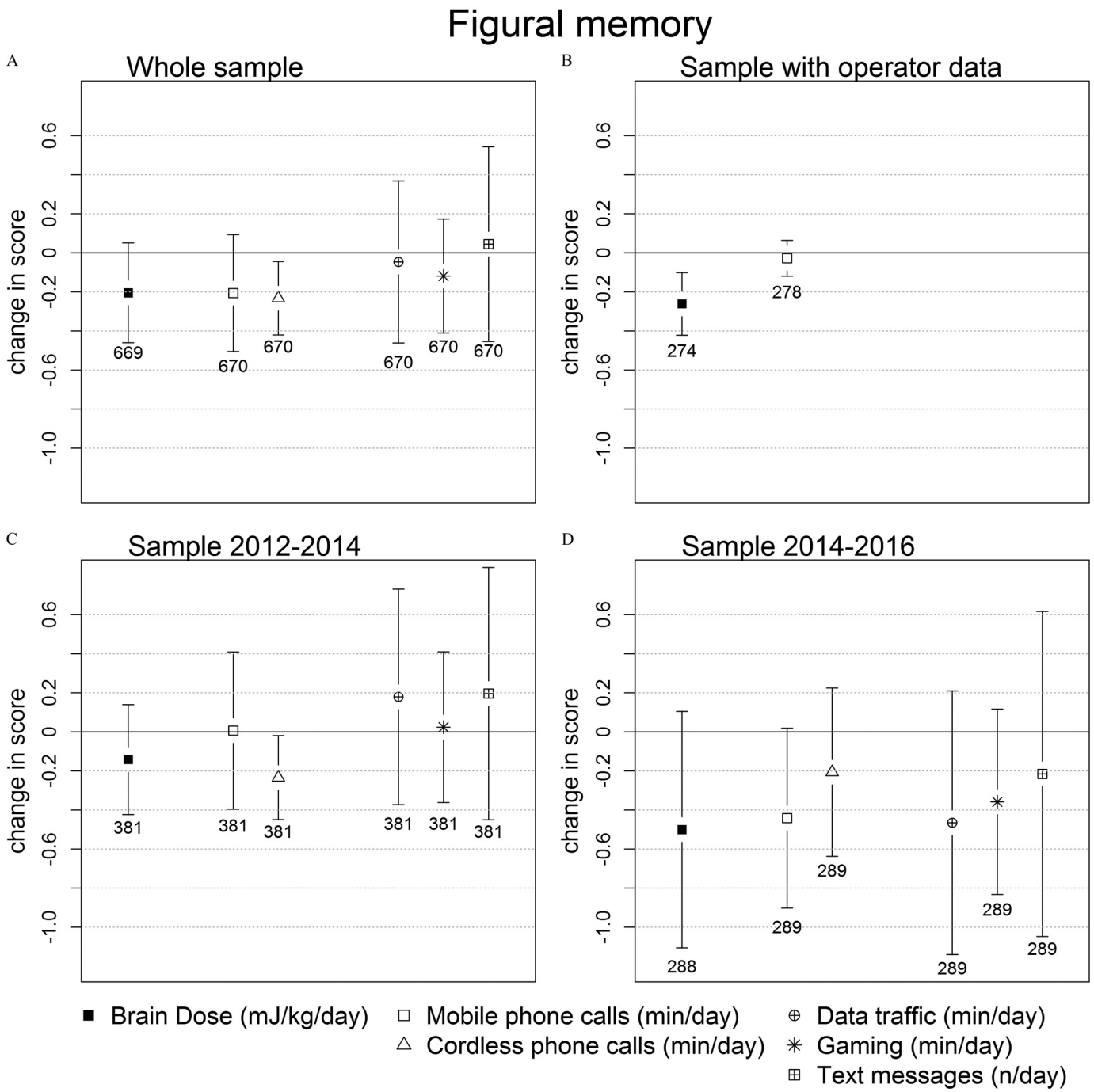

Figure 2. Results of linear exposure–response models for change in figural memory scores: (follow-up–baseline estimates relate to change in memory score for (*A*) the whole sample per interquartile range (IQR) of exposure of the whole sample; (*B*) the operator sample per IQR of operator sample; (*C*) the sample 2012–2013 per IQR of exposure of the whole sample; and (*D*) the sample 2014–2015 per IQR of exposure of the whole sample. IQRs of the whole sample: brain dose, 953 mJ/kg per day; mobile phone calls, 12.6 min/d; cordless phone calls, 5.1 min/d; data traffic, 55.4 min/d; gaming, 55.7 min/d; and text messages, 40 per day. IQRs of the operator data: brain dose, 341 mJ/kg per day; and mobile phone calls, 1.8 min/d. All models were adjusted for age, gender, baseline score, nationality, school level, physical activity, alcohol, and education of parents and change in height and time between baseline and follow-up investigation. Number of observations for each calculation is indicated below each estimate.

This study put a lot of emphasis on the exposure assessment and dose calculation. Information for the far-field exposure was retrieved from propagation models (Bürgi et al. 2010) and from personal measurements in 148 children (Roser et al. 2017). Operator-recorded mobile phone data is an asset, and, to our knowledge, it has not been available for other epidemiological studies of children and adolescents. Although operator data are objectively recorded, they have a disadvantage in that calls on other people's phones are not recorded. Furthermore, information on short message services does not represent texting behavior of adolescents using mostly Internet-based applications such as WhatsApp, and besides, the duration of data traffic and cordless phone use was not available from the operator. Thus, for these variables, the corresponding self-reported data had to be used for dose estimation as in the operator sample.

Uncertainty in the exposure assessment and in the RF-EMF dose calculations cannot be avoided. Estimation of SAR assumes a typical distance between emitting devices and body and average

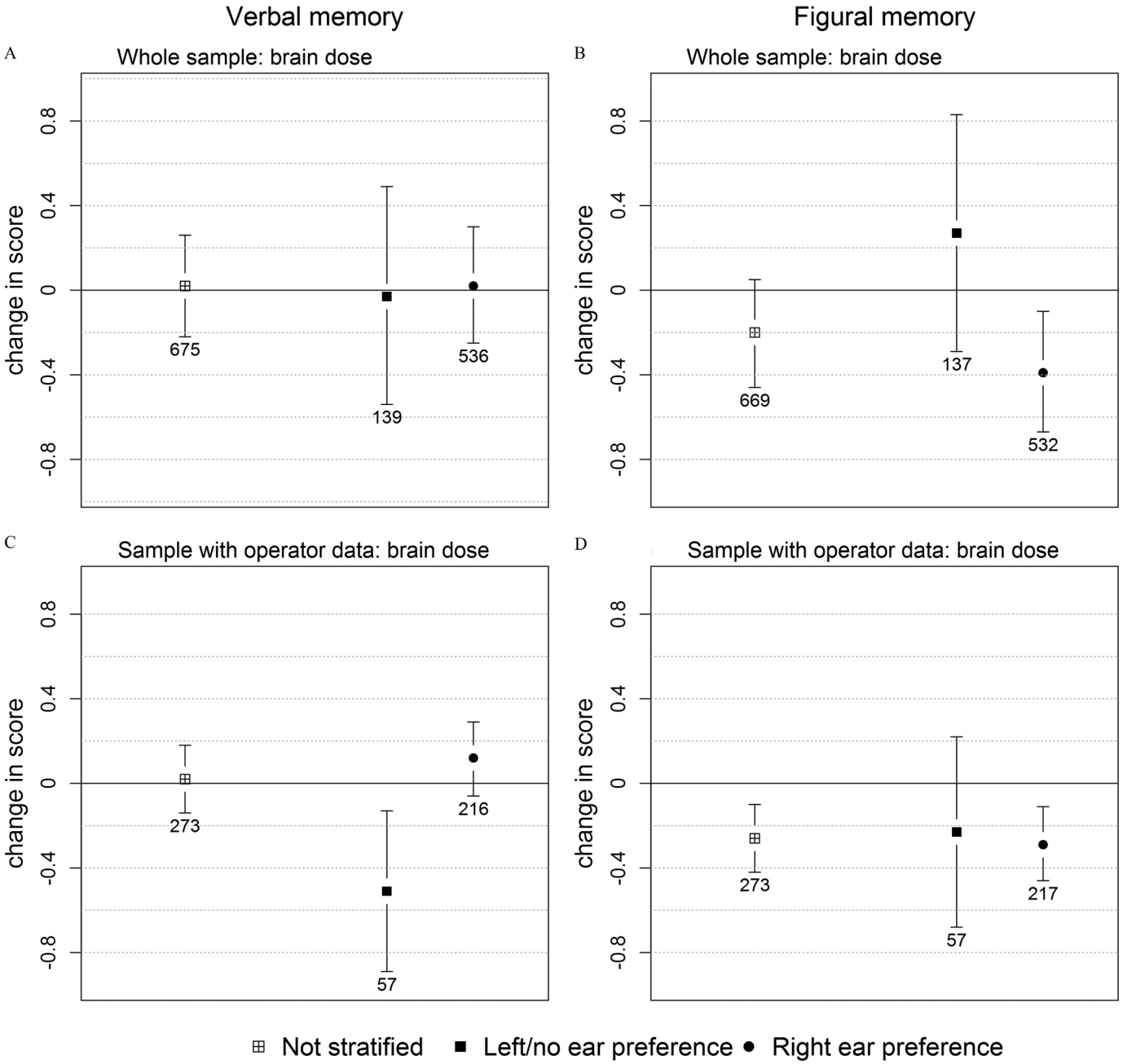

Figure 3. Results of the laterality analysis for the adjusted linear exposure response for the brain dose on changes in verbal and figural memory scores of the Intelligenz-Struktur-Test (IST). Estimates relate to (*A*) change in verbal memory score per interquartile range (IQR) of exposure for the whole sample; (*B*) change in figural memory score per IQR of exposure for the whole sample; (*C*) change in verbal memory score for the operator sample per IQR of the operator sample; and (*D*) change in figural memory score for the operator sample per IQR of the operator sample. Brain dose was derived via individual exposure modeling of relevant near- and far-field exposure sources. The most relevant predictors—duration of mobile phone calls and network proportion—were derived directly by network operators for the operator data sample. For the whole sample, these parameters were calibrated via multilevel linear regression models, predicting these parameters by self-reported questionnaire data, fitted for the operator sample. Change in memory score per IQR range of exposure. IQR for the whole sample, 953 mJ/kg per day; and IQR for the operator sample, 341 mJ/kg per day.

absorption characteristics of the body. But all of these aspects are variable in reality. A validation study could not be confirmed given than dose is not directly measurable and can only be computed.

Our study participants were recruited from the four common public school levels in urban and rural areas of Switzerland. Neither private nor religious schools were included because they play a minor role in Switzerland. All schools were located in Swiss German-speaking cantons, although Switzerland also has large French-, Italian-, and Rhaeto- Romanic-speaking areas. Generalizability might thus be restricted to public schools in German-speaking Switzerland. However, because RF-EMF brain dose is a biological measure, the exposure route should not differ among adolescents in general. Loss to follow-up was low (5.8%), but selection bias cannot be ruled out given that participation rates at baseline were only 37% for the first-wave (2012–2014) but 56% for the second-wave (2014–2016) study samples.

Comparison with Previous Analysis

The association between memory and RF-EMF exposure in the 2012–2014 sample has been analyzed previously (Schoeni et al. 2015). In the present work, we applied an improved RF-EMF dose estimation to the whole HERMES sample. The Spearman's correlation between the resulting new RF-EMF brain dose and the former dose estimate in the 2012–2014 sample was $\rho = 0.58$, demonstrating inherent uncertainties in dose estimation. The main difference compared with the previous dose modeling (Roser et al. 2015) was the use of operator calibrated self-reported call duration and different SAR values. Our new estimate of the first sample wave was of similar magnitude but less significant [−0.14 (−0.42, 0.14) per IQR of 953 mJ/kg per day] than in the previous analysis reported by Schoeni et al. (2015) [−0.26 (95% CI: −0.42, −0.10) per IQR of 1,579 mJ/kg per day].

Compared with the previous analyses, we have improved the dose calculations by various aspects. First, in the previous study, self-reported mobile phone use data was used for the dose calculation. It is well known that adolescents tend to overestimate duration of use and that the extent of overestimation is related to various sociodemographic factors (Aydin et al. 2011). This time, we used operator-recorded mobile phone data to adjust self-reported mobile phone use in order to reduce the overestimation of self-reported use. Consecutively, this led to a lower average RF-EMF dose estimation that might be closer to reality. The calibration was based on the assumption, that the factor and pattern by which participants overestimate their use could be extrapolated from the operator data sample. However, it must be noted that a large majority (approximately 75%) of the operator sample were participants from the first study wave. This might affect the generalizability of the operator sample–based estimates to the sample as a whole, in particular if relationships among self-reported variables considered for calibration and the operator-recorded data would be different for the first and second study wave due to increasing dissemination of smartphones in the study sample and the expansion of the UMTS network in the study region. However, differences in media usage behavior between the study waves might be more related to smartphone-specific applications rather than mobile phone calls (Foerster and Röösli 2017). Second, in the framework of the EU project GERoNiMO (Generalized EMF Research using Novel MethOds), new SAR estimates have been computed for various near- and far-field exposure conditions. Most relevant, these SAR estimates are based on the adolescent models Billie and Louis from the virtual population [for details see "1. Numeric simulations of brain gray matter specific absorption rates (SAR)" in the Supplemental Material], whereas in the past only SAR calculations from adult phantoms were available.

Brain Exposure and Differential Memory-Related Neuronal Circuits

Our findings require confirmation in other populations but suggest that RF-EMF brain exposure may have an adverse effect on figural memory functions in adolescents. The decrease in figural memory score with an IQR increase in exposure was 0.22 (95% CI: −0.47, 0.03; IQR: 953 mJ/kg per day) in the full sample ($n = 669$) and 0.26 (95% CI: −0.42, −0.10; 341 mJ/kg per day) in the operator sample ($n = 274$). To put this difference into context, in our main model adjusting for various factors, we observed a mean difference in figural memory score of 0.41 (95% CI: 0.13, 0.69) between adolescents from a lower school level (e.g., secondary school level C) to the next higher one (i.e., secondary school level B). Memory functions continue to develop in adolescents, and the ability to maintain and manipulate multiple spatial units (which is tested by the figural memory task) continues to develops until 15 y of age (Luciana et al. 2005).

Different brain areas and activation patterns are involved in neural memory processing, which is measured by different cognitive tests. Due to the differing specificity of cognitive tests, results often cannot be compared directly. Although we found decreases in figural memory, some experimental and epidemiological studies on RF-EMF found improvements in working memory performance. Working memory is usually assessed via reaction time tasks such as the *n*-back paradigm, where participants need to react in an accurate manner on a stimulus after a short time interval as fast as possible. This type of memory is also known as working attention and is related to very early stages of memory where stimuli are held actively in mind before being stored (Baddeley and Hitch 1974). For working memory, main brain activity is seen in executive structures involved in decision-making, predominantly the anterior cingulate and dorsolateral and inferior prefrontal cortices (Jansma et al. 2000). In addition to voluntary encoding, the memory processes evaluated in our study require consolidation (storage) of a stimulus and its subsequent recognition (retrieval) after a short period of time. In these later stages of memory, the activation shifts toward the temporal (verbal and object information processing) or parietal (spatial information processing) areas and later to the hippocampal and parahippocampal areas (memory storage and retrieval) (Brewer et al. 1998; Schacter and Wagner 1999; Schon et al. 2004). The memory tasks used in the present study might be more reliable for detecting alterations in adolescents' memory functions given that its execution involves more areas prone to high RF-EMF exposure from a mobile phone at the ear. This may partly contribute to the ambiguous results between our study and studies testing the working memory. However differences among populations with regard to specific exposures (or exposure patterns), differences in susceptibility, and other noncausal factors related to uncontrolled confounding or other sources of bias cannot be completely excluded.

Visual memory tasks similar to those applied in our study were also used in the Australian MoRPhEUS and ExPOSURE cohort studies in adolescents and primary school children. In line with our results, these studies found less accurate answers in the most frequent mobile phone and cordless phone callers (Abramson et al. 2009; Redmayne et al. 2013).

Although preliminary, findings from the laterality analysis might reflect separate lateralized neural pathways for verbal and figural memory. Figural and spatial memory processing are associated more with the right hemisphere of the brain, and verbal and auditory processing with the left hemisphere (Golby et al. 2001; Nagel et al. 2013). A more detailed description of the neural paths involved in the generation of new memory gives the influential model of working memory of Baddeley and Hitch (1974). The model differentiates between the visuospatial sketchpad for visual and the phonological loop for verbal information, running through the right and left temporal lobe, respectively. Evidence of a possible laterality effect in our study population might be consistent with impairment of this component step in object information memory processing.

How RF-EMF interacts with the brain is still unclear and no biophysical model exists for SAR values that do not noticeably increase the body temperature (International Commission on Non-Ionizing Radiation Protection 2010; Redmayne 2016). It may be speculated that our results are related to relatively consistently observed alterations in the electroencephalogram (EEG) during sleep in randomized crossover studies of participants exposed to mobile phone radiation prior to sleep (Loughran et al. 2012; Lustenberger et al. 2013; Regel et al. 2007; Schmid et al. 2012). Disturbed sleep negatively affects memory consolidation, in particular, in relation to

abstract and complex tasks involving higher brain functions (Kopasz et al. 2010). Lustenberger et al. (2013) observed reduced overnight performance improvement in a motor sequence task after a night with RF-EMF exposure compared with the sham condition. Thus, future studies should clarify whether RF-EMF has an impact on sleep-facilitated learning processes via altered sleep brain activity.

Conclusion

We found preliminary evidence suggesting that RF-EMF may affect brain functions such as figural memory in regions that are most exposed during mobile phone use. Our findings do not provide conclusive evidence of causal effects and should be interpreted with caution until confirmed in other populations. Associations with media use parameters with low RF-EMF exposures did not provide clear or consistent support of effects of media use unrelated to RF-EMF (with the possible exception of consistent positive associations between verbal memory and data traffic duration). It is not yet clear which brain processes could be potentially affected and what biophysical mechanism may play a role. Potential long-term risk can be minimized by avoiding high brain-exposure situations as occurs when using a mobile phone with maximum power close to the ear because of, for example, bad network quality.

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Cell phone use and behavioural problems in young children

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ABSTRACT

Background Potential health effects of cell phone use in children have not been adequately examined. As children are using cell phones at earlier ages, research among this group has been identified as the highest priority by both national and international organisations. The authors previously reported results from the Danish National Birth Cohort (DNBC), which looked at prenatal and postnatal exposure to cell phone use and behavioural problems at age 7 years. Exposure to cell phones prenatally, and to a lesser degree postnatally, was associated with more behavioural difficulties. The original analysis included nearly 13 000 children who reached age 7 years by November 2006.

Methods To see if a larger, separate group of DNBC children would produce similar results after considering additional confounders, children of mothers who might better represent current users of cell phones were analysed. This 'new' dataset consisted of 28 745 children with completed Age-7 Questionnaires to December 2008.

Results The highest OR for behavioural problems were for children who had both prenatal and postnatal exposure to cell phones compared with children not exposed during either time period. The adjusted effect estimate was 1.5 (95% CI 1.4 to 1.7).

Conclusions The findings of the previous publication were replicated in this separate group of participants demonstrating that cell phone use was associated with behavioural problems at age 7 years in children, and this association was not limited to early users of the technology. Although weaker in the new dataset, even with further control for an extended set of potential confounders, the associations remained.

Technological developments now bring social and economic benefits to large sections of society; however, the health consequences of these developments can be difficult to predict. Sources of radio frequency electromagnetic fields (EMF) have been present as a result of radio and TV broadcasts since the early 20th century. EMF from radar and related technologies has been present since the mid-20th century. EMF from cellular communications has come along in the last quarter of the previous century, and in just the past few years, sources of EMF from Wi-Fi, RFID and other novel technologies have come into existence. All these sources have increased considerably since first emerging, and increases in cellular communications and other radio frequency technologies in the past decade have been particularly rapid. The worldwide proportion subscribing to cell phones has increased from 5% approximately 15 years ago to well over 70% who are current users.[1] If cell phones lead to adverse health effects associated with their use, then the potential rise in health burden could be significant.

Exposure to cell phones is increasingly becoming prevalent among children at younger ages. Also of concern is use by expectant mothers. Previously, we reported an association from the Danish National Birth Cohort (DNBC) for prenatal and postnatal exposure to cell phone use and behavioural problems at age 7 years among nearly 13 000 Danish children born between 1997 and 1999.[2]

In order to determine whether our original results were a chance finding, or because the initial sample were 'early adopters of technology' who are more likely to have behavioural problems and whose children are likely to have similar behavioural patterns, we analysed a new and separate group of mothers and children from the DNBC. Compared with our previous efforts we further adjusted for an extended set of potential confounders, including variables that reflect mother's attention towards the child early in life.

METHODS

From March 1996 to November 2002, the DNBC recruited nearly 100 000 pregnant mothers with the intent to follow these women and their offspring longitudinally in a life-course perspective.[3 4] Mothers reported detailed information on lifestyle factors, dietary habits and environmental exposures collected by means of four telephone interviews—two during pregnancy and two within 18 months postpartum.[5] With the resources of the various administrative, health and socioeconomic registers, information was linkable for cohort participants by means of a 'central person register' number that is assigned to all Danish persons.[6] In this analysis, information from the Danish Medical Birth Registry was linked with DNBC data.[7]

When offspring reached 7 years of age, a new questionnaire was administered to mothers on information pertaining to the health of her child. Questions on cell phone use among children, as well as among mothers during pregnancy, were asked. More detailed prenatal cell phone use information included: historical use of cell phone by mother (year of first regular use, amount of use during pregnancy); use of hands-free equipment by mother (proportion of time); use of hands-free equipment during pregnancy and location of the phone (handbag or pant/shirt/jacket pocket) and current use of cell phones.

The Age-7 Questionnaire also included data on social conditions, family lifestyle and diseases in childhood, including behavioural problems as defined by the strengths and difficulties questionnaire (SDQ).[8 9] Mothers completed a list of 25

questions with scaled responses (very true, partly true, or not true) regarding their child's behaviour. Scores were summed over a particular group of questions assessing for overall and specific behavioural problems or disorders with a priori defined cut-off points. Based on the score, children were classified as normal (0–13), borderline (14–16), or abnormal (17–40) for having 'overall behavioural problems'.

Our analysis included comparisons between covariates (potential confounders) and prenatal and postnatal cell phone exposure. Covariates of interest included: child's gender; mother's age at birth; father's age at birth; mother's history of psychiatric problems (self-reported from Age-7 Questionnaire); mother's history of psychiatric, behavioural, or cognitive problems as child (self-reported from prenatal interviews); father's history of psychiatric, behavioural, or cognitive problems as child (spousal report from prenatal interviews); social occupational status; prenatal smoking (entire pregnancy, early pregnancy, or not a smoker); prenatal alcohol (entire, early, or late pregnancy only, or not at all) and prenatal marijuana use (yes or no); prenatal stress (14-point summary score categorised as low (0–4), medium (5), high (6–14)); prenatal physical activity (entire, early, or late pregnancy, or no activity); other sources of prenatal ionising and non-ionising radiation (ie, x-rays, ultrasound); parity; gestational age; birth weight; postpartum stress (15-point summary score categorised as low (0–3), medium (4), high (5–15)); child breastfed for at least the first 6 months (yes or no); hours spent with child daily by age 6 and 18 months; and child in daycare by 18 months.

An ordinal logistic regression model was used to estimate the odds of the overall behavioural problems (0, normal; 1, borderline; 2, abnormal) according to prenatal and postnatal exposure to cell phones. Regression models were adjusted for covariates from the original analysis such as child's gender, mother's age at birth, mother's social occupational status, prenatal smoking, and mother's history of psychiatric problems. Regression modelling also considered covariates not included in the previous publication such as both parents' history of psychiatric, cognitive, or behavioural problems as a child, a combined social occupational status, prenatal alcohol and drug use, prenatal physical activity, other prenatal radiation sources, father's age at birth, gestational age, parity, birth weight, postpartum stress, breast feeding, hours spent daily by ages 6 and 18 months, and child in daycare by 18 months. Certain covariates (risk factors) were not associated with the outcome of interest in this analysis and were eliminated. Also certain covariates were not associated with exposure and were found not to be statistically significant ($p > 0.05$) in a multivariate model that included the exposure and outcome. The log likelihood ratio test was utilised during the model building process to develop a parsimonious model by manually eliminating variables at a p value greater than 0.05.

Proxies of prenatal exposure intensity (times per day spoken, location of the phone when not used, proportion of time the phone was turned on, and use of an earpiece with cell phone) were used to evaluate possible dose–response patterns. Depending on the characteristic, the reference category was defined as the lowest possible category (ie, no use, 0–1 times per day spoken). For location of phone when not in use, the reference category was 'carried in bag' versus 'carried in dress/pant pocket'.

Previously, we reported data for 13 159 Danish children born between 1997 and 1999.[2] In this analysis, a 'new' and separate dataset of Danish children (born 1998–2002) was utilised. For comparison, results from 12 796 of the 'original' children were included after excluding 363 'original' children who were born as part of a set of twins or triplets. This analysis for comparability purposes includes singleton, live births in both datasets: 'original' and 'new', and concludes with an analysis of the 'combined' datasets.

Human ethics review approvals were obtained from the Danish Data Protection Agency (Datatilsynet) and the University of California, Los Angeles (UCLA) Office for the Protection of Research Subjects.

RESULTS

Results are presented for the 'original' (n=12 796) and 'new' (n=28 745) datasets for all DNBC singleton, live births followed up to age 7 years. In both datasets 30.5% (original) and 35.2% (new) of children, were using a cell phone at the age of 7 years, but less than 1% used a cell phone for more than 1 h per week in both datasets. In the original dataset, 10.1% of children had both prenatal and postnatal (joint) exposure, whereas among the new dataset of children, 17.9% were jointly exposed. Respectively, 53.3% and 39.5% of children in the original and new datasets

Table 1 Association of prenatal and postnatal exposure to cell phone use with overall behavioural problems by type of dataset and by birth year

	Original dataset			New dataset		
	OR	aOR†	95% CI	OR	aOR†	95% CI
All birth years*						
n	12 796‡			28 745§		
Prenatal and postnatal exposure	2.2	1.9	1.5 to 2.3	1.9	1.5	1.3 to 1.7
Prenatal exposure only	1.7	1.5	1.3 to 1.9	1.5	1.3	1.1 to 1.5
Postnatal exposure only	1.2	1.2	1.0 to 1.4	1.2	1.2	1.0 to 1.4
No exposure	1.0	1.0	–	1.0	1.0	–
1998						
n	5685‡			1090§		
Prenatal and postnatal exposure	2.4	2.0	1.5 to 2.8	3.4	3.4	1.5 to 7.9
Prenatal exposure only	1.4	1.2	0.8 to 1.7	1.7	1.5	0.6 to 3.8
Postnatal exposure only	1.2	1.1	0.8 to 1.4	2.0	2.1	1.0 to 4.4
No exposure	1.0	1.0	–	1.0	1.0	–
1999						
n	7076‡			4214§		
Prenatal and postnatal exposure	2.1	1.8	1.3 to 2.4	2.2	1.9	1.4 to 2.7
Prenatal exposure only	2.0	1.8	1.3 to 2.4	1.5	1.4	1.0 to 1.9
Postnatal exposure only	1.3	1.2	1.0 to 1.6	1.3	1.2	0.9 to 1.7
No exposure	1.0	1.0	–	1.0	1.0	–
2000						
n	–			13 115§		
Prenatal and postnatal exposure	–	–	–	1.9	1.4	1.1 to 1.7
Prenatal exposure only	–	–	–	1.5	1.3	1.0 to 1.6
Postnatal exposure only	–	–	–	1.2	1.2	0.9 to 1.5
No exposure	–	–	–	1.0	1.0	–
2001						
n	–			9682§		
Prenatal and postnatal exposure	–	–	–	1.8	1.4	1.1 to 1.8
Prenatal exposure only	–	–	–	1.5	1.3	1.1 to 1.7
Postnatal exposure only	–	–	–	1.0	1.0	0.7 to 1.4
No exposure	–	–	–	1.0	1.0	–

*Includes the years 1997 (n=24) and/or 2002 (n=635).
†Adjusted for sex of child, mother's age at birth, mother's socio-occupational status, smoking during pregnancy, and mother's psychiatric history.
‡Singleton, live births; our previous analysis included 13 159 children of singleton and multiple, live births; 363 children of multiple births were not included in this analysis.
§Singleton, live births.
aOR, adjusted odds ratio.

had neither prenatal nor postnatal cell phone use exposure. Tests for trend indicated that patterns of cell phone use did change with birth year for both datasets.

Regarding overall behavioural problems, 93.5% (original) and 93.0% (new) of children had no recorded behavioural problems. In both 3.3% were considered borderline and 2.9% (original) and 3.1% (new) of children scored as abnormal.

In table 1, the joint exposures were positively associated with overall behavioural problems. These estimates for both datasets were adjusted for the original set of covariates as previously published.[2] The highest OR for behavioural problems were observed for children who had a joint exposure compared with no exposure. Adjusting for potential confounders moved the results towards the null. In the new dataset, the joint exposure association with overall behavioural problems by birth year decreased from 1998 to 2001 yet remained incompatible with the null. Unadjusted and adjusted models with an interaction term (cell phone use and birth year) were tested and found not to be statistically significant at the p=0.05 level (not shown).

Figure 1 shows the association between certain adjusted covariates and the joint exposure to cell phone use for both datasets. Children with prenatal and postnatal exposures were more often in the lower social occupational status, to have mothers who smoked during pregnancy, to have younger mothers and to have mothers with higher prenatal stress scores. The percentage of parents for whom childhood history of psychiatric, cognitive, or behavioural problems was unknown was higher among the 'original' dataset (early adopters of cell phone technology).

Supplementary tables A1 and A2 (available online only) present all of the covariates considered in this analysis by levels of exposure (no cell phone exposure, prenatal exposure only, postnatal exposure only, or joint exposure) for both datasets. Worth noting are the greater number children whose mothers

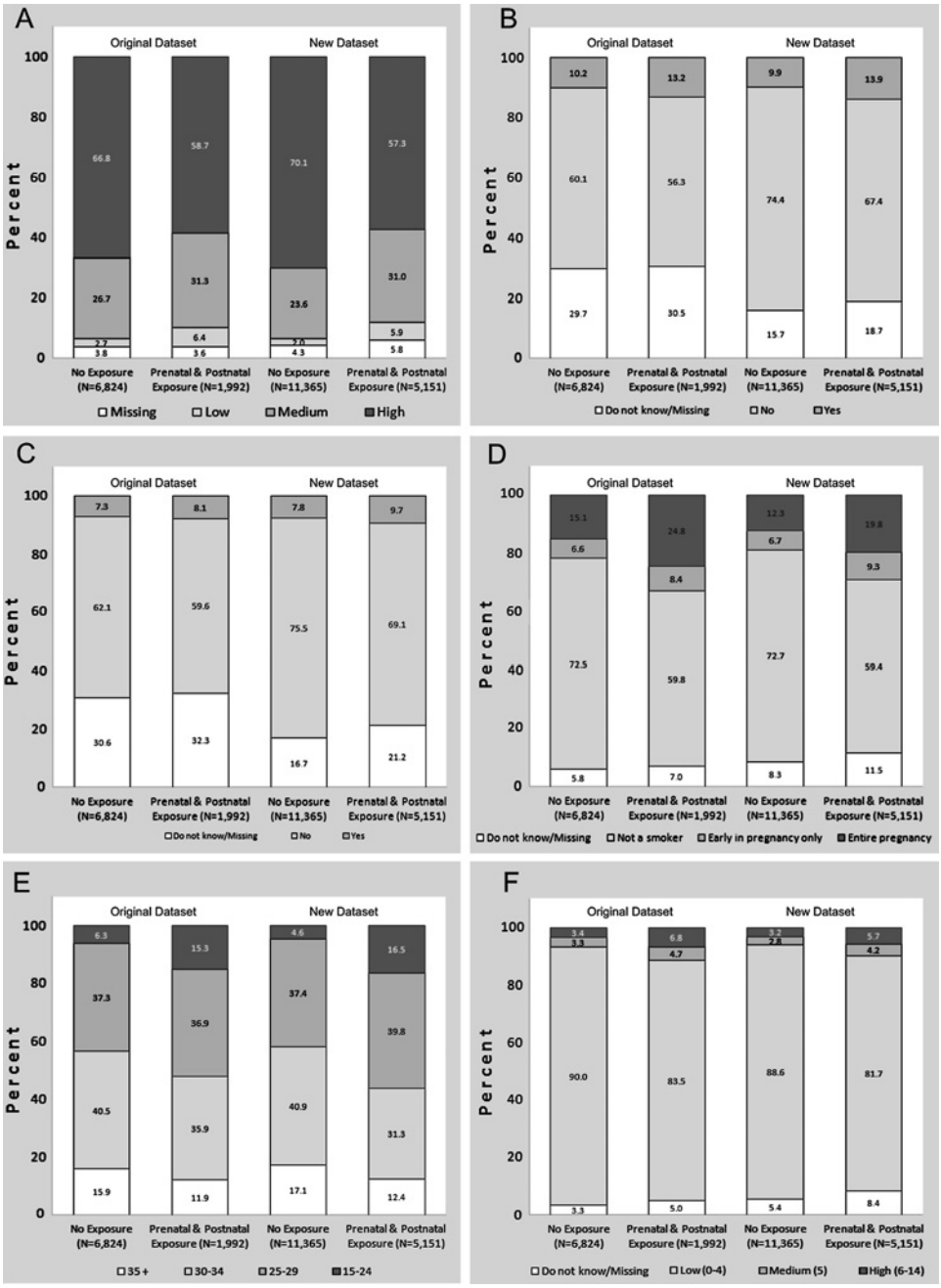

Figure 1 Prenatal and postnatal (joint) exposure to cell phone use by type of dataset and percentage distributions for selected covariates: parents' combined social ccupational status (A); mother's history of psychiatric, cognitive or behavioural problems as a child (B); father's history of psychiatric, cognitive or behavioural problems as a child (C); mother's smoking status during pregnancy (D); mother's age at child's birth (E); and mother's stress score during pregnancy (F).

reported 'not smoking' during pregnancy with no cell phone exposure or with prenatal exposure only compared with children with postnatal only or joint exposure in both datasets. Another difference is the greater percentage of children at birth with mothers 15–24 years of age with joint exposure compared with prenatal only, postnatal only, or no exposure in both datasets.

Table 2 presents estimates for the 'combined' dataset ('original' and 'new', n=41 541). The adjusted OR in the 'combined' dataset for overall behavioural problems score was 1.6 for the joint exposure. Upon further adjustment, the OR for prenatal and postnatal exposure was 1.5 (95% CI 1.4 to 1.7). This final model was adjusted for sex of child, mother's age at birth, mother's and father's history of psychiatric, cognitive or behavioural problems as a child, combined socio-occupational status, gestational age, mother's prenatal stress, and child breastfed up to 6 months of age. For prenatal or postnatal exposure only, the adjusted OR were 1.4 (95% CI 1.2 to 1.5) and 1.2 (95% CI 1.0 to 1.3), respectively.

When analyses were stratified by the modelled covariates, the associations between cell phone use and overall behavioural problems remained across the strata (table 3). These results demonstrate that the selected covariates confound the association between cell phone use and behavioural problems if not controlled, yet complete confounder control is unlikely due to residual confounding caused by measurement error for these covariates. For nearly all strata of covariates, the highest OR were for those with the joint exposure.

Table 2 Association of prenatal and postnatal exposure to cell phone use with overall behavioural problems by birth year among all children (combined dataset, n=41 541)

	OR	aOR†	95% CI	OR‡	95% CI
All birth years* (n=41 541)					
Prenatal and postnatal exposure	2.0	1.6	1.4 to 1.8	1.5	1.4 to 1.7
Prenatal exposure only	1.5	1.4	1.2 to 1.5	1.4	1.2 to 1.5
Postnatal exposure only	1.2	1.2	1.0 to 1.3	1.2	1.0 to 1.3
No exposure	1.0	1.0	—	1.0	—
1998 (n=6775)					
Prenatal and postnatal exposure	2.5	2.2	1.6 to 3.0	2.2	1.7 to 3.0
Prenatal exposure only	1.4	1.2	0.9 to 1.7	1.3	1.0 to 1.8
Postnatal exposure only	1.3	1.2	0.9 to 1.6	1.3	1.0 to 1.7
No exposure	1.0	1.0	—	1.0	—
1999 (n=11 290)					
Prenatal and postnatal exposure	2.2	1.9	1.5 to 2.3	1.8	1.5 to 2.3
Prenatal exposure only	1.8	1.6	1.3 to 2.0	1.5	1.3 to 1.9
Postnatal exposure only	1.3	1.2	1.0 to 1.5	1.2	1.0 to 1.5
No exposure	1.0	1.0	—	1.0	—
2000 (n=13 115)					
Prenatal and postnatal exposure	1.9	1.4	1.1 to 1.7	1.3	1.1 to 1.6
Prenatal exposure only	1.5	1.3	1.0 to 1.6	1.2	1.0 to 1.5
Postnatal exposure only	1.2	1.2	0.9 to 1.5	1.2	1.0 to 1.5
No exposure	1.0	1.0	—	1.0	—
2001 (n=9682)					
Prenatal and postnatal exposure	1.8	1.4	1.1 to 1.8	1.4	1.1 to 1.7
Prenatal exposure only	1.5	1.4	1.1 to 1.7	1.4	1.1 to 1.7
Postnatal exposure only	1.0	1.0	0.7 to 1.4	1.0	0.8 to 1.4
No exposure	1.0	1.0	—	1.0	—

*Includes the years 1997 (n=24) and/or 2002 (n=635).
†Adjusted for sex of child, mother's age at birth, mother's socio-occupational status, smoking during pregnancy, and mother's psychiatric history.
‡Adjusted for sex of child, mother's age at birth, mother's and father's history of psychiatric, cognitive or behavioural problems as a child, combined socio-occupational status, gestational age, mother's prenatal stress, and child breastfed up to 6 months of age.
aOR, adjusted odds ratio.

Table 3 Association of overall behavioural problems with prenatal and postnatal exposure to cell phone use stratified by covariates

	Prenatal and postnatal exposure OR (95% CI)	Prenatal exposure only OR (95% CI)	Postnatal exposure only OR (95% CI)
Social occupational status (combined)			
High level (n=27170)	1.6 (1.4 to 1.9)	1.2 (1.0 to 1.4)	1.1 (0.9 to 1.3)
Medium level (n=11 185)	2.1 (1.7 to 2.5)	1.9 (1.6 to 2.3)	1.4 (1.2 to 1.7)
Low level (n=1374)	1.8 (1.2 to 2.6)	2.2 (1.5 to 3.4)	1.2 (0.7 to 1.9)
Sex of child			
Boy (n=21 284)	2.1 (1.9 to 2.4)	1.6 (1.4 to 1.8)	1.3 (1.1 to 1.5)
Girl (n=20 237)	1.9 (1.6 to 2.3)	1.4 (1.1 to 1.6)	1.3 (1.1 to 1.6)
Mother's history of psychiatric, cognitive, or behavioural problems as a child			
Yes (n=4579)	2.4 (1.9 to 3.1)	1.7 (1.3 to 2.2)	1.2 (0.8 to 1.5)
No (n=28 411)	1.7 (1.4 to 1.9)	1.5 (1.3 to 1.7)	1.1 (1.0 to 1.3)
Father's history of psychiatric, cognitive, or behavioural problems as a child			
Yes (n=3378)	2.2 (1.6 to 2.9)	2.1 (1.5 to 2.9)	1.0 (0.7 to 1.5)
No (n=29 034)	1.8 (1.6 to 2.0)	1.4 (1.2 to 1.6)	1.2 (1.0 to 1.3)
Mother's age at child's birth (years)			
15–24 (n=3453)	1.8 (1.4 to 2.3)	1.6 (1.2 to 2.1)	0.8 (0.6 to 1.2)
25–29 (n=15 868)	1.7 (1.4 to 2.0)	1.5 (1.2 to 1.7)	1.2 (1.0 to 1.4)
30–34 (n=15 904)	1.7 (1.4 to 2.1)	1.3 (1.1 to 1.7)	1.2 (1.0 to 1.5)
35–39 (n=5625)	1.7 (1.2 to 2.4)	1.2 (0.8 to 1.7)	1.6 (1.2 to 2.3)
40 or older (n=691)	1.2 (0.3 to 4.5)	2.6 (1.1 to 6.4)	1.4 (0.5 to 4.2)
Gestational age at birth (weeks)			
<37 (n=1979)	2.1 (1.4 to 3.1)	2.1 (1.4 to 3.2)	1.2 (0.8 to 1.9)
37–41 (n=35 686)	1.9 (1.7 to 2.1)	1.5 (1.3 to 1.7)	1.0 (0.5 to 1.7)
42 or greater (n=3769)	2.2 (1.6 to 3.1)	1.4 (1.0 to 2.0)	1.2 (1.1 to 1.4)
Mother's stress score during pregnancy			
Low (0–4) (n=36 085)	1.8 (1.6 to 2.0)	1.4 (1.3 to 1.6)	1.2 (1.1 to 1.4)
Medium (5) (n=1430)	2.2 (1.4 to 3.4)	1.6 (1.0 to 2.6)	1.0 (0.5 to 1.7)
High (6–14) (n=1693)	2.9 (2.0 to 4.2)	2.5 (1.6 to 3.8)	1.2 (0.8 to 1.9)
Child breastfed for at least the first 6 months			
Yes (n=25 066)	1.7 (1.5 to 2.0)	1.5 (1.3 to 1.7)	1.3 (1.1 to 1.5)
No (n=7629)	1.8 (1.4 to 2.1)	1.4 (1.1 to 1.7)	0.9 (0.7 to 1.1)

To estimate mother's inattention we looked at variables such as breastfeeding up to 6 months of age, reported number of hours spent with child at ages 6 and 18 months, and whether child was in regular daycare by 18 months of age. In table 4, the only covariates that were associated with overall behavioural problems were breastfeeding up to 6 months of age and spending less time daily with the child at 6 months.

In the combined dataset, considering prenatal cell phone use characteristics (independent of postnatal use by child), almost 85% of mothers carried their cell phone in a bag during pregnancy rather than on their person or elsewhere, and nearly 80% reported not using an earpiece (not shown). In table 5, more than 10% of children with prenatal exposure had mothers who reported speaking four times per day or more during their pregnancy and 48.5% reported having the phone turned on at all times. For prenatal exposures, regardless of control for postnatal

Divan HA, Kheifets L, Obel C, *et al*. *J Epidemiol Community Health* (2010). doi:10.1136/jech.2010.115402

Table 4 Association of proxy covariates for mother's inattention with overall behavioural problems in children

	Original dataset (n=12 796)		New dataset (n=28 745)		Combined dataset (n=41 541)	
	OR	95% CI	OR	95% CI	OR	95% CI
Child breastfed for at least the first 6 months						
Yes	0.6	0.5 to 0.7	0.5	0.5 to 0.6	0.5	0.5 to 0.6
No	1.0	—	1.0	—	1.0	—
Reported amount of hours spent per day with child at age 6 months interview						
<1	1.5	1.1 to 2.0	1.5	1.2 to 1.9	1.5	1.2 to 1.8
1–7	1.1	0.9 to 1.4	1.3	1.1 to 1.5	1.2	1.1 to 1.4
8 or more	1.0	—	1.0	—	1.0	—
Reported amount of hours spent per day with child at age 18 months interview						
<1	1.1	0.9 to 1.4	0.9	0.8 to 1.1	1.0	0.9 to 1.1
1–4	1.1	0.8 to 1.5	1.2	1.0 to 1.4	1.2	1.0 to 1.3
5	1.0	0.8 to 1.3	0.9	0.8 to 1.1	1.0	0.8 to 1.1
6–7	1.0	0.8 to 1.3	0.8	0.6 to 0.9	0.8	0.7 to 1.0
8 or more	1.0	—	1.0	—	1.0	—
Child in regular daycare outside the home at age 18 months interview						
Yes	1.1	0.8 to 1.4	0.9	0.8 to 1.1	1.0	0.8 to 1.1
No	1.0	—	1.0	—	1.0	—

exposure, adjusted OR for the overall behavioural problems score tended to be greater with higher potential for fetal exposure. Proxies for intensity of mother's phone use during pregnancy did exhibit dose–response associations, and tests for trend were statistically significant.

DISCUSSION

Using a new group of participants from the DNBC, we replicated our previously reported study on prenatal and postnatal (joint) exposure to cell phones. Our results make it unlikely that the first finding was by chance, but our estimate was higher in the 'original' dataset (adjusted OR 1.9) compared with the 'new' dataset (adjusted OR 1.5).

Table 5 Association of characteristics of mother's cell phone use during pregnancy with overall behavioural problems score in children with prenatal exposure (n=13 938)

	No. (%)	OR	aOR* (95% CI)	aOR† (95% CI)
Times spoken daily				
0–1	7268 (52.2)	1.0	1.0	1.0
2–3	3703 (26.6)	1.4	1.2 (1.0 to 1.4)	1.2 (1.0 to 1.4)
4+	1409 (10.8)	1.7	1.4 (1.2 to 1.7)	1.4 (1.2 to 1.7)
Missing	1458 (10.4)	—	—	—
p for trend	—	0.09	0.07	0.07
Percentage of time turned on (%)				
0	1098 (7.9)	1.0	1.0	1.0
<50	1788 (12.8)	1.6	1.4 (1.0 to 2.1)	1.4 (1.0 to 2.1)
50–99	4201 (30.1)	2.2	1.7 (1.2 to 2.3)	1.7 (1.2 to 2.3)
100	6750 (48.5)	2.8	2.0 (1.4 to 2.7)	2.0 (1.4 to 2.7)
Missing	101 (0.7)	—	—	—
p for trend	—	<0.0001	0.003	0.004

*Adjusted for sex of child, mother's age at birth, mother's and father's history of psychiatric, cognitive or behavioural problems as a child, combined socio-occupational status, gestational age, mother's prenatal stress and child breastfed up to 6 months of age.
†Adjusted for sex of child, mother's age at birth, mother's and father's history of psychiatric, cognitive or behavioral problems as a child, combined socio-occupational status, gestational age, mother's prenatal stress, child breastfed up to 6 months of age and postnatal exposure to cell phones.
aOR, adjusted odds ratio.

Many including ourselves have raised concerns regarding the role of uncontrolled confounding as well as unmeasured confounding in the original analysis.[10] Here, we examined numerous other covariates that were not considered previously. With the addition of these variables, the association still remained. Although we took a larger set of potential confounders into consideration there was no appreciable effect on the results.

We also hypothesised that greater cell phone use during pregnancy may be indicative of mother's inattention in rearing her child, thus providing an alternative explanation for the positive association with behavioural problems in children. As this study was not designed to observe direct mother–child interactions or how much attention a mother gave her child, we used measures of breastfeeding and hours spent per day as proxy measures for this covariate. Breastfeeding was inversely associated (OR 0.5 in the combined dataset) with overall behavioural problems but did not diminish the association between cell phone exposure and the outcome when included. If breastfeeding and time spent with child are good measures of mothers' attention then we believe that our results do not support inattention as a likely explanation for the observed association.

It has been suggested that our initial results were due to characteristics of early technology adopters of cell phones and that these parents' behaviour may strongly influence and predict overall behavioural problems in their children. These findings are not limited to a unique group of parents in the early part of our cohort, but are replicated in a more general population of Danish mothers who used cell phones during pregnancy.

There were concerns that the SDQ as an instrument might be too non-specific and biased if mothers have children with other serious mental and health conditions before SDQ administration. However, our work and the work of others indicates both the internal validity of SDQ and its ability to predict clinical diagnosis for overall behavioural problems.[8 9 11]

We also do not believe that differential recall bias explains the observed associations. We have tested this exposure assessment method with other outcomes and did not find an association (data not shown). It is highly unlikely that reporting prenatal or postnatal cell phone use would be influenced by the mother's knowledge or suspicion of her child's behavioural status and not by more debilitating neurological outcomes such child's history of febrile seizures or epilepsy, which we looked at.

Modelling specific absorption rates (SAR) of radiofrequency fields to the womb of pregnant mothers suggest that exposures are likely to be low and not high enough to elevate the body temperature,[12–14] but modelling is based on numerous assumptions and extrapolations. In addition, possible non-thermal effects of radiofrequency fields remain of interest. In a recent letter to the editor, Hocking[15] cites a review article by Brzezinski[16] that suggests talking on a cell phone—placed on the side of the head by the ear and jaw—may lead to increased melatonin secretion due to the excitation of nearby post-ganglionic nerves that lead to the pineal gland, which is responsible for producing melatonin. One of the many things that this hormone does is to inhibit the secretion of gonadotropin-releasing hormone thus directly affecting steroid metabolism within the ovaries and progesterone synthesis. It is believed that diverse changes in maternal metabolism or the sex hormone environment can affect the development of the fetal brain thus leading to behavioural problems.[15]

Vrijheid *et al*[17] recently published results reporting no association between prenatal exposure to cell phone use and neurodevelopment at 14 months among a smaller pregnancy

What is already known on this subject

Previous studies of cell phone use have emphasised health effects in adults. Yet the most susceptible population to environmental exposures are children. This past decade has seen a great increase worldwide in cell phone use and access. During this same period, an equally important public health outcome that has increased in prevalence is childhood behavioural problems.

What this study adds

There is an association between prenatal as well as postnatal use and behavioural problems by age 7 years among a general population of mothers who are cell phone users. These results replicate the findings of an association observed among only early technology adopters. These new results also reduce the likelihood that these are chance findings or findings that did not adequately consider the influence of other important factors for behavioural problems. These results should not be interpreted as demonstrating a causal link between cell phone use and adverse health effects for children, but if real—and given the nearly universal use of cell phones—the impact on the publics' health could be of concern.

cohort. Their findings point to the possibility that exposure may have specificity for a particular outcome such as behavioural problems, which probably has a different causal pathway than infant neurodevelopment delays.

Whereas it is unlikely that mothers would erroneously recall using or not using a cell phone, more detailed information such as trimester of use was difficult to recall. We assume that reported use correlates with levels of radiofrequency field exposure, which are truly unknown, and prenatal exposure is dichotomised, whereas the true exposure is a continuous value.

Data from the Age-7 Questionnaire represents nearly 60–65% of mothers and children eligible to participate. This is down from 80% participation for the 6 and 18 month interviews. In this research a proportional odds model for an ordinal logistic regression was utilised to understand behavioural problems. If the proportional odds assumption was truly incorrect, then model misspecification bias would have been introduced. This can be explored further through multinomial logit analyses in which such an assumption is not necessary.

Although it is premature to interpret these results as causal, we are concerned that early exposure to cell phones could carry a risk, which, if real, would be of public health concern given the widespread use of this technology. Even with limited scientific investigations into this research hypothesis, given that exposures to children and fetuses are easily reduced at virtually no cost, precautionary measures might be warranted. It is our hope that other scientists will attempt to replicate or refute the findings of our research based upon similar study designs. Also, prospective and detailed ascertainment would greatly improve exposure measurement quality. A random subsample, who are offered clinical evaluation for behavioural problems, would be another enhancement. Adequate populations of both exposed and unexposed are needed, but as cell phone technology is widely used, researchers will find it difficult to enrol these shrinking, unexposed populations.

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Competing interests None.

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