Wifi Radiation in Schools in Maryland

DRAFT REPORT

Maryland Children's Environmental Health and Protection Advisory Council

December 13, 2016

CONTENTS

INTRODUCTION

The Maryland Children's Environmental Health and Protection Advisory Council (the Council) identifies environmental health issues that impact children and seeks to protect them from exposure to environmental hazards. Under Md. Code Ann., Health-General §13–1506, one of the responsibilities of CEHPAC is to:

> (4) Gather and disseminate information to the public, including the research and medical communities, community–based organizations, schools, and State agencies, on how to reduce, treat, and eliminate children's exposures to environmental hazards to further the public's understanding of the environmental hazards that may potentially affect children;

and

> (5) Recommend uniform guidelines for State agencies to follow to help reduce and eliminate children's exposure to environmental hazards, especially in areas reasonably accessible to children…

In May, 2014, the Council received a request from a member of the public to consider the health and safety of wireless radiation (microwave radiation). The Council subsequently discussed the issue and heard from the public over a series of meetings, and invited input from the public. It also received a presentation on the topic from a resident physician in training in the Johns Hopkins Preventive Medicine Residency Program, and a literature review prepared by a graduate student enrolled in the University of Maryland School of Public Health. Throughout the process, the Council has heard from concerned citizens about the issue.

Based on this input, a work group of the Council (see Appendix A for Council and work group members) prepared an initial draft of this report, which was then reviewed by the Council. The work group set out to answer the following questions:

1. What exposures are linked to WiFi technology?
2. What health outcomes are linked to exposure?
3. Is the Federal Communications Commission radio-frequency energy exposure limit protective of children when it comes to WiFi exposures? Is it overprotective?
4. What are the policy options?

SCOPE OF THE REPORT

The original request concerned non-ionizing radiation generally, but focused on WiFi radiation in schools (see Background, below). In subsequent Council meetings the issue has at various times been framed as concerns about all WiFi radiation, or particular sources of non-ionizing radiation in schools (primarily, school-based WiFi routers), instructional electronic devices used by students (laptops, tablets), WiFi radiation sources near schools (cell towers located on or near school property), personal devices used by students (cell phones), or WiFi sources not related to schools (e.g., “smart meters”). The health effects of concern have included chronic health effects such as cancer, as well as chronic and acute effects such as impacts on vision from use of personal electronic devices, and non-health outcomes such as educational performance.

The Council recognizes that many decisions regarding electronic device use are under the personal control of parents and children, but has also heard concerns from parents that the increasing use of wireless electronic instructional devices in schools lessens their control of WiFi radiation exposures. In addition, the Council heard from the public about health concerns related to the use of electronic instructional devices (laptops, tablets) that include not only the potential exposure to WiFi radiation, but also related to ergonomics and effects on vision.

Even more than in other environmental health questions involving children, the Council recognized the complexity of isolating for consideration just some of the sources of WiFi radiation exposure. Humans live within an environment in which WiFi radiation is omnipresent, which adds to the difficulty of determining its health impacts. Further, even determining how much exposure an individual or population has over a lifetime is extremely complex, and the nature of electromagnetic radiation is such that there are many possible ways of evaluating exposure, such as mean dose, peak dose, or the measure used officially, the specific absorption rate (SAR).

The Council has attempted to respond to this complexity within its statutory mandate, which focuses on its role both as an advisory body to organs of State government (i.e., the General Assembly and State agencies) and its role in public education. This has led the Council to take a somewhat expansive view of the issue in this report, which, while it is focused primarily on the issue of WiFi radiation exposure from sources within schools (mainly school-based routers), it also mentions some of the other health concerns, with the goal of provoking public discussion as well as discussion within State agencies. Regarding cellular towers located on or near school properties, the Council notes that there are complex issues related to siting and Federal law that the Council cannot

address adequately in this report. The Council has also heard concerns expressed regarding WiFi exposures and sources outside of schools, such as so-called “smart meters.” This report does not address those issues.

BACKGROUND

What exposures are linked to WiFi techology?

“WiFi radiation” (WiFi), also referred to as radiofrequency radiation (RFR), is non-ionizing radiation typically in the microwave frequencies of approximately 900 megahertz (million cycles/second, or MHz) to approximately 5 gigahertz (1,000 million cycles per second, or GHz). WiFi is used primarily for cellular telephones, local area networks (LANs), and other communications technologies. The primary bands used for WiFi are generally 2.4 GHz and 5 GHz.

WiFi radiation exposures are regulated by several agencies. The U.S. Federal Communications Commission (FCC) issues radiation exposure guidelines as specific absorption rates (SARs) for fixed antennas, hand-held cellular telephones, and personal communications services (PCS) devices.[1] These guidelines were last issued by the FCC in 1996. The U.S. Occupational Safety and Health Administration (OSHA) has established occupational exposure limits for microwave radiation.[2] The U.S. Food and Drug Administration (FDA) does not have standards for cellular telephones, but can take regulatory action if these devices are shown to have adverse health impacts.[3]

What Health Outcomes Are Linked to Exposure?

Some of the biological effects of WiFi radiation are well characterized. In particular, WiFi radiation is known to have thermal effects on tissues, due to the absorption of microwave RFR by water, which results in heating of the water. These thermal effects can be seen in a variety of tissues, and form the basis for most of the health standards that currently apply to WiFi radiation. There are also concerns about non-thermal effects, including cancer.

The Council’s review included a wide variety of sources, including:

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[1] 47 Code of Federal Regulations § 1.1310, accessed 11/22/2016 at: http://www.ecfr.gov/cgi-bin/text-idx?SID=005917bcee652d12d9ad4d725bf3e4d9&mc=true&node=se47.1.1_11310&rgn=div8.
[2] See https://www.osha.gov/SLTC/radiofrequencyradiation/standards.html.
[3] See http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/default.htm.

- Public comments received during Council meetings, and emails received by the Council
- A literature review prepared by a graduate student at the University of Maryland School of Public Health as part of the student's Capstone project
- A presentation prepared by a resident physician in the Johns Hopkins Preventive Medicine Residency Program

The Council heard from multiple sources about some of the organizations that have issued statements or findings relevant to children's health and RFR or WiFi. These include the World Health Organization's International Agency for Research on Cancer (IARC), which in 2011 classified radiofrequency radiation as a Class 2B (possible) human carcinogen, based on the evaluation of limited evidence for an association between cellular telephone use and the development of gliomas (a type of brain cancer) and acoustic neuromas.[4] These data are summarized in a 2013 IARC monograph on electromagnetic fields and cancer.[5]

In a May 19, 1999 letter to the National Toxicology Program of the National Institute for Environmental Health Science, the FDA nominated radiofrequency radiation emissions of wireless communications devices for study by the National Toxicology Program, due to concerns about potential long term health effects.[6] This prompted a large multi-year exposure study by the National Toxicology Program (NTP), which released its preliminary findings in 2016.[7] These findings were released during the Council work group's evaluation, and have informed its recommendations. While the NTP study focused on cellular telephones, it was the largest animal study of its kind, and the preliminary findings were discussed by the work group and the Council. The Council also heard that, based in part on the preliminary findings of the NTP study and other evidence, a number of other organizations have formally requested that the FCC

[4] *IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans.* IARC Press Release No. 208, May 31, 2011. Accessed November 26, 2016 at: http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf.
[5] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2013. *Non-ionizing radiation part 2: Radiofrequency electromagnetic fields*. International Agency for Research on Cancer, vol. 102: Lyons, France.
[6] Letter of Willam T. Allaben, PhD, May 19, 1999: Accessed on November 15, 2016 at: http://ntp.niehs.nih.gov/ntp/htdocs/chem_background/exsumpdf/wireless051999_508.pdf.
[7] 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). Accessed November 25, 2016 at: http://biorxiv.org/content/early/2016/06/23/055699.

reconsider its exposure standards, including the American Academy of Pediatrics (2013).[8]

FINDINGS

Is the Federal Communications Commission radio-frequency energy exposure limit protective of children when it comes to WiFi exposures?

Regarding the third question, the Federal Communications Commission (FCC) guidance is decades old and some groups have called for it to be updated to reflect current science and newer exposures, especially to children. The Council recommends that the Maryland Department of Health and Mental Hygiene 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.

What are the policy options?

There are a range of policy approaches to address environmental exposures: from adopting the precautionary principle to experimenting directly on humans. Below are some examples of policy approaches from around the world (more can be found at http://www.parentsforsafetechnology.org/worldwide-countries-taking-action.html):

- In Massachusetts, the Ashland Public School District reduces wireless radiation exposures through a "best practices for mobile devices".
- France banned WiFi in nursery schools and ruled that routers in schools for children up to 11 should be turned off when not in use for pedagogic purposes.
- In Vitoria City, Spain citizens will be informed of the location of wireless transmitters are in civic centers and municipal buildings.
- In Israel, the Ministry Of Education issued guidelines limiting WiFi in schools including.
    - Preschool through 2nd grade have banned the use of wireless networks.
    - A hard wired direct cable connection is required if the teacher has a computer in the class. Magnetic fields below 4MG are being reduced.
    - In third and fourth grade class internet is restricted to 3 hours per week.

[8] Letter of Thomas K. McInerney, MD, FAAP, August 29, 2013: Accessed November 26, 2016 at: https://ecfsapi.fcc.gov/file/7520941318.pdf.

- The German Federal Ministry for Radiation Protection states,"supplementary precautionary measures such as wired cable alternatives are to be preferred to the WLAN system."

RECOMMENDATIONS

The literature review of exposures and health effects from WiFi prepared for the Council indicated that the research is still inconclusive. While scientists work to answer questions about the impact of WiFi on children's health, the Council recommends limiting exposures as much as feasibly practical[9], without negatively impacting education. Science has yet to determine if the following recommendations will reduce exposure; however they are based on principles of industrial hygiene and occupational health. The Council recommends that:

- The Maryland Department of Health and Mental Hygiene 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 Maryland State Department of Education should:
    - Consider using wired devices.
        - Where classrooms are powered, but without wired access to the school networks, a centralized switch and dLAN units can provide a reliable and secure form of networking for as many laptops as necessary without any microwave electromagnetic field exposure.
        - 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 network access with minimal extra cost and time.
    - 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.
    - Teach children to turn off WiFi when not in use.
    - Consider placing routers as far away from students as possible.
    - Share this document with teachers and parents.

[9] Wifi in Schools Australia: Reducing EMR. http://www.WiFi-in-schools-australia.org/p/blog-page_13.html.

- 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 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.
- This report should be posted on the Council website and shared with the:
    - United States Department of Health and Human Services
    - Federal Communications Commission
    - Maryland State Department of Education
    - Maryland General Assembly

CONCLUSION

Many members of the public participated in Council meetings and contributed documentation relevant to these deliberations (Appendix B); we appreciate their input and dedication. While this report focused on WiFi radiation in schools, there are additional concerns about mobile phones and cell phone towers. CEHPAC plans to take a look at these broader issues over the next year.

APPENDIX A: Members of the Children's Environmental Health and Protection Advisory Council

Name	
	Appointed by the Governor, representing the following:
Abney, Dr. Diana	Maryland Association of County Officials
Bishai, Dr. David	Economist skilled in measuring the economic costs of illness and the benefits of prevention
Carrella, Veronika*	Parent or guardian whose child has been clinically diagnosed as having been exposed to
Diette, Dr. Gregory	Representative from an academic institution who has expertise in studying the impact of environmental exposures on childhood disease
Gitterman,Dr. Benjamin*	Licensed health care provider with expertise in the field of children's environmental health
Latshaw, Dr. Megan**	Epidemiologist with expertise in children's environmental health
Levy, Julian	Representative of private industry representing the regulated community
Matsui,Dr. Elizabeth	Licensed health care provider with expertise in the field of children's environmental health
Witherspoon, Nsedu*	Environmental toxicologist with expertise in issues of importance to children's environmental health
Thomas, Benoy	Maryland Commission on Environmental Justice and Sustainable Communities
	Appointed by:
Church, Christina	Special Secretary of the Governor's Office for Children
Del. Angela Angel	Speaker of the House
Senator Guy Guzzone	President of the Senate
Hofstetter, Rob	Secretary of Agriculture
Mezu, Alicia	Secretary of Education
VACANT	Secretary of the Environment – Vice Chair
Mitchell, Dr. Clifford	Secretary of Health and Mental Hygiene - Chair
Stocksdale, Brandi	Secretary of Human Resources
Varney-Alvarado, Caroline	Secretary of Housing and Community Development

*WiFi work group member. **Chair of WiFi work group.

APPENDIX B: Review and Analysis of Wi-Fi Devices and Radiofrequency Radiation in Schools

(found at https://drive.google.com/open?id=0B1ZNBgMUm-vALUFQLUx4d3dPQjA)

MEMORANDUM

DATE: May 23, 2016

FROM: Clifford S. Mitchell, Chair

TO: CEHPAC Members

RE: **Review and Analysis of Wi-Fi Devices and Radiofrequency Radiation in Schools for the Maryland Children's Environmental Health and Protection Advisory Council**

As part of her MPH Capstone project, a University of Maryland student in the Maryland Institute for Applied Environmental Health has prepared a review and analysis of WiFi radiofrequency radiation for the Maryland Children's Environmental Health and Protection Advisory Council. This is the original report, with no input from or editing by anyone in the Department of Health and Mental Hygiene. The report does not represent the views of the State of Maryland or any of its agencies. It is presented to CEHPAC by request of the members of the WiFi work group, for informational purposes.

I want to thank Linda Li for the hard work that went into the preparation of this report.

Review and Analysis of Wi-Fi Devices and Radiofrequency Radiation in Schools for the Maryland Children's Environmental Health and Protection Advisory Council

Linda Li
MPH Capstone Project, Spring 2016
Maryland Institute for Applied Environmental Health
Committee: Dr. Paul Turner (Advisor), Dr. Lesliam Quirós-Alcalá, Dr. Devon Payne-Sturges

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Abstract

With growing concern over the potential adverse health effects of chronic exposure to Wi-Fi radiation, the Maryland Children's Environmental Health and Protection Advisory Council (CEHPAC) has formed a Workgroup to examine the issue of Wi-Fi routers and their use in K-12 schools in the state. This review serves as an overview of the state of the science available to date on Wi-Fi effects on biological outcomes, as well as exposure assessments of radiofrequency radiation in the general, non-occupational population. This literature search and review yielded mixed results and studies of varying quality. Exposure assessments found that typical and worst case scenario exposures are well below US and international guidelines for radiofrequency exposure. However, decades-old standards need updating in light of new science. This review will contribute to a larger report from CEHPAC in which recommendations will be made to aid policymakers and school administrators regarding the best way to approach Wi-Fi exposure in schools.

Introduction

In the past twenty years, Wi-Fi use has become near ubiquitous in homes, workplaces, public spaces, and increasingly, schools. "Wi-Fi" is defined by the Wi-Fi Alliance as any certified product using wireless local area network (WLAN) within IEEE 802.11 standards (Wi-Fi Alliance, 2016). Wi-Fi, therefore, applies to any product that can support WLANs, including mobile phones, laptops, tablet computers, and video game consoles, among others. With the widespread adoption of wireless technology in almost every aspect of modern life comes increasing concern for the potential negative health effects of constant exposure to radiofrequency electromagnetic radiation (RF-EMR) from electronic devices utilizing Wi-Fi technology. As more schools across the country become Wi-Fi equipped, advancing past traditional "hardwired" Ethernet internet connections, parents and other concerned parties are advocating for increased research into the potential adverse effects that could result from RF-EMR in environments where children spend a significant portion of their day. In fact, the concern is so strong that some parents and experts recommend that schools eschew Wi-Fi altogether and stay hard-wired, citing the precautionary principle (Sage & Carpenter, 2009).

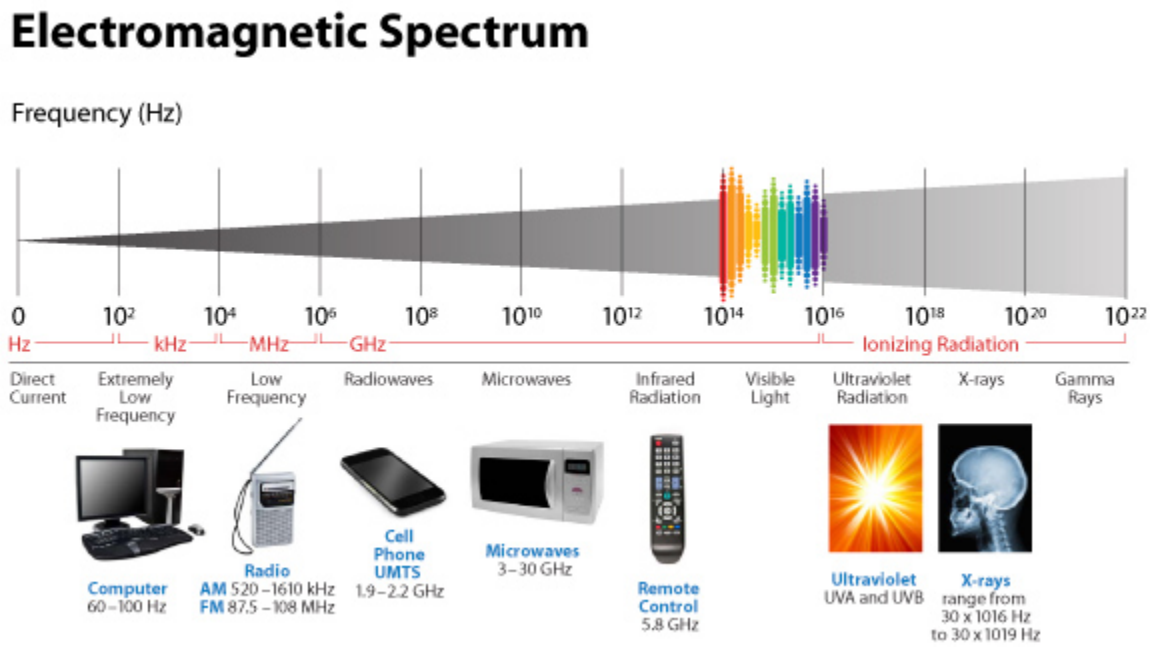
In Maryland, the Children's Environmental Health and Protection Advisory Council (CEHPAC) has formed a Wi-Fi Workgroup to investigate the issue of Wi-Fi in schools in the state. CEHPAC was created in 2000 when the Maryland General Assembly passed HB313 to establish a council to advise the Governor and General Assembly on environmental issues that may pose a threat to children. The Council is composed of members from Maryland state agencies such as the Department of Health and Mental Hygiene, the Department of Environment, and the Department of Education, as well as health care providers and partners from non-profit agencies and academic institutions (Maryland State Archives, 2016). The Wi-Fi Workgroup, comprised of scientists and environmental health experts, was specifically formed with the intention of reviewing the potential adverse effects of RF-EMR from Wi-Fi routers and to make recommendations in response to the urging of concerned parents in Maryland, particularly those with children in the Montgomery County Public School System.

This review seeks to examine the current state of the science regarding RF-EMR emitted by Wi-Fi devices. While there have been decades of research into RF-EMR, only recently has the focus turned to Wi-Fi. To date, the vast majority of the existing body of research on microwave radiation in the general population examines RF-EMR from mobile phones, which operate at different frequency bands than Wi-Fi devices. Usage of mobile phones also differs from that of Wi-Fi in that phones are typically held up to specific parts of the body (e.g. the face/ears, or the legs when the phone is in a pants pocket) and thus exposure to radiation from mobile phones is highly localized. This review will cover scientific research as it relates to exposure, dose, and potential adverse effects as a result of exposure to Wi-Fi. The results of this review will contribute to CEHPAC's larger goal of determining whether any action should be taken with regard to Wi-Fi in Maryland schools. This review will later become part of a larger report from the Workgroup that will provide guidance to state legislators and other policymakers.

Background

Certified Wi-Fi devices in the United States operate in the 2.45 GHz and 5 GHz frequency bands, both of which fall under the spectrum of radiofrequency microwave radiation (Institute of Electrical and Electronics Engineers, 2013). Microwaves, which cover electromagnetic radiation frequencies between 300 MHz and 300 GHz, are considered non-ionizing radiation (See Figure 1). Compared to ionizing radiation, non-ionizing radiation does not have enough energy to ionize atoms and molecules, a process that leads to tissue and DNA damage (US EPA, 2015). Because of this, non-ionizing radiation has, up until recently, generally been considered safe at the levels emitted by electronic devices. Although non-ionizing radiation does not have enough energy to damage cells and DNA, it can cause atoms to vibrate, which produces thermal effects at high levels (US EPA, 2006).

Figure 1. The electromagnetic spectrum. Source: NIEHS (National Institute of Environmental Health Sciences, 2016)



While the thermal effects of high levels of exposure to microwaves are well-documented, there is increasing concern in regards to non-thermal effects of microwaves in the case of lower, chronic exposure (Pall, 2015). In 2011, the International Agency for Research on Cancer (IARC) classified RF-EMR, which includes microwaves, as Class 2B or "possibly carcinogenic" (Baan et al., 2011). The decision to classify RF-EMR as possibly carcinogenic was largely based on a handful of epidemiological studies that provide evidence for a possible association between mobile phone use and glioma (Auvinen, Hietanen, Luukkonen, & Koskela, 2002; Hardell, Carlberg, & Hansson Mild, 2011; Inskip et al., 2001; Muscat JE, Malkin MG, Thompson S, et al, 2000; Schüz et al., 2006; The INTERPHONE Study Group, 2010). Although the IARC review and report do not specifically mention Wi-Fi devices and RF-EMR in the Wi-Fi frequency bands, many are wary that the same health effects demonstrated through long-term mobile phone use may also occur from lifelong exposure to Wi-Fi radiation.

Currently in the US, wireless devices, including routers, are subject to regulation under the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards (Institute of Electrical and Electronics Engineers, 2013) as well as the Federal Communication Commission (FCC). All wireless devices sold in the US must not exceed the maximum allowable specific absorption rate (SAR) level when operating at the device's highest possible power level. The SAR is a value that corresponds to the rate at which RF energy is absorbed by body tissue. This limit, set in 1996, is 1.6 watts per kilogram (W/kg), averaged over one gram of tissue (Federal Communication Commission, 1997). Additionally, the International Commission on Nonionizing Radiation Protection (ICNIRP) published SAR guidelines for whole-body and local exposure in 1998. These limits are 0.08 W/kg and 2.0 W/kg, respectively (International Commission on Non-Ionizing Radiation Protection, 1998). These standards and guidelines are based on documented thermal effects of microwaves.

Methods

Literature Search

Literature searches were completed using PubMed/MEDLINE using the following search terms in late December 2015 to early January 2016:

wlan[All Fields] AND ("health"[MeSH Terms] OR "health"[All Fields])
wlan[All Fields] AND exposure[All Fields]
wifi[All Fields] AND exposure[All Fields]
wifi[All Fields] AND ("health"[MeSH Terms] OR "health"[All Fields])
wi-fi[All Fields] AND ("health"[MeSH Terms] OR "health"[All Fields])
wi-fi[All Fields] AND exposure[All Fields]

This search strategy yielded a total of 260 articles that were then vetted for relevance. Searches were completed primarily on the University of Maryland (UMD), College Park campus. For additional resources such as access to medical science databases not available in College Park, some articles were retrieved at the UMD, Baltimore Health Sciences and Human Services

Library. After database search, additional articles for review were identified through e-mail correspondence with experts. During the course of this literature search, CEHPAC received e-mails from scientists and physicians calling for hardwired schools in Maryland, many of which cited peer-reviewed articles and other materials related to the issue of Wi-Fi in schools. This yielded 25 additional records for review.

Exclusion Criteria

The literature review process was based on the PRISMA Statement guide for reporting systematic reviews and meta-analyses (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). From the database search, 260 articles were identified, 92 of which were kept after an initial screening based on title and abstract. Due to the timeline and scope of this report, only studies conducted using Wi-Fi frequencies, i.e. 2.45 GHz or 5 GHz, were considered. Articles related to cell phones, cordless landline phones, and other sources of microwave radiation besides WLAN access points/routers and antenna were excluded. Articles focusing on Wi-Fi radiation from cell phones were also excluded as they did not contribute to the main research question regarding routers in schools. After 34 duplicates were removed, 58 articles remained for full-text review. Of the 25 records from the e-mails, 12 were duplicates of articles identified from the database search, leaving 13 records for review. In total, 71 records advanced to full-text assessment and review.

The remaining 71 records from e-mails and database searches were assessed for eligibility for inclusion in the final literature review. Ten articles were excluded because they were methods papers written with the intention of informing the design of future studies in exposure assessment and/or measuring potential biological effects of microwave radiation at Wi-Fi frequencies. These articles are highly technical and do not contribute results that would be useful for this literature review. Three articles were excluded because they did not measure exposure or effects specifically of Wi-Fi from routers, but rather radiation from cell phones and other sources. Two articles were reviews of EMF-related health concerns that had no specific focus on Wi-Fi. Two records were excluded because they were not scientific studies of EMF exposure; one was an exposé of the electronics industry and one was a signed letter. Seven records were excluded because they did not specifically address the issue of Wi-Fi exposure, but instead proposed biological mechanisms for non-thermal effects of all RF-EMF.

The 47 studies included in this report were reviewed for article type (*in vitro, in vivo*, exposure assessment, etc.; see "Results of Literature Review"), study population, methods and/or study design, exposure system when applicable, main results, and strengths and limitations.

Results of Literature Review

Exposure assessment

The majority of surveys of RF-EMR exposure have taken place in Europe in a variety of indoor and outdoor environments. While every study in this review included Wi-Fi frequencies in their exposure assessments, most studies measured all sources of RF radiation to ascertain the relative contributions of each source. Many exposure studies used the ICNIRP reference level for

electric field strength exposure for the general public, currently set at 61 V/m for devices in the 2-300 GHz range (International Commission on Non-Ionizing Radiation Protection, 1998). This is different from the ICNIRP reference level SAR because electric field strength does not measure absorbed RF-EMR, but instead describes the strength of radiation from devices in a given area. Urbinello et al. performed measurements in Basel, Ghent, and Brussels in Belgium with portable RF exposure meters in outdoor residential and urban areas, inside public transportation, and in indoor spaces such as airports, shopping malls, and railway stations (Urbinello, Joseph, Verloock, Martens, & Röösli, 2014). The highest measured exposure occurred in public transport, with means of 0.84 V/m in Brussels, 0.72 V/m in Ghent, and 0.59 V/m in Basel. All exposure levels obtained in the study were below ICNIRP guidelines. This study measured 11 frequency bands, ranging from Wi-Fi to FM radio and mobile phones. Therefore, the exposure levels obtained by the researchers are an indication of total exposure from all RF-EMR, not just Wi-Fi itself. However, the authors did note that mobile phones were the main source of exposure inside trains, and that base stations contributed most of the radiation in outdoor settings. In indoor settings, both sources had considerable contributions.

Verloock and colleagues completed several other exposure assessments in Belgium. Looking at Wi-Fi frequencies only, the researchers characterized WLAN exposure in 222 office location scenarios and in a wireless sensor lab environment (WiLab) (Verloock, Joseph, Vermeeren, & Martens, 2010). Average exposure to WLAN in an office environment with WiLab off was 0.12 V/m with a 95th percentile measurement of 0.90 V/m. With WiLab on, exposure increased to 1.9 V/m with a 95th percentile of 4.7 V/m. Results from the study were all below the ICNIRP guidelines of 61 V/m for distances of more than one meter from the Wi-Fi access point. It should also be noted that the intensity of radiation from wireless devices falls of rapidly with increasing distance from the source of energy, in what is known as the inverse-square law (Foster & Moulder, 2013). Another study by the same group characterized RF-EMR in schools, homes, and public places – three microenvironments where children are likely to be present. Average and maximal total RF-EMR values in schools, homes, and public places were 0.2 and 3.2 V/m, 0.1 and 1.1 V/m, and 0.6 and 2.4 V/m respectively, all of which are lower than ICNIRP limits (Verloock et al., 2014). In schools, the highest exposures came from Wi-Fi, while telecommunication signals such as those from mobile phones were highest at home and in public places. Joseph et al. found that 95th percentiles of field values due to Wi-Fi ranged between 0.36 and 0.58 V/m in indoor and office environments (W. Joseph, Vermeeren, Verloock, Heredia, & Martens, 2008).

Viel et al. supplied participants with personal exposure meters deployed for 24 hours in the rural/suburban region of Besançon and the urban area of Lyon (Viel, Cardis, Moissonnier, de Seze, & Hours, 2009). The meters measured RF-EMR in 12 different bands, and participants also kept a time-location-activity diary. Though the majority of recorded field strengths were below detection level, the highest mean exposure resulted from FM sources (0.044 V/m), followed by WiFi-microwaves (0.038 V/m), cordless phones (0.037 V/m), and mobile phones (UMTS: 0.036 V/m, UMTS: 0.037 V/m). Exposure was highest in urban areas during daytime. Bolte and Eikelboom conducted 24 hour personal exposure measurements in 12 frequency bands in Amsterdam and Purmerend in The Netherlands (Bolte & Eikelboom, 2012). Mean total exposure was 0.277 V/m with 37.5% of power density from mobile phones, 31.7% from cordless phones, 14.1% from Wi-Fi, 12.7% from base stations, and 3% from FM. In a study by Valič et al.,

children under the age of 17 wore personal exposure meters living in an apartment above a transformer substation and found exposure to RF-EMR to be under ICNIRP guidelines (Valič, Kos, & Gajšek, 2015).

Several other studies investigated scenarios of typical personal exposure at home, work, and public spaces. Vermeeren et al. measured exposure in 55 indoor microenvironments in Belgium and Greece (Vermeeren et al., 2013). The highest cumulative field values found were 3.6 V/m and 2.1 V/m in Belgium and Greece, respectively, both of which fall within ICNIRP guidelines. Dominating signals in almost every setting were GSM900 and GSM1800, both of which come from mobile phones. Schmid et al. measured RF-EMR from wireless communication devices such as WLAN, Bluetooth, cordless phones, and baby monitors in indoor environments, and found all devices fall under ICNIRP guidelines as well (Schmid, Lager, Preiner, Uberbacher, & Cecil, 2007). Lahham et al. examined RF-EMR exposure in Hebron, West Bank and found contributions to exposure were 46% from FM radio, 26% from mobile phones, 15% from cordless phones, 9% from WLAN, 3% from unknown sources, and 1% from TV broadcasting (Lahham, Sharabati, & ALMasri, 2015). Power densities measured in this study were also below ICNIRP guidelines. Tomitsch and Dechant examined temporal trends in household RF-EMR in Austria between 2006 to 2012 and found the highest increases in exposure from mobile communications and WLAN frequencies, with higher overall RF-EMR in urban areas (Tomitsch & Dechant, 2015).

Four exposure studies from this literature search focused exclusively on RF-EMR from Wi-Fi. Foster measured RF-EMR from WLANs in the US, Germany, France, and Sweden in private residences and public spaces (Foster, 2007). Measurements in public spaces were conducted as close as possible to access points and additional measurements were made one meter from an internet-connected laptop to simulate bystander exposure. All measurements were below ICNIRP exposure limits. Peyman et al. measured power densities of Wi-Fi devices in UK schools (Peyman et al., 2011). The maximum electric field strength recorded from the laptops and access points in this study at 0.5 m was 5.716 V/m which corresponds to a maximum power density value of 87 mW/m^2 (0.087 W/m^2), well below the ICNIRP reference value of 10 W/m^2.

Khalid et al. examined duty factors of laptops and access points in primary and secondary schools in the UK (Khalid et al., 2011). Duty factor refers to the fraction of time in which the Wi-Fi device is transmitting signal. This is an important aspect to consider in exposure assessments because Wi-Fi devices emit intermittent bursts of RF energy that differ over time. Duty factors in the laptops ranged from 0.02 to 0.91%, with a mean of 0.08%. Duty factors were higher in access points, which ranged from 1.0% to 11.7% with a mean of 4.79%. Applied to a model of a 10 year old child, the approximate SAR would be 80 μW/kg with a power density of 220 $\mu W/m^2$ at 0.5 m away from the laptop. Khalid then goes further and extrapolates the exposure to a classroom of 30 laptops, where personal exposure in the classroom could reach 16.6 mW/m^2 (0.0166 W/m^2), which falls under the ICNIRP reference level of 10 W/m^2. Findlay and Dimbylow also calculated SARs from a sitting 10 year old child voxel, or 3D graphical model, using Wi-Fi frequencies at 2.45 GHz and 5 GHz (Findlay & Dimbylow, 2010). In this study, a “typical” exposure scenario was an antenna operating at 100 mW, a duty factor of 0.1, and an antenna-body separation of 34 cm. This resulted in a peak localized SAR of 3.99 mW/kg

(0.00399 W/kg) in the torso. With a high duty factor of 1, the SAR was 5.7 mW/kg (0.0057 W/kg). Both of these estimates fall below ICNIRP guideline SARs.

Human phantom models, including voxel models, are often used by scientists in the field of health physics to conduct ionizing radiation dosimetry studies. The phantoms are computer-generated graphical representations of human physiology that allow for modeled exposure. Joseph et al. used human phantom models to derive SAR values following the collection of field measurements (Wout Joseph, Vermeeren, Verloock, & Martens, 2010). A typical scenario in which a person is exposed to multiple sources of RF-EMR, including Wi-Fi, yields an SAR below the ICNIRP recommended level. However, it is important to note that the authors found the highest estimated SAR values for the 1-year old child, followed by the 5-year old, the 10-year old, and then the average woman and man. Martínez-Búrdalo et al. calculated the SAR in a model of a human head and torso exposed to Wi-Fi and a Bluetooth signal at the same time (Martínez-Búrdalo, Martín, Sanchis, & Villar, 2009). Results of this study were also below ICNIRP limits even when set at worst-case scenario exposure levels. A summary of the exposure assessments discussed is seen in Table 3.

In vitro studies

In vitro studies have primarily focused on human sperm cells and the potential effects of Wi-Fi on fertility. Avendaño et al. exposed motile sperm to an internet-connected laptop for four hours and compared the results to an aliquot of unexposed sperm sample (Avendaño, Mata, Sanchez Sarmiento, & Doncel, 2012). Exposed sperm were placed 3 cm away from the laptop to simulate a scenario in which a man holds a laptop in his lap. While there was no significant difference in dead sperm count between the exposed and unexposed samples, there was significant decrease in sperm progressive motility and a higher proportion of sperm with DNA fragmentation in exposed sperm. Oni et al. also exposed sperm to 2.4 GHz Wi-Fi from a connected laptop for one hour, but kept the samples 60 cm away from the laptop antenna (Oni, Amuda, & Gilbert, 2011). The researchers found significant effects of Wi-Fi exposure on sperm concentration, motility and morphology grading of the sperm. Yildirim et al. did not conduct an experiment with sperm samples and Wi-Fi exposure, but collected samples from men who then completed a questionnaire for information on mobile phone and Wi-Fi use (Yildirim et al., 2015). There was a negative correlation between wireless internet usage and sperm count, with total and progressive motile sperm count decreasing with increased internet usage.

Other than *in vitro* studies of sperm, one study was conducted that assessed the effect of RF-EMR in breast cancer cells. Çiğ and Nazıroğlu had three exposure groups at 900 MHz and 1800 MHz mobile phone radiation, and 2.45 GHz Wi-Fi signals, which were further divided by 0 cm, 1 cm, 5 cm, 10 cm, 20 cm, and 25 cm exposure distance (Çiğ & Nazıroğlu, 2015). Researchers examined calcium signaling, cytosolic reactive oxygen species production, cell viability, apoptosis, and caspase-3 and -9 in response to exposure at the three frequency bands. Exposure within 10 cm of the cells induced excessive oxidative responses and apoptosis. These effects would indicate heat and oxidative stress as a result of RF exposure. However, no significant effects were found at 20 cm and 25 cm distances when compared to the control group, indicating protection from RF-EMR with increased distance from the source. A summary of *in vitro* studies is seen in Table 2.

In vivo studies: animal

Animal studies of Wi-Fi exposure have yielded mixed results. Studies have been conducted to test a variety of hypothesized effects, including reproductive function, oxidative stress, cognitive impairment, pregnancy and prenatal development, and immune system development.

Shahin et al. investigated the long-term effects of low-level 2.45 GHz microwave exposure on the reproductive function of male Swiss strain mice (Shahin, Mishra, Singh, & Chaturvedi, 2014). Mice were exposed for two hours a day for 30 days at an average SAR of 0.018 W/Kg, after which sperm count and sperm viability tests were conducted and vital organs were collected and processed for other analyses. Compared to unexposed mice, the researchers found a significant reduction in sperm count and viability, as well as reduction in testicular 3β HSD activity and plasma testosterone levels and an increase in nitric oxide synthase in the exposed group. These results indicate chronic exposure to microwaves could potentially lead to infertility through a free radical species-mediated pathway (Shahin et al., 2014). Shokri et al. found similar decreases in sperm parameters in male Wistar rats exposed to 2.45 GHz microwaves for one hour a day for two months and seven hours a day for two months (Shokri, Soltani, Kazemi, Sardari, & Mofrad, 2015). Dasdag et al. exposed male Wistar rats to 2.4 GHz microwave radiation for 24 hours a day for a year and found increased head defects in sperm, and altered reproductive physiology, including decreases in weight of the epididymis and seminal vesicles, seminiferous tubules diameter, and tunica albuginea thickness in the exposed group (Dasdag, Taş, Akdag, & Yegin, 2015). Rat testes were also examined by Atasoy et al. after exposing male Wistar rats to 2.4 GHz microwaves for 24 hours a day for 20 weeks (Atasoy, Gunal, Atasoy, Elgun, & Bugdayci, 2013). This group found significant increases in serum 8-hydroxy-2'-deoxyguanosine levels and 8-hydroxyguanosine staining in the testes of the exposed group indicating DNA damage.

Several studies investigated the effects of Wi-Fi exposure during pregnancy and in pre- and post-natal and developing rats and mice. Sambucci et al. found no effect on pregnancy outcome or immune system development in newborn C57BL/6 strain mice following exposure to Wi-Fi at an SAR of 4 W/kg for two hours a day for 14 consecutive days starting five days after mating (Sambucci et al., 2010). No significant differences were found between exposed and unexposed groups when comparing spleen cell number, B-cell frequency, or antibody serum levels. A later study by the same group exposed newborn mice to two different SAR levels – 0.08 W/kg and 4 W/kg – for two hours a day, five days a week, for five weeks (Sambucci et al., 2011). The only significant difference between the exposed and sham-exposed groups was reduced IFN-γ production in spleen cells in male mice exposed to microwaves at an SAR of 4 W/kg. The same group exposed pregnant mice at an SAR of 4 W/kg for two hours a day starting five days after mating until one day before delivery and found no significant differences between offspring from the exposed and unexposed groups with regard to indicators of T cell development and function (Laudisi et al., 2012). Based on these three studies, the authors conclude that there is no sufficient evidence to suggest that pre-natal and early post-natal exposure to Wi-Fi RF-EMR incurs any negative effects on immune system development.

Another research group examined *in utero* and early life exposure to Wi-Fi and its potential effects on various aspects of development. Poulletier de Gannes et al. exposed pregnant Wistar rats to a 2.45 GHz Wi-Fi signal for two hours a day, six days a week, for 18 days at three SAR levels (0.08, 0.4, and 4 W/kg) in addition to control and sham-exposed groups (Poulletier de Gannes et al., 2012). After observation for 28 days after delivery, no abnormalities in the rat pups or teratogenic effects were observed at all three levels of exposure. Aït-Aïssa et al. also exposed pregnant Wistar rats to 2.45 GHz at the same three SARs for two hours a day, five days a week from day six to day 21 of gestation; newborn rats were exposed from birth to 35 days (Aït-Aïssa et al., 2012). Enzyme-linked immunosorbent assays were completed for sera collected from the pups but no change in humoral response was observed, indicating no effect of RF-EMR on the immune system at any level of exposure. Another study was conducted where male and female Wistar rats were exposed to 2.45 GHz Wi-Fi radiation for one hour a day, six days a week for three weeks before mating and three weeks afterward at SARs of 0.08 and 4 W/kg in addition to a sham-exposed group (Poulletier de Gannes et al., 2013). No abnormalities were found in the reproductive organs of both male and female rats, and no abnormalities in fetal development were detected at any of the exposure levels tested.

The effects of Wi-Fi exposure *in utero* and during early life were also assessed by a group in Turkey. Özorak et al. exposed female Wistar rats and their newborn male offspring to 2.45 GHz, 900 MHz, and 1800 MHz RF-EMR (the latter two frequencies are commonly used by mobile phones) at an SAR of 0.1 W/kg for an hour a day through the experiment, during which kidney and testes samples were taken at four, five, and six weeks of exposure (Özorak et al., 2013). The results of the study demonstrated increased lipid peroxidation and iron levels, and decreased total antioxidant status, copper, and GSH values among the exposed groups, indicating potential oxidative damage. A year-long study was later conducted by Yüksel et al., with exposure to pregnant Wistar rats at the same frequency bands and SAR, which found decreased prolactin, estrogen, and progesterone levels in the plasma of maternal rats and their offspring, and increased oxidative stress in the uteri of maternal rats in the exposed groups (Yüksel, Nazıroğlu, & Özkaya, 2015). Çelik et al. also exposed pregnant Wistar rats and their newborns to 2.45 GHz radiation at the same SAR for one hour a day, five days a week, from pregnancy until pups were three weeks of age (Çelik, Kahya, & Nazıroğlu, 2015). Results from this study found reduced glutathione peroxidase, glutathione, and antioxidant vitamin concentrations in the exposed groups, indicating oxidative stress to the brain and liver.

A handful of studies examined the effects of Wi-Fi exposure on the brains of mice and rats. Banaceur et al. compared 2.4 GHz exposure in wild type and 3xTg-AD transgenic mice at an SAR of 1.6 W/kg for two hours a day for a month (Banaceur, Banasr, Sakly, & Abdelmelek, 2013). The transgenic mice in this experiment were bred to develop Alzheimer's-like cognitive impairment. Wi-Fi exposure actually improved performance of cognitive tasks in these mice, leading the researchers to conclude that RF-EMR exposure may play a memory-enhancing role in Alzheimer's disease (Banaceur et al., 2013). Dasdag et al. examined micro RNA (miRNA) expression in brain tissue of male Wistar rats after exposure to 2.4 GHz radiation for 24 hours a day for 12 months at an estimated whole-body SAR of 141.4 μW/kg (Dasdag, Akdag, et al., 2015). This experiment determined that expression of some miRNAs were lower in the exposed group than in the sham-exposed group. Because some diseases may originate from altered expression of some miRNAs, the results of this study indicate the possibility of the development

of neurodegenerative diseases from long-term exposure to Wi-Fi RF-EMR. Ghazizadeh and Nazıroğlu tested the effect of 2.45 GHz Wi-Fi radiation in male Wistar rats and found Wi-Fi is involved in oxidative stress effects in certain types of neurons in the brain (Ghazizadeh & Nazıroğlu, 2014).

Other potential effects of Wi-Fi exposure have been tested. Fasseas et al. examined the effect of RF-EMR from several sources in *C. elegans* (Fasseas et al., 2015), including mobile phones, cordless landline phones, and Wi-Fi routers. Exposure was set below ICNIRP guidelines but no statistically significant changes in growth, fertility, lifespan, memory, gene expression, apoptosis, or reactive oxygen species were found. Aynali et al. investigated the possible protective effect of melatonin on oxidative stress in the throat cells of male Wistar rats exposed to 2.45 GHz Wi-Fi for one hour a day for 28 days at an average SAR of 0.1-W/kg and found lowered glutathione peroxidase activity and increased lipid peroxidation in the Wi-Fi exposed groups, again suggesting oxidative stress (Aynali et al., 2013). A similar protective effect of melatonin on Wi-Fi exposure was investigated by Tök et al. (Tök, Nazıroğlu, Doğan, Kahya, & Tök, 2014). The lens of male Wistar rats exposed to 2.45 GHz Wi-Fi for one hour a day for 30 days had higher lipid peroxidation levels and lower glutathione peroxidase activity than those in the unexposed groups. While Wi-Fi exposure induced some indicators of oxidative stress, melatonin supplementation decreased those effects. Saili et al. found increased heart rate and arterial blood pressure and altered heart rhythm in male rabbits exposed to Wi-Fi for one hour, demonstrating acute effects of Wi-Fi on the cardiovascular system (Saili et al., 2015). Çiftçi et al. found exposure to 2.45 GHz Wi-Fi at an average SAR of 0.009 W/kg for 2 hours a day *in utero* and during lactation does not interfere with the development of teeth and surrounding tissues but may alter the elemental composition of the teeth (Çiftçi, Kırzıoğlu, Nazıroğlu, & Özmen, 2015).

In vivo studies: human

To date, the body of research on the potential adverse effects of Wi-Fi exposure in humans is currently extremely limited and shows mixed results. Papageorgiou et al. examined the effect of Wi-Fi exposure in male and female subjects while the subjects were completing a working memory task known as the Hayling Sentence Completion test (Papageorgiou et al., 2011). Scalp electrodes recorded P300 event-related potentials, which are linked to attention and working memory. These signals were found to be significantly lower in the presence of RF-EMR. In a non-peer-reviewed study, Maganioti et al. created a Faraday room in which male and female subjects completed a Wechsler test for memory while exposed to a 2.4 GHz Wi-Fi signal and wearing scalp electrodes for an electroencephalogram (EEG) (Maganioti et al., 2010). The researchers saw reduced EEG energies of female subjects, but not male subjects, indicating possible gender-related differences in exposure to Wi-Fi and its effects on brain activity. Average SAR was not specified in either study. Zentai et al. also investigated cognitive function in subjects completing a computerized psychomotor vigilance test (PVT) after being exposed to 2.4 GH Wi-Fi at an SAR of 99.22 mW/kg for one hour (Zentai et al., 2015). Spontaneous awake electroencephalographic (sEEG) activity was also measured. No differences were found between the exposed and unexposed groups with regard to EEG data or reaction time in the PVT task. Summary of *in vivo* studies is seen in Table 1.

Summary of Literature

Table 1: Summary of in-vivo studies.

Author/Year	Title	Study Population	Outcome/Main Results
Fasseas 2015	Response of Caenorhabditis elegans to wireless devices radiation exposure	C. elegans	No effects
Maganioti 2010	Wi-Fi electromagnetic fields exert gender related alterations on EEG	male and female human subjects	Reduced energy of Alpha and Beta bands in EEGs of females only
Papageorgiou 2011	Effects of wi-fi signals on the p300 component of event-related potentials during an auditory hayling task	male and female human subjects	P300 event-related potentials found to be significantly lower in the presence of RF-EMR
Shahin 2014	2.45-GHz microwave irradiation adversely affects reproductive function in male mouse, Mus musculus by inducing oxidative and nitrosative stress	male Swiss strain mice	Significant decrease in sperm count and sperm viability, decrease in seminiferous tubule diameter and degeneration of seminiferous tubules, reduction in testicular 3β HSD activity and plasma testosterone levels, increased expression of testicular i-NOS
Shokri 2015	Effects of Wi-Fi (2.45 GHz) Exposure on Apoptosis, Sperm Parameters and Testicular Histomorphometry in Rats: A Time Course Study	male Wistar rats	Decrease in sperm parameters in a time dependent pattern; number of apoptosis-positive cells and caspase-3 activity increased in the seminiferous tubules of exposed rats; reduced seminal vesicle weight reduced in exposed groups
Aynali 2013	Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin	male Wistar rats	Apparent protective effect of melatonin; radiation-exposed groups had higher lipid peroxidation levels, lower glutathione peroxidase activity

Banaceur 2013	Whole body exposure to 2.4 GHz WIFI signals: effects on cognitive impairment in adult triple transgenic mouse models of Alzheimer's disease (3xTg-AD)	wildtype and 3xTg-AD transgenic mice	Beneficial effect of Wi-Fi on anxiety; no difference in Flex field test
Laudisi 2012	Prenatal exposure to radiofrequencies: effects of WiFi signals on thymocyte development and peripheral T cell compartment in an animal model	female C57BL/6 mice and offspring	No effects
Sambucci 2010	Prenatal exposure to non-ionizing radiation: effects of WiFi signals on pregnancy outcome, peripheral B-cell compartment and antibody production	female C57BL/6 mice and offspring	No effects
Sambucci 2011	Early life exposure to 2.45GHz WiFi-like signals: effects on development and maturation of the immune system	female C57BL/6 mice and offspring	Reduced IFN-γ production in spleen cells from exposed (SAR 4 W/kg) male offspring
Saili 2015	Effects of acute exposure to WIFI signals (2.45GHz) on heart variability and blood pressure in Albinos rabbit	male rabbits	Exposure to Wi-Fi affects heart rhythm, blood pressure, and catecholamine efficacy on cardiovascular system
Aït-Aïssa 2012	In utero and early-life exposure of rats to a Wi-Fi signal: screening of immune markers in sera and gestational outcome	female Wistar rats and offspring	No effects
Çelik 2015	Oxidative stress of brain and liver is increased by Wi-Fi (2.45GHz) exposure of rats during pregnancy and the development of newborns	female Wistar rats and offspring	Wi-Fi exposure induced oxidative stress in the brain and liver of developing rats

Çiftçi 2015	Effects of prenatal and postnatal exposure of Wi-Fi on development of teeth and changes in teeth element concentration in rats. [corrected]	female Wistar rats and offspring	No effects
Dasdag 2015	Effects of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on microRNA expression in brain tissue	male Wistar rats	Changed expression of some of the examined miRNAs
Dasdag 2015	Effect of long-term exposure of 2.4 GHz radiofrequency radiation emitted from Wi-Fi equipment on testes functions	male Wistar rats	Altered general morphology of rat testes
Ghazizadeh 2014	Electromagnetic radiation (Wi-Fi) and epilepsy induce calcium entry and apoptosis through activation of TRPV1 channel in hippocampus and dorsal root ganglion of rats	male Wistar rats	Epilepsy and Wi-Fi are involved in Ca2+ influx and oxidative stress-induced hippocampal and DRG death through activation of TRPV1 channels
Özorak 2013	Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring	female Wistar rats and male offspring	Increased lipid peroxidation and oxidizable iron content and decreased antioxidant trace elements (copper and zinc), TAS, and GSH during kidney and testis development
Poulletier de Gannes 2012	Effect of in utero wi-fi exposure on the pre- and postnatal development of rats	female Wistar rats and offspring	No effects
Poulletier de Gannes 2013	Rat fertility and embryo fetal development: influence of exposure to the Wi-Fi signal	male and female Wistar rats	No effects

Tök 2014	Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats	male Wistar rats	GSH-Px activities were significantly lower in Wi-Fi group
Yüksel 2015	Long-term exposure to electromagnetic radiation from mobile phones and Wi-Fi devices decreases plasma prolactin, progesterone, and estrogen levels but increases uterine oxidative stress in pregnant rats and their offspring	female Wistar rats and offspring	EMR exposure decreased the prolactin, estrogen, and progesterone levels in the plasma of maternal rats and their offspring; EMR-induced oxidative stress in the uteri of maternal rats increased during the development of offspring
Atasoy 2013	Immunopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices	male Wistar rats	Increases in serum 8-hydroxy-2′-deoxyguanosine levels and 8-hydroxyguanosine staining in the testes; decreased levels of catalase and glutathione peroxidase activity in the exposed group
Zentai 2015	No Effects of Acute Exposure to Wi-Fi Electromagnetic Fields on Spontaneous EEG Activity and Psychomotor Vigilance in Healthy Human Volunteers	male and female human subjects	No effects
Nazıroğlu 2013	Recent reports of Wi-Fi and mobile phone-induced radiation on oxidative stress and reproductive signaling pathways in females and males	(review)	There is no evidence to this date to support an increased risk of female and male infertility related to EMR exposure
Foster 2013	Wi-Fi and health: review of current status of research	(review)	No basis to anticipate that Wi-Fi exposure will cause any biological effects; RF exposures below international (ICNIRP or IEEE) exposure limits have not been shown to produce any health hazard

Table 2: Summary of in-vitro studies.

Author/Year	Title	Study Population	Outcome/Main Results
Çiğ 2015	Investigation of the effects of distance from sources on apoptosis, oxidative stress and cytosolic calcium accumulation via TRPV1 channels induced by mobile phones and Wi-Fi in breast cancer cells	human cancer cells	Wi-Fi and mobile phone EMR placed within 10 cm of the cells induced excessive oxidative responses and apoptosis via TRPV1-induced cytosolic Ca2 + accumulation in the cancer cells
Avendaño 2012	Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation	semen from healthy human donors	Significant decrease in progressive sperm motility and an increase in sperm DNA fragmentation
Oni 2011	Effects of radiofrequency radiation from WiFi devices on human ejaculated sperm	semen from males aged 20-30	Sperm concentration, motility and morphology grading of the sperm were significantly affected by exposure to Wi-Fi
Yildirim 2015	What is harmful for male fertility: cell phone or the wireless Internet?	semen from patients at infertility clinic	Negative correlation between wireless internet usage duration and the total sperm count ($r = -0.089$, $p = 0.039$)

Table 3: Summary of exposure assessments.

Author/Year	Title	Study Population or Geographic Area	Outcome/Main Results
Valič 2015	Typical exposure of children to EMF: exposimetry and dosimetry	21 children under the age of 17 + voxel model	SAR values for the typical and the worst-case situation show low exposure under ICNIRP guidelines
Martínez-Búrdalo 2009	FDTD assessment of human exposure to electromagnetic fields from Wi-Fi and Bluetooth devices in some operating	high-resolution model of the human head and torso	Exposure levels from Wi-Fi are lower than those obtained from mobile phone exposure; field and SAR values are far below the limits established by IEEE and ICNIRP guidelines

	situations		
Joseph 2010	Estimation of whole-body SAR from electromagnetic fields using personal exposure meters	human spheroid phantoms - 1 year old, 5-year-old child, 10-year-old child, average woman, average man	Highest whole body SAR values were obtained for the 1 year old; all values were below restrictions for the general public
Findlay 2010	SAR in a child voxel phantom from exposure to wireless computer networks (Wi-Fi)	child voxel (graphic) model	Calculated SARs below ICNIRP restrictions (19.1 μW/kg for plane wave, 1.8 mW/kg for dipole antenna, and 3.99 mW/kg in the torso and 5.7 mW/kg in the head for laptop mounted antenna) and exposures to Wi-Fi represent about 1% of that of mobile phones
Vermeeren 2013	Spatial and temporal RF electromagnetic field exposure of children and adults in indoor micro environments in Belgium and Greece	Greece and Belgium	All instantaneous and maximal exposures satisfied international exposure limits; highest average exposures were found in office environments and lowest in homes and in schools; exposure in offices was mainly due to mobile telecommunications whereas in home environments, DECT and Wi-Fi 2G were the dominating sources
Foster 2007	Radiofrequency exposure from wireless LANs utilizing Wi-Fi technology	U.S., France, Germany, Sweden	Measured Wi-Fi signal levels were very far below international exposure limits (IEEE C95.1-2005 and ICNIRP)
Schmid 2007	Exposure caused by wireless technologies used for short-range indoor communication in homes and offices	Austria	None of the devices considered in this study exceeded the limits according to the ICNIRP guidelines

Bolte 2012	Personal radiofrequency electromagnetic field measurements in The Netherlands: exposure level and variability for everyday activities, times of day and types of area	Netherlands	Mean total exposure was 0.277 V/m with 37.5% of power density from mobile phones, 31.7% from cordless phones, 14.1% from Wi-Fi, 12.7% from base stations, and 3% from FM
Joseph 2008	Characterization of personal RF electromagnetic field exposure and actual absorption for the general public	Belgium	Indoor exposure in office environments can be higher than outdoor exposure; 95th percentiles of field values due to Wi-Fi ranged from 0.36 to 0.58 V/m
Tomitsch 2015	Exposure to electromagnetic fields in households--trends from 2006 to 2012	Austria	Median RF-EMF exposure from WLAN increased from 0.00 μW/m2 in 2006 to 0.46 μW/m2 in 2012; increase in number of installed and activated WLAN routers from 2006-2012; median exposure in households with activated WLAN was 4.08 μW/m2 and the median of the 105 households with no, switched off, or deactivated WLAN was 0.07 μW/m2
Urbinello 2014	Temporal trends of radio-frequency electromagnetic field (RF-EMF) exposure in everyday environments across European cities	Switzerland and Belgium	Mobile phone handsets and base stations contributed the most to overall RF exposure in all situations; highest exposure levels occurred in public transport (trains); all exposure levels were far below reference levels proposed by ICNIRP
Verloock 2010	Procedure for assessment of general public exposure from WLAN in offices and in wireless sensor network testbed	Belgium	Average background exposure to WLAN (WiLab off) is 0.12 V/m, with a 95th percentile of 0.90 V/m; with the WiLab in operation, average exposure increases to 1.9 V/m, with a 95th percentile of 4.7 V/m; all values were well below the ICNIRP guidelines

Verloock 2014	Assessment of radio frequency exposures in schools, homes, and public places in Belgium	Belgium	Average and maximal total electric-field values in schools, homes, and public places were 0.2 and 3.2 V/m (Wi-Fi), 0.1 and 1.1 V/m (telecommunication), satisfying the ICNIRP reference levels; in the schools considered, the highest maximal and average field values were due to internal signals (Wi-Fi)
Viel 2009	Radiofrequency exposure in the French general population: band, time, location and activity variability	France	Highest mean exposure resulted from FM sources (0.044 V/m), followed by WiFi-microwaves (0.038 V/m), cordless phones (0.037 V/m), and mobile phones (UMTS: 0.036 V/m, UMTS: 0.037 V/m)
Khalid 2011	Exposure to radio frequency electromagnetic fields from wireless computer networks: duty factors of Wi-Fi devices operating in schools	UK	Duty factors of individual laptops were considerably less than those of the access points; the maximum time-averaged power density from a laptop would be 220 μW/m2, at a distance of 0.5 m, and the peak localized SAR predicted in the torso region of a 10 year old child model, at 34 cm from the antenna, would be 80 μW/kg, which is lower than ICNIRP guidelines
Lanham 2015	Public Exposure from Indoor Radiofrequency Radiation in the City of Hebron, West Bank-Palestine	Palestine	Maximum total power density found at any location was about 2.3 x 10-2 W/m2 with a corresponding exposure quotient of about 0.01, indicating compliance with the guidelines of ICNIRP; relative contributions to the total exposure were 46% from FM radio, 26% from GSM900, 15% from DECT phones, 9% from WLAN, 3% from unknown sources, and 1% from TV broadcasting; RF sources located outdoors contribute about 73% to the population exposure indoors

Peyman 2011	Assessment of exposure to electromagnetic fields from wireless computer networks (wi-fi) in schools; results of laboratory measurements	UK	The spherically-integrated radiated power (IRP) ranged from 5 to 17 mW for 15 laptops in the 2.45 GHz band and from 1 to 16 mW for eight laptops in the 5 GHz band; for wall mounted access points, power ranged from 3 to 28 mW for 12 access points at 2.4 GHz and from 3 to 29 mW for six access points at 5 GHz; all vales were under ICNIRP guidelines

Discussion

Although the current body of literature specifically regarding Wi-Fi exposure is still extremely limited compared to the existing research into RF-EMR from mobile phones, it is encouraging that more scientists have started investigating the issue in the last decade. Still, it is clear that more work needs to be done to further elucidate the true, or lack of, biological effects of Wi-Fi exposure. Thus, this review does not provide a definitive answer as to whether schools in Maryland should opt for hardwired computers, but instead provides a summary of the state of the science completed to-date on the issue.

A large portion of the studies in this review are *in vitro* studies of mammals, particularly rats and mice. The four studies examining effects of Wi-Fi on sperm and reproductive organs of rats and mice (Atasoy et al., 2013; Dasdag, Taş, et al., 2015; Shahin et al., 2014; Shokri et al., 2015) found significant differences between exposed and unexposed groups, indicating potential negative effects of Wi-Fi exposure on male fertility. This was the only group of studies that showed consistent biological effects due to exposure. Investigations into other hypothesized biological effects resulted in more mixed or no conclusions. Studies of Wi-Fi exposure on pregnant rats and mice and their newborn offspring yielded no significant differences between exposed and unexposed test animals when measuring teratogenic or developmental outcomes (Aït-Aïssa et al., 2012; Laudisi et al., 2012; Poulletier de Gannes et al., 2012, 2013; Sambucci et al., 2010, 2011). There is some indication of oxidative stress from prenatal to early life, however two out of three of these studies exposed the test animals to multiple RF-EMR frequencies, including those from mobile phones (Çelik et al., 2015; Özorak et al., 2013; Yüksel et al., 2015).

In vitro studies of human sperm show some signs of cell damage as a result of Wi-Fi exposure, although one study measured exposure from a questionnaire instead of an actual experiment (Yildirim et al., 2015) and the other two studies (Avendaño et al., 2012; Oni et al., 2011) conducted their experiments with an unknown dose, specifying only the distance from which the sperm were placed from the Wi-Fi source. In general, study designs in many of the articles in this review were lacking and could be improved in future experiments. Overall, the literature on this topic is not of high enough quality to make a convincing argument for biological effects of Wi-Fi on sperm function and quality.

Population-level exposure assessments in the literature provide some insight into the proportion of daily exposure to RF-EMR from Wi-Fi frequencies. For the most part, studies found that signals from mobile phones dominate exposure in both indoor and outdoor settings (Bolte & Eikelboom, 2012; W. Joseph et al., 2008; Vermeeren et al., 2013; Viel et al., 2009). In some cases, FM radio signals make up the highest proportion of overall RF exposure, but 900 and 1800 MHz mobile phone signals follow close behind (Lahham et al., 2015). When evaluating Wi-Fi alone, average power density measured in schools, homes, and public places was well below ICNIRP guidelines (Foster, 2007; W. Joseph et al., 2008; Peyman et al., 2011; Verloock et al., 2014, 2010). Voxel and phantom models of RF-EMR absorption found that with a typical power density and duty cycle scenario in a classroom, the estimated SAR in a child's torso would also be below ICNIRP reference levels (Findlay & Dimbylow, 2010; Wout Joseph et al., 2010; Khalid et al., 2011).

A noticeable gap in the literature is in human studies – both *in vivo* and large scale epidemiologic studies. The existing studies using mammals as test subjects in exposure experiments are not adequate for determining true human health risk, especially with the mixed quality of studies included in this review. As several epidemiologic studies have already been conducted regarding the risks of mobile phone use, as cited in the IARC monographs of EMFs (Baan et al., 2011), the same must be done for Wi-Fi. Additionally, although some groups have begun to incorporate the 5 GHz Wi-Fi band in exposure studies, all studies moving forward should consider both frequencies. Though the majority of commercially available Wi-Fi access points and routers still operate at 2.45 GHz by default, they are increasingly supporting both frequencies for better performance (Institute of Electrical and Electronics Engineers, 2013). Although Wi-Fi devices currently operate at two frequencies, additional frequency bands below 2.45 GHz or above 5 GHz may be added for devices in the future. This would potentially push the spectrum of WLAN solidly into radiofrequency (with lower frequencies) or further into microwave territory (higher frequencies). The health effects of an expanding Wi-Fi spectrum need to be addressed if and when the time comes.

Another consideration for future studies is to conduct more exposure assessments in the US; only one exposure assessment study in this review was partially completed in the US (Foster, 2007). The issue of RF-EMR in general seems to have more traction in Europe than in the US, but with the growing concern from parents and advocates, it is important to conduct more studies in settings that reflect the lives of children in the US. This includes exposure assessments in rural, suburban, and urban areas, as well as different school settings. Since exposure to RF-EMR seldom, if ever, occurs from one frequency band at a time, more cumulative exposure and risk assessments must be completed to assess the combined effects of exposure to multiple sources of radiation at the same time. It is also worth considering the cumulative effects of RF-EMR exposure in conjunction with other environmental hazards, as many health outcomes, such as cancer, are seldom due to just one cause.

More robust methods and exposure systems must be developed if more *in vivo* animal studies are to be completed. Because this research area is relatively new, there is no established standard for creating exposure systems to test for biological effects and thus there is a lack of consistency across studies. Currently, the only consistency in exposure systems is seen within

research groups who use the same system across multiple studies. The Wi-Fi exposure itself must also be better characterized for use in experiments. As seen in this review, some research groups employed complex techniques to estimate an SAR in their test animals, while others used more arbitrary measurements such as distance from the access point. Test animals are also kept in optimal conditions during the experiment, including adequate nutrition and antioxidants in their feed. Given that several studies found oxidative stress effects from Wi-Fi exposure, supplements in the food may have attenuated results. Future studies should also test cumulative exposure from multiple sources of RF-EMR, as well as cumulative exposure to other agents that cause oxidative stress. Finally, as with human studies, future animal studies also need to include the 5 GHz Wi-Fi frequency band moving forward.

There were some limitations in the implementation of this literature review. Due to time restrictions, a more thorough search of the available literature was not possible. Some literature may not have been captured using the search strategy described above; some articles do not use the word "Wi-Fi" but instead describe exposures by the wavelength only (e.g. "2.45 GHz microwaves") and some articles may not have been searchable using PubMed/MEDLINE. Additionally, studies with null results may not have been published, particularly with a new and sensitive topic such as Wi-Fi. Although several studies in this review showed no effects, it is possible there is more unpublished evidence of null effect that were not included in this review. The vast majority of the research available on Wi-Fi is based on animal studies, adding uncertainty when extrapolating the results to humans, particularly when determining typical exposure to Wi-Fi across different populations.

All studies cited in this review either used SARs below ICNIRP guidelines (in the case of *in vivo* and *in vitro*) or found that measured and simulated exposure were well below limits (in the case of modeled and actual exposure assessments). However, this does not provide any reassurance for those who insist that the ICRNIRP guidelines and FCC standards are inadequate for public health protection and must be revisited after close to 20 years of new research (Gandhi et al., 2012; McInerny, 2013; Sage & Carpenter, 2009; US Government Accountability Office, 2012). Calls for revision also stress the importance of developing exposure guidelines separately for children and adults, based on some evidence that children may absorb more radiation than adults (Wout Joseph et al., 2010; Morgan, Kesari, & Davis, 2014; Morris, Morgan, & Davis, 2015). ICNIRP is currently revising its guidelines, though with no anticipated completion date (International Commission on Non-Ionizing Radiation Protection, 2016). The FCC opened a review of their current RF-EMR standards in 2013 but no updates to regulations have been made to date (Federal Communications Commission, 2013).

Although teachers and staff, not just students/children, are exposed to RF-EMR in schools equipped with Wi-Fi, the main research question in this report is the issue of children's exposure specifically in response to the urging of concerned parents. Children are, of course, more vulnerable to environmental exposures in general and Wi-Fi is likely no exception. Recommendations by CEHPAC and any potential policy changes in Maryland leading to reduced exposure would have an overall protective effect on the school environment that would not only benefit children, but adults in that environment as well.

A simple solution for those who favor the precautionary approach is to simply hardwire schools instead of opting for Wi-Fi enabled laptops. However, this could potentially have a negative impact on teachers' ability to access the wide range of educational resources and content available on the internet. In a recent Pew survey, 92% of teachers said the internet has a major impact on their ability to access materials for teaching, and the majority of teachers surveyed said they often use wireless devices such as tablets, mobile phones, and e-book readers in addition to laptops in the learning process (Purcell, Heaps, Buchanan, & Friedrich, 2013). Access to the internet is perceived as an essential part of modern education, as evidenced by President Obama's ConnectEd Initiative to ensure all students in the US will have access to broadband internet by 2018 (The White House Office of the Press Secretary, 2013). Administrators and health experts must weigh the benefits of fully connected schools with the unknown possible biological effects of Wi-Fi exposure.

Conclusion

Wi-Fi exposure, particularly in schools, is a contentious issue that will remain controversial as more studies are conducted regarding its potential biological effects. The current literature provides inconclusive evidence that, for the most part, points to an absence of adverse health consequences from long-term and acute exposure to Wi-Fi frequencies. Completed exposure assessments show typical and worst-case scenario exposures fall well below US and international reference levels. However, those guidelines and standards have their own limitations; they are almost two decades old, do not reflect current science, and do not take into account vulnerable populations such as children. Wi-Fi connected classrooms have huge advantages both for students and teachers, but may not be worth the trade-off of possible health effects later in life. It is clear that more and better studies are needed, particularly large-scale epidemiological studies, before a definitive conclusion can be reached.

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APPENDIX C: Presentation to CEHPAC on WiFi (September 9, 2014)

RADIOFREQUENCY ELECTROMAGNETIC FIELDS

Vikram Krishnasamy

September 9, 2014

Outline

- Electromagnetic Fields, a Review
- Health Impacts of Radiofrequency EMF
  - Cellular
  - Animal
  - Human
- Conclusions
- Recommendations

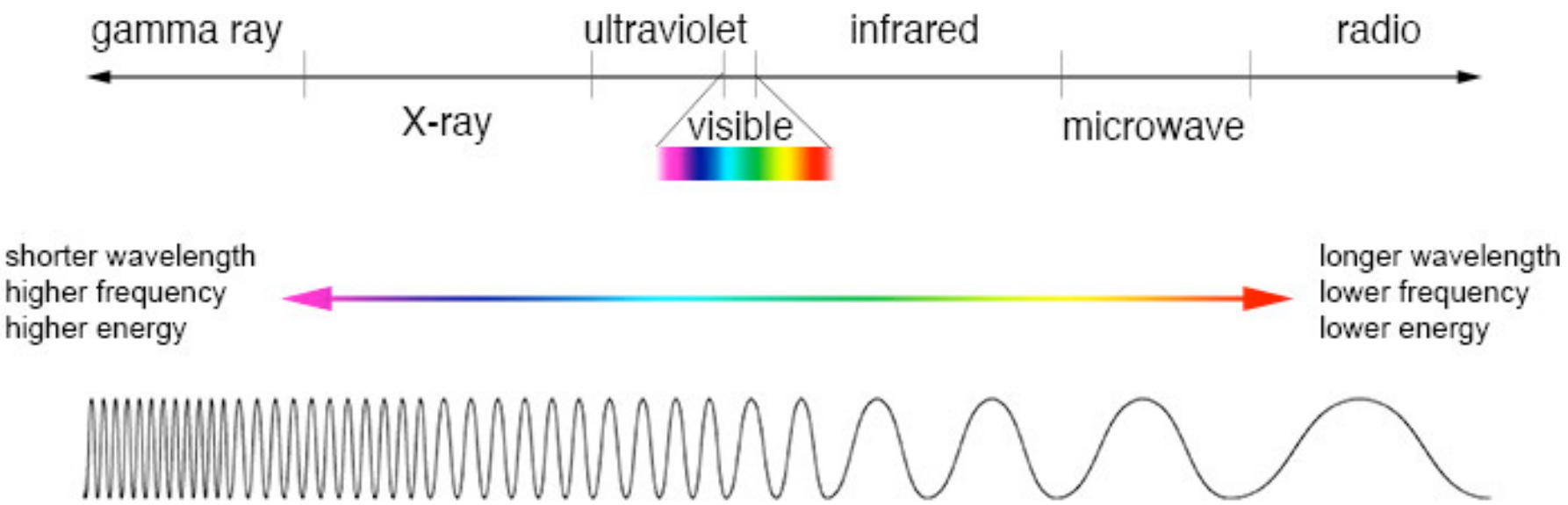
Questions

1. What are the health impacts of RF EMF

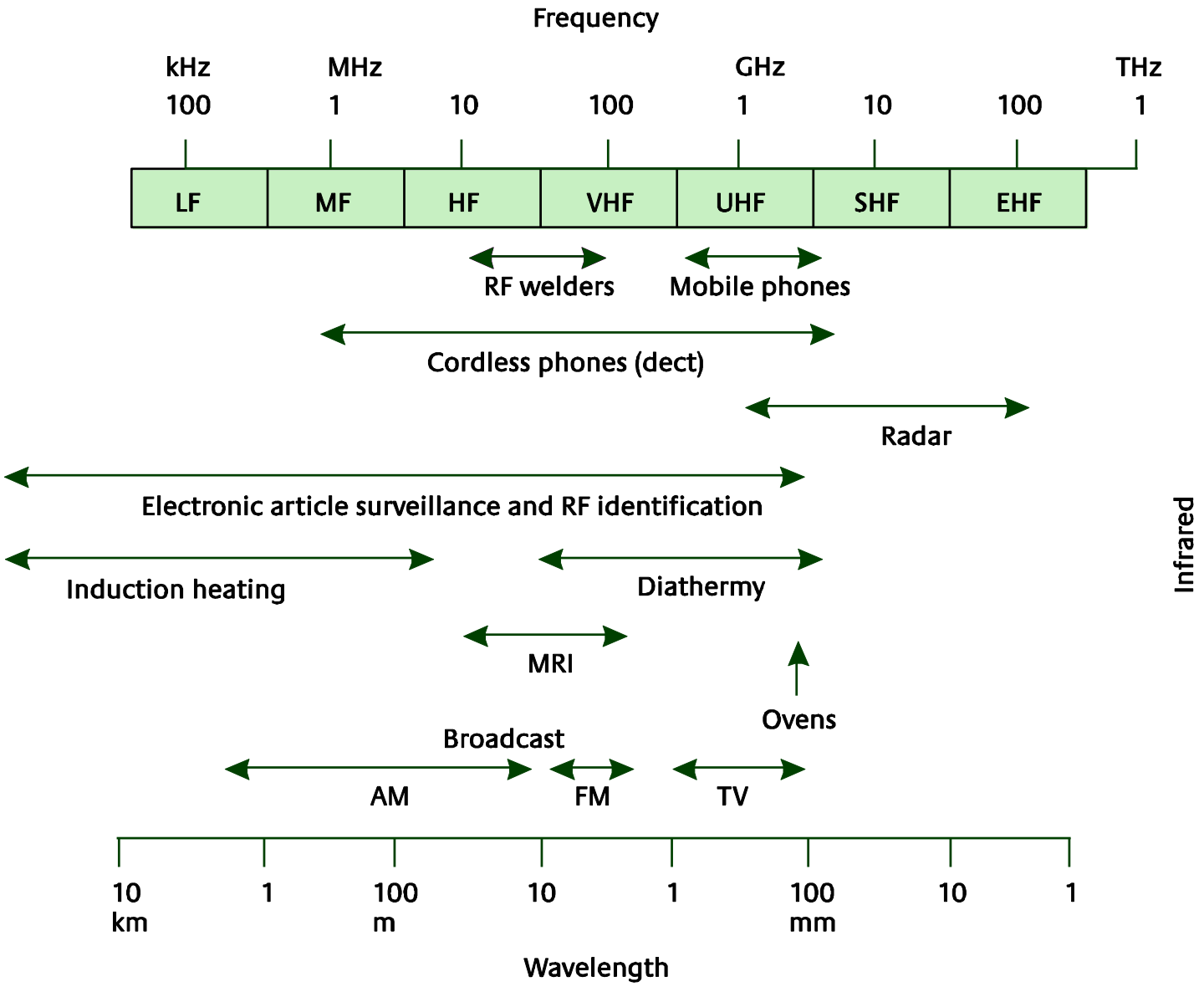
2. Are there health impacts of Wi-Fi exposures?

What is Radiofrequency Electromagnetic Radiation?

Spectrum



Source: http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html



Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/333080/RCE-20_Health_Effects_RF_Electromagnetic_fields.pdf

Radiofrequency Fields

- Radiofrequency refers to the parts of the EM spectrum used for radio communications purposes and that are below the infrared region
- These frequencies are in the range of 100khz to 300Ghz
  - Definitions vary
- The FCC and the International Telecommunications Union have dedicated specific bands within this range for specific purposes
  - Certain frequencies are reserved for cell phones
  - Certain frequencies are left for Wi-Fi

Sources of RF Fields

- Exposed to RF fields from many sources:
  - Radio and TV transmitters
  - Telecommunications links, satellite communications
  - Mobile phones and base stations
  - Wireless applications like Wi-Fi, cordless telephones
  - Occupational exposures

- People are exposed continuously to RF field sources

Exposures – Waveform Properties

- Important to look at signal characteristics when examining human exposure
- Original waveforms from source are sinusoidal
- Signal fading
- Source dependent considerations
  - Properties of EM fields change with distance

Measuring RF Field Sources

- There is no single method to measure the electric and magnetic field strengths of an RF source
  - Characteristics of sources vary greatly
  - The magnitude of electric/magnetic fields vary throughout space and time
  - Other factors involved
  - Approaches also differ whether in the near field or the far field region
  - However, there are standard protocols for measuring EM field strength

RF Field Measurement Instruments

- 2 types of instruments for measuring: broadband and narrowband

- Recently, personal exposure meters for measuring the strengths of environmental RF signals have become available

  - However these can altered by the presence of field strengths of the body

RF Dosimetry

- RF sources give rise to electric and magnetic fields
  - Fields can induce currents or raise temperature inside the body
- Assess both the physical quantities of the fields (electric, magnetic) and dosimetric quantities (induced current density or rise in temperature)
- Physical quantities can be measured directly while dosimetric quantities are generally measured indirectly

RF Dosimetry

- Dosimetry – Process of determining internal quantities relating to exposure in tissues, such as electric field strength, induced current density and energy absorption rate, from external fields

- The role of dosimetry is to evaluate the induced electric fields in the body
  - Using SAR
  - Correlate with the biologic effect of concern

RF Fields and the Body

- When the body is exposed to radio waves, some of the energy is absorbed
  - This is a direct effect that leads to heating of the body tissues
  - This heating is governed by a quantity known as the specific energy absorption rate (SAR), units of W/kg
  - SAR is derived from electric field strength, the conductivity, and the density of tissues
  - SAR provides a measure of the power absorbed from the radiation per kilogram body tissue

Dosimetric Assessment of SAR

- SAR is averaged either over the whole body or over a small sample volume or mass of tissue
- Usually averaged over 1 or 10g
- Experimental evaluation of SAR
  - Difficult to measure the internal induced electric field strength inside human body non-invasively
  - Phantoms are used to replicate human head or body
  - Experimental exposure systems
  - Numerical techniques using computer models

Age Dependence in Dosimetry Studies

- Rise in the use of telecommunications devices amongst the young has led to calls for research into the difference in the exposure of children and adults

- 2 key factors are different
  - physical size of the body
  - properties of tissues as a function of age

- Head exposure

- Whole-body SAR

Quantities and Units

- Quantity of EM energy per unit area per second is call the Power Density
- Often expressed as W/m^2
- Power density decreases with increasing distance from source
  - Follows inverse square law
  - Rapid decrease in power as you move away from source
- Other measures include Electric Field Strength (V/m) and Magnetic Field Strength (A/m)

Factors Affecting Human Exposure

- Power density – depends on output power
- Distance form source
- Tissue type – reflection, absorption, transmission
  - SARs different in different parts of the body
- Frequency
- Volume and duration of exposure

Guidelines for Exposures

- 2 main international organizations set guidelines for exposures
- ICNIRP and the IEEE
- Reference Levels
- Basic Restrictions

Dosimetric Considerations in Studies

- Epidemiological studies – challenges to assessing exposure of individuals in these studies
  - Use questionnaire information or billing records to derive estimates of the time and duration of use as the main exposure surrogate
- Experimental studies
  - Need to use a well-characterized exposure system to determine SARs
  - A need to use cage controls as well as sham-exposed animals

Health Effects

- The widespread adoption of mobile phone technologies and wireless internet has caused concern regarding health consequences

- However, this is not new
  - There has been concern about possible effects since the mid-20th century and likely earlier

Health Effects

- There have been numerous national and international reviews regarding this issue
- The majority have said that the weight of the evidence does not show that there are adverse effects from exposures below current guidelines (ICNIRP)
- However, all say that further and better research is needed

Mechanisms for Effects

- Thermal mechanisms seem to be the dominant cause of adverse effects over the RF spectral range

- There may be other mechanisms but the evidence has not borne this out
  - Some authors have described other effects but the mechanisms have not been elucidated

Cellular Studies

- Advantages of using in vitro systems over experimental animal or human studies
- Disadvantages
- Many of the published studies can be criticized for poor dosimetry and inadequate experimental controls
- Positive findings should be considered preliminary until verified by repeat studies

Cellular Studies – Genotoxic Effects

- The evidence that exposure to RF fields has a direct genotoxic effect is weak
- The weight of the evidence is not consistent
- Multiple studies have conflicting results

Cellular Studies – Potential Carcinogenesis

- Cell transformation
- Cell proliferation
- Apoptosis

Cellular Studies – Other Changes in Cellular Processes

- Gene expression
- Intracellular signaling
- Membrane effects
- Direct effect on proteins

Cellular Studies – Summary

- Results of similar studies remain divergent
- Lack of replication of studies
  - When replication does occur, study results differ
- No consistent pattern of exposure conditions on cells that consistently show effects

Animal Studies

- Performed using inbred strains of mice or rats
- Advantages of in vivo
- Allow for multigenerational studies
- Extrapolation to humans is not straightforward
- Study design is again important

Animal Studies – Brain and Nervous System

- Considered sensitive targets for the effects of RF fields
- Cellular physiology, neurotransmitters, electrical activity
- Blood-brain barrier
- Autonomic Functions
- Behavior Studies

Animal Studies – Endocrine System

- Previous studies have shown consistent changes in endocrine function due to thermal impacts (above guideline levels)
- Recent research has focused on mobile phone signal and melatonin
- Weight of evidence is against changes in melatonin levels
- Not enough information on other hormones

Animal Studies – Auditory System

- Concerns have been raised as to whether these exposures could have an adverse effect
- Weight of the evidence is against adverse effects on hearing and auditory function in animals
- Studies have looked at both young and adult animals

Animal Studies – Cancer

- Weight of the studies are against genotoxicity in animal models
- Evidence argues against increased cancer risk
- Evidence against increased risk in tumor prone animals

Animal Studies – Heme / Immune Systems

- Various frequencies tested
- Different cell lines
- Some studies show positive effects
- Some studies show no effects
- More research is needed

Animal Studies – Reproduction and Development

- Testicular function
  - Mixed studies. Well done studies show no effect

- Pregnancy outcome and development
  - No consistent adverse effects
  - More research is needed

Human Studies

- Gold standard of evidence are randomized controlled trials
- For many reasons, RCTs are unlikely
- Rely mainly on case-control and cohort studies

Human Studies – Neurocognitive Effects

- Provocation studies
  - Method for investigating the possible effects of RF field exposure on cognitive performance and nervous system function
  - Do not reveal mechanisms
- Cognitive and performance studies
  - Studies in children
  - Mobile phone base station signals
- EEG studies
  - Resting EEG studies
  - Sleep EEG studies

Human Studies – Neurocognitive Effects

- Auditory and Vestibular Studies
  - Few studies
  - Evidence tends towards no acute or chronic affects though some studies have shown positive results

- Developmental Effects
  - Few studies
  - Unable to draw robust conclusions
  - More research is needed

Human Studies – Reproduction

- Male sexual function and fertility
  - Limited studies
  - Cross-sectional
  - Some show decreases in sperm quality measures
  - Others show no changes
  - Recall bias is an issue
  - Need further studies with better exposure assessments
- Female sexual function and fertility
  - Limited studies
  - No conclusions can be drawn

Human Studies – Cancer

- Occupational Exposures
  - Mixed evidence of increased risk
  - Problems with many of the studies
- Residence near RF transmitters
  - Weight of the evidence against increased risk of cancer among children exposed to RF fields from radio/television/mobile phone base stations
  - Limitations in studies however

Mobile Phones

- Extremely controversial
- We will not get into this here because of the complexities

Mobile Phone Base Stations

- Networks are divided into areas called cells
  - Each cell has a base station
- Main coverage for each cell is provided by macrocell base stations covering distances of 1-10 km
- Antennas are usually mounted on tall structures to avoid obstructions (buildings)
- The height of these structures limits exposures

Mobile Phone Base Stations

- Exclusions zones are specified
  - Due to high output powers around these zones

- Multiple studies have been done to assess potential exposure level
  - Show power density levels are well below threshold values set by guidelines

Wireless Local Area Networks

- WLAN technologies operate in frequency bands of around 2.4 and 5 GHz
- License exempt and the bandwidth is shared between multiple users
- Technical standards are produced by the Institute of Electrical and Electronic Engineers (IEEE).
- Wi-Fi is the most popular technology for the wireless portion of networks

Exposures to Wi-Fi

- Multiple studies have been done assessing Wi-Fi exposures
- Levels are well below guidelines
- Given low duty cycles, exposures are lower
- Much lower than mobile phone exposures

Studies on Health Effects of Wi-Fi

- Overall many studies have been done in this frequency range
- The use of Wi-Fi as the exposure source is more limited as this is a more recent technology
- There are too few studies of Wi-Fi directly to draw robust conclusions on health effects

Studies on Health Effects of Wi-Fi

- In vivo studies in rats generally do not show shown adverse effects
- Some show changes in EEG but the implications of this remain unclear and there were flaws in these studies
- Some in vitro studies show changes in sperm quality

Recommendations

- Controversial issue
- Committee should monitor future studies which are currently ongoing and will provide more information
- Committee should invite experts from this area to present to the council

Precautionary Principle

- Interpretations of the precautionary principle vary
- The goal of this commission is to provide scientific advice
- The precautionary principle is a policy mechanism best left to entities with legislative authority

Glossary

- EMF – Electromagnetic Fields
- FCC – Federal Communications Commission
- SAR – Specific Absorption Rate
- ICNIRP – International Commission on Non-ionizing Radiation Protection
- IEEE – Institute of Electrical and Electronics Engineers
- RF – Radiofrequency
- WLAN – Wireless Local Area Network

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* There are numerous references; I have not included them all for the sake of space.

APPENDIX D: Materials Provided to CEHPAC by the Public

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Comments on the Maryland Children's Environmental Health and Protection Advisory Council Wi-Fi Report

1 message

theodorams@aol.com <theodorams@aol.com>
To: rachel.hess-mutinda@maryland.gov

Fri, Sep 9, 2016 at 12:03 PM

Rachel,

I am sending you my initial comments so that the Wi-Fi Workgroup can see them now as the Draft is clearly incomplete. There is another set of documents and comments coming.

Thank you

Theodora Scarato

Comments on the Maryland Children's Environmental Health and Protection Advisory Council Wi-Fi Report

The Council needs a presentation by an expert in the field of electromagnetic radiation and health to be fully informed on the health issues.

The Draft Wi-Fi Report reads: The first two questions were addressed as part of an MPH Capstone project by Linda Li, a University of Maryland student in the Maryland Institute for Applied Environmental Health (see Appendix). Since her report, the National Institutes of Health released an interim report indicating a correlation between high exposure to cell phone radiation and low incidences of tumors in the brains and hearts of male rats, but not in female rats1 .

Linda Li does not have expertise in the area of radio frequency radiation and health and her report does not fully address the issue. While I applaud the work she has compiled it is missing critical information on children and electromagnetic radiation. The most important omission is the fact that children are exposed to various radiofrequency signals in a classroom all at the same time. To simply look at just Wi-Fi frequencies misses the total exposure. In addition one cannot just look at Wi-Fi research to understand the links to health. The World Health Organization International Agency for the Research on Cancer specifically refers to Wi-Fi in its classification and WHO/IARC scientists state that Wi-Fi is "the same agent" as other RF.

The Council needs to be informed of the following information.

Li's Report states that "The SAR is a value that corresponds to the rate at which RF energy is absorbed by body tissue. This limit, set in 1996, is 1.6 watts per kilogram (W/kg), averaged over one gram of tissue (Federal Communication Commission, 1997)."

This is incomplete. In fact, the FCC SAR limit is 1.6 W/kg *for the head.* It is in fact- 4 W/kg for *other body parts* including the ear (ear was labeled in 2013 as a pinna). This is very important because the NTP Study used SAR RF exposures at 0, 1.5, 3, and 6 W/kg GSM or CDMA RFR.

Li's report states: "The report on exposures and health effects from Linda Li shows that the research is still inconclusive."

This is not accurate. The WHO/IARC has classified RF as a Class 2 B possible Carcinogen and the classification includes wireless radiation as stated repeatedly by WHO IARC scientists. **This information is missing from the report.** 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."

According to the NIEHS here is the summary of the recent NTP Study:

- Body weights at birth and throughout lactation in rat pups exposed in utero tended to be lower than controls
- In general, survival was greater in all groups of GSM or CDMA RFR-exposed rats compared to controls
- Increased incidence of schwannoma was observed in the hearts of male rats at 6 W/kg – Significant SAR-dependent positive trend (GSM and CDMA) – Significant pair-wise increase at 6 W/kg (CDMA)
- There was a significant SAR-dependent trend for increased gliomas in the brain of rats exposed to CDMA-modulated RFR
- No exposure-related effects were observed in the brains or hearts of female rats
- The hyperplastic lesions and glial cell neoplasms of the heart and brain observed in male rats are considered likely the result of whole-body exposures to GSM- or CDMA-modulated RFR. – There is higher confidence in the association between RFR exposure and the neoplastic lesions in the heart than in the brain.

In addition DNA damage was found in the brains of exposed animals.

"The NTP results provide "strong evidence for the genotoxicity of cell phone radiation," Ron Melnick told *Microwave News.* Melnick led the team that designed the NTP study; he is now retired. This "should put to rest the old argument that RF radiation cannot cause DNA damage."

Comet assay summary for rats and mice

		MALE					FEMALE				
RATS	CDMA	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood
	GSM	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood
MICE	CDMA	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood
	GSM	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood	Frontal Cortex	Cerebellum	Hippocamp	Liver	Blood

Yellow — Statistically significant trend *and* pairwise SAR-dependent increase

Blue — Statistically significant trend *or* a pairwise increase

Green — Not significantly different, but increased in 2 or more treatment groups

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This is pulled from the slides presented to the NIEHS on June 15. See the video presentation by lead NTP RF Study researcher here.

Here is the link to the slides from this lecture. http://ntp.niehs.nih.gov/ntp/about_ntp/bsc/2016/june/presentations/cellphone_508.pdf

Li's Report fails to note the funding source of the studies. Funding and sponsorship are shown to influence research outcomes.

Li's Report also does not explore these other issues

1. Childrens unique vulnerability to RF due to their developing brains and bodies.
2. Childrens unique physiology whereby they absorb the radiation more deeply into their bodies.
3. Children's cumulative exposure in school includes *all the sources of RF energy in the classroom* which includes cell phones, fitbit, apple watches, virtual reality, cell towers on school grounds and all other wireless devices in use.

Due to time constraints I am unable to do a full response to Linda Li's Report but ask that the Council take the time to watch these two videos to understand the health issues for children posed by wireless radiation.

- Dr. Erica Mallery-Blythe - Electromagnetic Radiation, Health and Children 2014 Lecture https://www.youtube.com/watch?v=sNFdZVeXw7M
- Press Conference: Cell Phones, Wireless And Children's Health Symposium 2016 Pediatric Academic Societies https://www.youtube.com/watch?v=_ScEwqpaSYE

Additional Comments on the Draft

1. **Please update the link to international policy on EMFS** The EHT trust link on policy is the most up to date resource on international policy action. http://ehtrust.org/wp-content/uploads/International-

Policy-Precautionary-Actions-on-Wireless-Radiation.pdf

2. Please add a section on how to reduce exposure to cell phones (used in classrooms as classroom tools.)

This list is from EHT.

1. **Distance is your friend: While talking on your cell phone, prefer to position the cell phone away from your body as far as possible**. Whenever possible, use the speaker-phone mode or a airtube wired headset (not a Bluetooth). The electromagnetic field (radiation) is one fourth the strength at a distance of two inches and fifty times lower at three feet.
2. **Avoid using your cell phone when the signal is weak.** Phones in low service areas emit a maximum amount of radiation because the phone repeatedly attempts to connect to each nearest network antenna.
3. **Avoid carrying your cell phone on your body at all times.** Do not carry a powered on cell phone in your pocket or bra. Cell phones emit radiation constantly, even when you are not actively using them. Power them 100% off before you carry them near your body.
4. **Children should only use cell phones for emergencies.** Children's skulls are thinner than adults' and their brains are still developing. Hence, radiation from cell phones penetrates more deeply into their brains and is likely to cause more damage.
5. **Do not sleep with your cell phone powered on.** Research shows that sleep is disrupted by cell phone radiation. Need an alarm clock? Simply put the phone on "airplane" or "flight" or "off-line" mode, which will stop "wireless" electromagnetic field emissions.
6. **Use Your Home And Office Corded Landline For Most Conversations: F**orward your cell phone to landlines whenever you are at home so you can turn the cell phone off without missing a call. Biological effects can be related to both strength of cell phone radiation dose and duration of exposure, so consider whether or not your communication is urgent. Remember: Use a corded home landline, not a home cordless phone, because those use electromagnetic microwave technology just like cell phones. Most cordless phone base stations constantly emit microwave radiation regardless whether or not any connected handset is in use. The cordless phone handsets also emit microwave radiation. Corded landlines have no radiation emissions and are the best choice.
7. **Avoid using your cell phone in metal contained spaces like a car, elevator, bus, train or airplane.** The metal surroundings reflect the waves inside the vehicle, often increasing your radiation exposure. Your use also passively exposes other persons near you (children, pregnant women, and other adults) to your phone's electromagnetic radiation fields when you are in an enclosed space.
8. **Whenever possible, minimize talk time and choose to communicate via text messaging rather than making a voice call,** to limit the duration of exposure and the proximity to the body. Hold the phone out, away from your body, when you press "send" and do not rest your phone against your abdomen as you text.
9. **Protect your fertility.** This radiation has been shown to damage sperm and the ovaries. Many people move the phone away from their head to reduce exposure but down to their torso forgetting that a cell phone or laptop to the abdomen results in higher radiation absorption to the reproductive organs.
10. **Less Aps =Less Radiation.** Reduce the Aps on your phone to decrease radiation.
11. **Read your cell phone manual to find the minimum distance the federal government recommends that your cell phone must be kept away from your body.** Keeping it closer than the designated distance can result in a violation of the FCC Exposure Limit. Exceeding FCC levels is proven to result in burns, sterility, and brain damage. Learn more about fine print instructions at Show The Fine Print.Org.

    Remember that these "minimum distances" in the cell phone manuals do not protect you from nonthermal effects such as sperm damage, damaged brain cells and increased brain cancer

risk. Federal guidelines are set thousands of times too high to protect from these "nonthermal" effects from long term low level cumulative exposures.

Recommendations to the General Assembly

The Wi-Fi Draft states *"As schools add wifi to classrooms, the General Assembly should consider funding education and research on electromagnetic radiation and health."* This should be changed to:

- Schools should not add wifi to classrooms until a proper review of the issue has been done.
- The General Assembly should fund education and research on electromagnetic radiation and health to properly characterize children's projected exposures in classrooms and detail the potential health risks posed by this technology.
- The General Assembly should act immediately to inform Maryland citizens about the fact that cell phones and wireless devices emit radio-frequency radiation and consider doing what Berkeley California has done in ensuring the public has a right to know.

  2014 California, Berkeley: 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."* Full text here.
  Watch a video of the historic vote featuring Harvard Law professor Lawrence Lessig.
  Watch a video of testimony to Berkeley from November 8, 2011 on the need for cell phone radiation guidelines.

3. The Department of Health should provide suggestions to the public on ways to reduce exposure from not only cell phones but all types of wireless devices. See some examples.

- The Dept of Connecticut states the following. *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.
- **Government of Germany:**
  - Smartphones and Tablets: Read the recommendations to reduce exposure here:

    "Smartphones and tablets for children?

    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."
  - They recommends landline phone instead of mobile phone base stations and that schools should not connect wirelessly to the internet. Read a 2015 statement here.
  - **See their poster "Less radiation when Telephoning" here.**
- **San Francisco, California has a webpage entitled** Cell Phone Radiation (How to Reduce Exposures) with public information on how to reduce exposures to cell phone radiation. 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.

Additional Tips for People to reduce Wireless Exposures include:

Airplane Mode ON, and Wi-Fi OFF, and Bluetooth OFF

"Airplane mode", also known as "flight mode," is a setting on your wireless device that stops the microwave radiation emissions.

- On every computer, laptop, tablet or WTD, there is a function key that turns OFF the Wi-Fi transmitter. There is also a function key that turns OFF the Bluetooth transmissions.
- Whenever you hand a child a technology device such as cell phone, tablet, or laptop, please set the Airplane mode to ON, and Wi-Fi to OFF, and Bluetooth to OFF.

Prefer Non-Wireless Connections

For home phones (landline), internet, printer, speakers, and entertainment gear, connect by cord or cable with all wireless features off.

- *Wi-Fi Internet Connections at Home:* As an easy first step, power off the Wi-Fi router at bedtime. Then ask your internet provider how to connect with plug-in cords and turn off the antennae feature of the modem or router. Many companies allow you to manage the wireless settings online and you can simply turn it off via the internet. Sometimes a swap to a non-wireless modem is necessary.
- *Trade in your home cordless phones for corded phones.* Most cordless phone base stations constantly emit high levels of microwave radiation regardless whether or not any connected handset is in use. The cordless phone handsets also emit microwave radiation. Corded landlines have no wireless radiation emissions and therefore this simple step can substantially reduce your daily microwave radiation exposures.
- *Wire Up Game Stations and Controllers:* Choose gaming devices that have the option to connect the hand controllers with a cord.
- *Hardwire Accessories (Printer, Keyboard, Mouse, Speakers, etc.)*: Wi-Fi printers are a hidden source of constant Wi-Fi emissions, just like a Wi-Fi router or cordless phone base. The safest choice is a hardwired non-wireless printer. Some wireless printers allow the wireless antennae to be turned off via an internal network setting so contact the manufacturer for directions. For some machines, the "OFF" setting is retained in memory, but for some machines you must reset to "OFF" each time you power on. A mouse with a cord has no wireless radiation emissions (there is no setting to change).

Turn It Off When Not in Use

Wireless enabled devices are *always* transmitting radiation *even* when you are not surfing the internet or using the device to talk or message. The only way to stop these emissions is to set the wireless antennas to OFF.

- Why? Wi-Fi devices continuously check in with their main network (cell tower or Wi-Fi router to be sure a connection exists. This radiation activity called a digital handshake. For example, a Wi-Fi router emits a beacon signal at regular intervals to signal the available network (whether or not any person or machine is using the network). Similarly, a Wi-Fi enabled tablet or other personal use device will also signal at regular intervals hunting for a network (whether or not a person is using that connection). Those signals are all radiation emissions.
- You can easily decrease your family's firsthand and secondhand radiation exposure *by turning off wireless networks and devices whenever you aren't actively using them.*
- Turning off wireless devices (and their related gear)—for example, gaming, entertainment, and computer systems—*when not in use* also saves significant energy and makes all around good sense.

Power Off Wireless Devices When Driving

Power off wireless connectivity in vehicles. Mobile devices distract drivers even if hands-free. Cell phones and streaming tablets and laptops also emit higher power radiation during travel because the metal surroundings create radiation hotspots inside the driver and passenger areas of your vehicle. Plan ahead so that you do not need to use any cell phones or wirelessly enabled devices in the car. *Going on a road trip and your children want to watch movies?* Before you leave, download the movies onto the device so that during the trip wireless access is not necessary.

Safeguard Your Sleep

Pew Research reported that 75% of children sleep every night with their cell phone beneath their pillow. Be aware that wireless radiation and light seriously impact our sleep so be sure to *power off* all screens and electronics *well before bedtime.*

- Many newer TVs, gaming systems, and computers plugged into electricity or on battery power will have radiation emissions even if in power off mode, so it is best to remove them from the bedroom or completely disconnect them from their power source.
- Need an alarm on your phone? You can set the phone to Airplane/Flight Mode ON and the Wi-Fi and Bluetooth to OFF *and still use the alarm feature.*
- Be sure to charge cell phones and tech devices outside the bedroom, because charger gear generates other types of electromagnetic fields that are also linked to health issues.
- Locate screens in family areas—not in bedrooms.

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Letters from Doctors to be included in the Wi-Fi Report Draft Report CEHPAC

1 message

theodorams@aol.com <theodorams@aol.com> Sat, Sep 10, 2016 at 1:51 PM
To: cliff.mitchell@maryland.gov, veronika.carella@mdcehc.org, nobot@cehn.org, rachel.hess-mutinda@maryland.gov, megan.latshaw@aphl.org

Dear Dr. Cliff Mitchell,

I have attached four letters, from Dr. Hardell, Dr. Miller, Dr. Herbert and Dr. Carpenter on the health risks associated with Wi-Fi in Schools. They are the first letters written on Wi-Fi in schools I have seen *since the NTP study was released* and I especially will draw your attention to what Dr. Hardell states in his letter about recommendations.

They were sent this month.

I would like them included in the appendix of the WiFi Draft Report.
Thank you,
Theodora Scarato

4 attachments

- **Dr. Miller to Petaluma Schools .pdf** 64K
- **Hardell 2016 Letter to Petaluma City Schools-2.pdf** 129K
- **Carpenter to Petaluma Wi-Fi (1).pdf** 212K
- **DRHerbert-wifi-in_schools-Petaluma-ltrhd-pdf.pdf** 584K

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

District Office
200 Douglas Street
Petaluma, California
94952
USA

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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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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9 September 2016

District Office
200 Douglas Street
Petaluma, California 94952

Dear Petaluma City 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/wpcontent/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).

More recently I published an article entitled "Connections in Our Environment: Sizing upElectromagnetic Fields," in Autism Notebook Spring 2015 edition. 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 linkhttp://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.

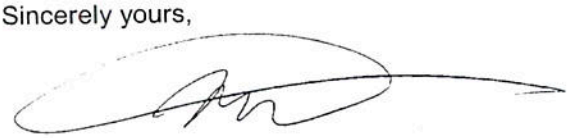
Radiofrequency electromagnetic radiation from WiFi and cell towers can exert a disorganizing effect on the ability to learn and remember, and can also be destabilizing to immune and metabolic function. This will make it harder for some children to learn, particularly those who are already having learning 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 Petaluma City School District 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.

Sincerely yours,



Martha Herbert, PhD, MD

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Mandatory irradiation of children by Wi-Fi and cell phones is harmful to their health and must end.

1 message

Ronald M. Powell, Ph.D. <ronpowell@verizon.net>
To: "Rachel M. Hess-Mutinda" <rachel.hess-mutinda@maryland.gov>

Wed, Sep 14, 2016 at 12:30 PM

****** Please forward this message, with its two attached documents to all members of CEHPAC. ******

September 14, 2016

Dear Members of the Maryland Children's Environmental Health and Protection Advisory Council,

I am writing to you in response to the draft CEHPAC statement, "Wifi in Schools in Maryland", posted here:

http://phpa.dhmh.maryland.gov/OEHFP/EH/Shared%20Documents/WifiinSchoolsinMaryland_CEHPAC.pdf

I am pleased by the increased awareness of the link between wireless devices and health demonstrated by this draft. But I urge thoughtful consideration of the information that follows.

In brief, this is the message that scientists and physicians, who are conducting research on the impact of wireless devices on health, want you to hear:

> The radiofrequency/microwave radiation produced by wireless devices, like Wi-Fi, wireless computers, cell phones, cordless phones, and smart meters, is harmful to human health.

For this reason, it is vital that the mandatory irradiation of children, teachers, and staff in our schools must end. That step must include turning Wi-Fi off permanently in all of our schools.

If you doubt that such radiation is harmful, please see the two attached documents. They will point you to major references on this subject:

- The first document is "Message to Schools and Colleges about Wireless Devices and Health". It will introduce you to the health issues associated with wireless devices, with an emphasis on Wi-Fi.
- The second document is "The Health Argument against Cell Phones and Cell Towers". It will provide additional information about the health risks of cell phones by describing the link between cellular radiation and tumors, including malignant brain cancer. That link has just been reinforced by a new study from the National Toxicology Program at the National Institutes of Health.

If you still think that wireless technology is safe, please consider these questions:

- Which sources of information are assuring you that wireless technology is safe?
- Do those sources have any vested interest in wireless technology? Do they sell, install, or service wireless devices; or are they funded by the wireless industries?
- Will those sources give you **written evidence,** for public scrutiny, that backs up their claims of safety for the wireless devices that they advocate for use in schools?
- Does the expertise of those sources match, in any way, the expertise of the world's leading scientists and physicians, referenced in the attached documents, including those at the National Institutes of Health, who are actively conducting research on the health effects of the radiation from wireless devices.

If you would like to read the views, of scientists, physicians, and other knowledgeable individuals, already provided to the Montgomery County Public Schools, please find the letters that they have submitted here:

http://safetechforschoolsmaryland.blogspot.com/2016/08/letters-to-montgomery-county-public.html

If you have any doubts about the safety of wireless technology, what is the prudent step to take?

- Keep irradiating the children, teachers, and staff; and add even more sources of radiation, such as wireless thermostats and virtual-reality cell-phone devices throughout the schools, without concern for the consequences to health.
- OR, keep irradiating the children, teachers, and staff; but take half measures to reduce the radiation levels somewhat even if not enough to protect health.
- OR, take Precautionary Action NOW by stopping the irradiating of the children, teachers, and staff, while you await additional evidence sufficient to convince you that the radiation is either harmful or safe, and at what level.

If you elect Precautionary Action

You can largely resolve the problem of the mandatory irradiation of children in the schools by moving from wireless connectivity, like Wi-Fi, to shielded wired connectivity using any of the following:

- shielded Ethernet cable
- coaxial cable which is inherently shielded
- optical fibers which do not need shielding.

If you feel that you need help in assessing the impact of wireless devices on health, please seek competent advisors. They should be individuals with biomedical backgrounds, preferably scientists and physicians conducting research on the biological effects of radiofrequency/microwave radiation. And they should be free of conflicts of interest, such as funding from the wireless industries.

Who am I?

I am a retired U.S. Government career scientist. I hold a Ph.D. in Applied Physics from Harvard University. 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. My background is further described in both of the attached documents.

Thank you for your attention to this important issue.

Regards,

Ronald M. Powell, Ph.D.
20316 Highland Hall Drive
Montgomery Village, MD 20886-4007
United States of America
E-mail: ronpowell@verizon.net
Tel: (301) 926-7568

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2 attachments

Message to Schools and Colleges about Wireless Devices and Health.pdf
412K

The Health Argument against Cell Phones and Cell Towers.pdf
449K

November 24, 2015

Ronald M. Powell, Ph.D.

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
Telephone: 301-926-7568
Email: ronpowell@verizon.net

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/

August 26, 2016

Ronald M. Powell, Ph.D.[1]

The Health Argument against Cell Phones and Cell Towers

The biomedical evidence showing that the radiofrequency radiation emitted by cell phones and cell towers is harmful to health continues to grow. This document summarizes the health argument against cellular technology, whatever the benefits of that technology may be. You may wish to inform yourself about these arguments for any of several reasons:

- You use a cell phone.
- You encourage, or do not discourage, the use of cell phones by family members.
- You live in, or are contemplating moving into, a community close to a cell tower.
- Your school or college is considering permitting the installation of a cell tower on its property.
- Your community is considering permitting the installation of cellular repeaters, small-cell towers, or even full cell towers within its jurisdiction.

Below, I introduce myself, provide evidence of the harmfulness of cellular radiation, and show that government is not protecting us from harm and is unlikely to do so in the near future. That means that we must protect ourselves and our families at the individual and the community levels while working toward protective action by governments at the local, state, and Federal levels.

Who am I?

I am a retired U.S. Government career 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 electromagnetic fields on human health.

Evidence of harm

I present below key evidence, and associated references, that the exposure of humans to radiofrequency radiation, and specifically cellular radiation, is harmful.

In 2016, the National Toxicology Program, at the National Institutes of Health, linked cellular radiation to brain and heart tumors.

The National Toxicology Program (NTP), at the National Institutes of Health (NIH), just published the "Partial Findings" of a $25 million multi-year study of the impact of cellular radiation on health. The U.S. Food and Drug Administration "nominated" this NTP study. The NTP indicated that this is the largest and most complex study ever conducted by the NTP.

[1] Ronald M. Powell, Ph.D., USA, email ronpowell@verizon.net, web site https://www.scribd.com/document/291507610/.

The NTP study exposed each of six separate groups of male rats to one of the six possible combinations of three different levels of cellular radiation and two different modulation formats. The modulation format is the method used to impress information on the cellular signal. A separate seventh group of male rats was used as a "control", that is, for comparison, and was protected from exposure to any cellular radiation.

The NTP study found a "likely" causal relationship between exposure to cellular radiation and the occurrence of malignant brain cancer (glioma) and benign nerve tumors (schwannomas) of the heart in the male rats:

> The rates of occurrence of brain glioma in the male rats ranged from 0 to 3.3 percent for the six groups exposed to radiation. The mean rate of occurrence was 2.0 percent across all six groups.[2]
>
> The rates of occurrence of heart schwannoma in the male rats ranged from 1.1 to 6.6 percent for the six groups exposed to radiation. The mean rate of occurrence was 3.5 percent across all six groups.[3]
>
> The seventh group of male rats, which was used as a control and which was protected from exposure to any cellular radiation, experienced no instances of brain glioma or heart schwannoma.

The NTP considered its findings so important to public health that it issued the "Partial Findings" (May 2016) prior to completing the full study. The NTP then presented those findings at an international conference (BioEM2016, June 2016) attended by 300 scientists from 41 countries. The NTP characterized the motivation for the early release of the "Partial Findings" this way:

> "Given the widespread global usage of mobile communications among users of all ages, even a very small increase in the incidence of disease resulting from exposure to RFR [radiofrequency radiation] could have broad implications for public health. There is a high level of public and media interest regarding the safety of cell phone RFR and the specific results of these NTP studies."

The NTP promised further findings from its study for publication through 2017. Included in those further findings will be test results on mice. You can learn more about this study from the following references:

> **Reference:** NTP's brief description of its study. National Toxicology Program: Cell Phones. (http://ntp.niehs.nih.gov/results/areas/cellphones/index.html)
>
> **Reference:** NTP's published "Partial Findings" of the study. Michael Wyde, Mark Cesta, Chad Blystone, Susan Elmore, Paul Foster, Michelle Hooth, Grace Kissling, David Malarkey, Robert Sills, Matthew Stout, Nigel Walker, Kristine Witt, Mary Wolfe, and John Bucher, 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), posted June 23, 2016. (http://biorxiv.org/content/biorxiv/early/2016/06/23/055699.full.pdf)
>
> **Reference:** Informative discussion of the NTP study. Environmental Health Trust, Frequently Asked Questions about the U.S. National Toxicology Program Radiofrequency Rodent Carcinogenicity Research Study. (http://ehtrust.org/science/facts-national-toxicology-program-cellphone-rat-cancer-study)

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[2] In the "Partial Findings" reference cited above, the mean (average) rate of occurrence for malignant glioma in male rats was determined from Table 1 on page 13 as follows: (3 + 3 + 2 + 0 + 0 + 3)/(90 + 90 + 90 + 90 + 90 + 90) = 2.0 percent.

[3] In the "Partial Findings" reference cited above, the mean (average) rate of occurrence for heart schwannoma in male rats was determined from Table 3 on page 15 as follows: (2 + 1 + 5 + 2 + 3 + 6)/(90 + 90 + 90 + 90 + 90 + 90) = 3.5 percent.

Reference: Announcement of the BioEM2016 presentation. Results of NIEHS' National Toxicology Program GSM/CDMA phone radiation study to be presented at BioEM2016 Meeting in Ghent, 05 June 2016 — 10 June 2016 Ghent University, Belgium.
(http://www.alphagalileo.org/ViewItem.aspx?ItemId=164837&CultureCode=en)

Reference: Viewgraphs presented by Michael Wyde, Ph.D., NTP study scientist, at BioEM2016 Meeting, Ghent, Belgium, June 8, 2016. NTP Toxicology and Carcinogenicity Studies of Cell Phone Radiofrequency Radiation.
(http://ntp.niehs.nih.gov/ntp/research/areas/cellphone/slides_bioem_wyde.pdf)

The NTP study reinforces the classification of radiofrequency radiation, including cellular radiation, as a possible human carcinogen, made by the International Agency for Research on Cancer of the World Health Organization in 2011.

In its "Partial Findings" the NTP noted that its study reinforces a decision made by the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO) in 2011. That decision classified radiofrequency radiation, including specifically cellular radiation, as a Group 2B carcinogen (possible carcinogen for humans). This classification was based on the increased risk of malignant brain cancer (glioma) and acoustic neuroma (a benign tumor of the auditory nerve), which is a form of schwannoma.

Reference: Announcement of the IARC classification. International Agency for Research on Cancer, IARC Classifies Radiofrequency Electromagnetic Fields as Possibly Carcinogenic To Humans, Press Release No. 208, 31 May 2011.
(http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf)

Reference: Full report on the IARC classification. IARC Monographs: Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields, Volume 102, 2013.
(http://monographs.iarc.fr/ENG/Monographs/vol102/mono102.pdf)

The findings of the NTP study, in combination with the findings of other studies conducted since 2011, have greatly increased the likelihood that the IARC will raise its classification of radiofrequency radiation to Group 2A (probable carcinogen for humans) or even to Group 1 (known carcinogen for humans) in the near future.

In 2015, hundreds of international scientists appealed to the United Nations and the World Health Organization to warn the public about the health risks caused by electromagnetic fields (EMF), including radiofrequency radiation and, specifically, cellular radiation.

220 scientists from 41 nations have signed an international appeal, first submitted to the United Nations and to the World Health Organization in May 2015. These scientists seek improved protection of the public from harm caused by 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 more than 2000 research papers and studies on EMF." They state the following:

"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. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life."

Reference: International EMF Scientist Appeal: Scientists call for Protection from Non-ionizing Electromagnetic Field Exposure, May 15, 2015 (updated April 27, 2016). (https://www.emfscientist.org/index.php/emf-scientist-appeal)

Reference: International Scientists Petition U.N. to Protect Humans and Wildlife from Electromagnetic Fields and Wireless Technology. (https://www.emfscientist.org/images/docs/International_EMF_Scientist_Appeal_Description.pdf)

In 2012, the BioInitiative Working Group published the most comprehensive of the recent analyses of the international biomedical research, showing a multitude of biological effects from exposure to radiofrequency radiation, including cellular radiation, at levels below the current exposure guidelines set by the Federal Communications Commission (FCC).

The health risks posed by the expanding use of radiofrequency radiation in wireless devices are not limited to cancer, as devastating as that consequence is. The broad range of health effects was extensively reviewed in the BioInitiative Report 2012. This 1479-page review considered about 1800 peer-reviewed biomedical research publications, most issued in the previous five years. The BioInitiative Report 2012 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 greatest number of experts (10). The report concludes the following:

"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."

Reference: 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)

The BioInitiative Report 2012 documented, in its "RF Color Charts", examples of eight categories of biological effects that occurred at levels below the current exposure guidelines set by the FCC:

- stress proteins, heat shock proteins, and disrupted immune function
- reproduction and fertility effects
- oxidative damage, reactive ion species (ROS), DNA damage, and DNA repair failure
- disrupted calcium metabolism
- brain tumors and blood-brain barrier
- cancer (other than brain) and cell proliferation
- sleep, neuron firing rate, electroencephalogram (EEG), memory, learning, and behavior
- cardiac, heart muscle, blood-pressure, and vascular effects.

These biological effects were attributed to "Radiofrequency Radiation at Low Intensity Exposure" from "cell towers, Wi-Fi, wireless laptops, and smart meters".

Reference: See the "RF Color Charts", accessed from the left column of the web page below. (http://www.bioinitiative.org)

The U.S. Government is not protecting us.

The radiation exposure guidelines of the FCC do not protect us because they are outdated and based on a false assumption.

The current radiation exposure guidelines of the FCC were adopted in 1996, 20 years ago. Those guidelines are based primarily on an analysis by the National Council on Radiation Protection and Measurements (NCRP) which was published in 1986, 30 years ago. That was many years before the emergence of nearly all of the digital wireless devices in use today.

> "The FCC-adopted limits for Maximum Permissible Exposure (MPE) are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP) in 'Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields,' NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3. Copyright NCRP, 1986, Bethesda, Maryland 20814...."

> **Reference:** Federal Communications Commission, Office of Engineering & Technology, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, OET Bulletin 65, Edition 97-01 (August 1997). See the last paragraph on page 64. (http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf)

Those exposure guidelines have not been substantially changed since that analysis in 1986. They are based on the *thermal assumption* that the only harm that radiofrequency radiation can cause is due to tissue heating. This thermal assumption has been thoroughly disproved since, as biological effects have been found to occur at levels of radiation below, and even far below, those that cause significant tissue heating. Such lower levels are commonly referred to as *nonthermal* levels. The result is that many authorities now consider the FCC's current exposure guidelines as entirely outdated and much too high (that is, much too permissive) to protect the public.

The evidence disproving the thermal assumption is based on the broadened understanding of the biological effects of radiofrequency radiation made possible by thousands of peer-reviewed papers published by international biomedical scientists since 1986. The BioInitiative Report 2012 is the most recent comprehensive review of that research and provides many examples of bioeffects occurring at nonthermal radiation levels, as described above. Further, the new study by the National Toxicology Program, also described above, added to the evidence disproving the thermal assumption. That study exposed rats to levels of radiation below those that cause significant heating, and both above and below the FCC's current exposure guidelines as well. Yet , even below the FCC's current exposure guidelines, the male rats still developed malignant brain cancer (glioma) and benign tumors (schwannomas) of the nerves of the heart.

The shortcomings of the FCC's exposure guidelines are described in detail in the following reference:

> **Reference:** Outdated FCC "Safety" Standards: The Five Fallacies of the Electromagnetic Radiation Exposure Limits.
> (http://ehtrust.org/policy/fcc-safety-standards/)

The FCC is not a credible source for exposure guidelines because it lacks health expertise and because it is too heavily influenced by the wireless industries that it is supposed to regulate.

The FCC lacks the health expertise required for developing health-related radiation exposure guidelines. Further, the FCC seems more interested in assuring compatibility among electronic systems than in assuring the compatibility of electronic systems with human, animal, and plant life. Since the exposure guidelines relate to health, it would make more sense for them to be developed by an agency with health expertise, such as the Environmental Protection Agency (EPA).

In addition, the FCC lacks the impartiality required to be a source of credible guidelines. The FCC is too heavily influenced by the wireless industries that the FCC is supposed to regulate. The 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 recent monograph from the Center for Ethics at Harvard University.

> **Reference:** 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

As an example of that capture, President Obama, in 2013, appointed Thomas Wheeler, as the Chairman of the FCC. At that time, Mr. Wheeler was the head of the CTIA – The Wireless Association, which is the major lobbying organization for the wireless industries. This is the infamous "revolving door".

The FCC's decision to fast-track Fifth Generation (5G) cellular technology without prior study of its health impact demonstrates the FCC's disinterest in the public health.

On July 14, 2016, the FCC adopted new rules that would promote fast-tracking the expansion of cellular service to new and higher frequencies as part of the Fifth Generation (5G) of cellular technology. This decision will open selected frequency bands above 24 gigahertz (GHz) and up to 71 GHz. At the same time, the FCC has requested comment on opening even higher frequencies, possibly above 95 GHz.

> **Reference:** FCC Takes Steps to Facilitate Mobile Broadband and Next Generation Wireless Technologies in Spectrum above 24 GHz: New rules will enable rapid development and deployment of next generation 5G technologies and services.
> (http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0714/DOC-340301A1.pdf)

> **Reference:** Fact Sheet: Spectrum Frontiers Rules Identify, Open Up Vast Amounts of New High-Band Spectrum for Next Generation (5G) Wireless Broadband.
> (http://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0714/DOC-340310A1.pdf)

All five commissioners of the FCC, including Chairman Wheeler, approved this expedited move to 5G. No commissioner called for evaluating the health impact before proceeding with 5G, despite the recent findings of the National Toxicology Program at NIH that cellular radiation likely causes tumors. Nor did even one commissioner expressed any interest in, or concern about, the impact of this new technology on public health. Rather, the FCC's emphasis was on the billions of dollars to be made by proceeding to implement 5G as rapidly as possible, with a minimum of regulatory interference, to assure an international competitive position.

In contrast to the FCC's disinterest in the impact of 5G on the public health, extensive written comments from individual members of the public and from many interested organizations raised a host of health concerns that were totally ignored in the FCC's presentations.

> **Reference:** July 2016 Open Commission Meeting addressing "Spectrum Frontiers" and "Advancing Technology Transitions".
> (https://www.fcc.gov/news-events/events/2016/07/july-2016-open-commission-meeting)

> **Reference:** The FCC Approves 5G Millimeter Wave Spectrum Frontiers. Includes excerpts from selected comments provided to the FCC by individuals and organizations that expressed concern about the health impact of the FCC's plan for 5G.
> (http://ehtrust.org/policy/fcc-approves-5g-millimeter-wave-spectrum-frontiers/)

> **Reference:** Comments on FCC Docket 14-177, Spectrum Bands above 24 GHz. All of the comments submitted to the FCC about the key docket leading to the implementation of 5G.
> (https://www.fcc.gov/ecfs/search/filings?proceedings_name=14-177&sort=date_disseminated,DESC)

U.S. Government agencies, and U.S. medical organizations, have disputed the validity of the FCC's exposure guidelines.

U.S. Government agencies, as well as U.S. medical organizations, have disputed the validity of the FCC's thermal exposure guidelines, maintaining that they are outdated and need to be updated to provide adequate protection of human beings, including children and seniors as well as other vulnerable groups.

U.S. Environmental Protection Agency

The Environmental Protection Agency (EPA) would be a better agency than the FCC to entrust with setting radiofrequency radiation exposure guidelines because the EPA has both health expertise and environmental responsibilities. The EPA is often cited by the FCC, and by the wireless industries, as one of the agencies that the FCC has *consulted* about the FCC's exposure guidelines, as if to increase the credibility of those guidelines. However, the fact that the EPA has *explicitly disputed* the validity of those guidelines is consistently omitted from those citations.

Specifically, in 2002, the EPA addressed the limitations of the thermal exposure guidelines of the FCC, and the similar guidelines of private organizations, including the Institute of Electrical and Electronics Engineers and the International Commission on Non-Ionizing Radiation Protection:

> "The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations.... The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified."

> "Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures. When developing exposure standards for other physical agents such as toxic substances, health risk uncertainties, with emphasis given to sensitive populations, are often considered. Incorporating information on exposure scenarios involving repeated short

duration/nonthermal exposures that may continue over very long periods of time (years), with an exposed population that includes children, the elderly, and people with various debilitating physical and medical conditions, could be beneficial in delineating appropriate protective exposure guidelines."

Reference: Letters from Frank Marcinowski, Director, Radiation Protection Division, EPA, and Norbert Hankin, Center for Science and Risk Assessment, Radiation Protection Division, EPA, to Janet Newton, President, the EMR Network, with copies to the FCC and the IEEE, dated July 16, 2002. (http://www.emrpolicy.org/litigation/case_law/docs/noi_epa_response.pdf)

In summary, the EPA makes the following points: (1) the FCC 's thermal exposure guidelines do *not* protect against all harm, only the harm caused by too much heating; (2) the FCC's thermal exposure guidelines do *not* apply to "chronic, nonthermal exposure", which is the type of exposure generated by cell towers and many other wireless devices; and (3) when new FCC guidelines are developed for chronic nonthermal exposures, they must accommodate "children, the elderly, and people with various debilitating physical and medical conditions" because those groups are not accommodated now.

U.S. Food and Drug Administration

The Food and Drug Administration (FDA) is also often cited by the FCC, and by the wireless industries, as one of the agencies that the FCC has consulted. But the FDA is the agency that "nominated" the NTP study of the possible health effects of cellular radiation, in part because of the FDA's uncertainty about the validity of the FCC's exposure guidelines:

"Currently cellular phones and other wireless communication devices are required to meet the radio frequency radiation (RFR) exposure guidelines of the Federal Communications Commission (FCC), which were most recently revised in August 1996. The existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposures."

Reference: Nominations from FDA's Center for Devices and Radiological Health: Radio Frequency Radiation Emissions of Wireless Communication Devices, February 8, 2000. (http://www.goaegis.com/fda_letter0200.html)

The FDA's wisdom in nominating the NTP study was well justified by NTP's publication of the "Partial Findings" described above. Those findings demonstrated both that the FCC's exposure guidelines are not protective and that the thermal assumption on which those guidelines are based is invalid.

U.S. Department of the Interior

In 2014 the Department of the Interior (Fish and Wildlife Service) also addressed the limitations of the FCC's thermal exposure guidelines. The Department of the Interior was motivated by the multiple adverse effects of electromagnetic radiation on the health, and the life, of birds, particularly in connection with cell towers. The Department of the Interior stated the following:

"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."

Reference: Letter from Willie R. Taylor, Director, Office of Environmental Policy and Compliance, Office of the Secretary, United States Department of the Interior, to Mr. Eli Veenendaal, National Telecommunications and Information Administration, U.S. Department of Commerce, dated February 7, 2014.
(https://www.ntia.doc.gov/files/ntia/us_doi_comments.pdf)

American Academy of Environmental Medicine

The American Academy of Environmental Medicine (AAEM), which trains physicians in preparation for Board Certification in Environmental Medicine, states the following:

"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'."

"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."

"To install WiFi in schools plus public spaces risks a widespread public health hazard that the medical system is not yet prepared to address."

Reference: American Academy of Environmental Medicine, Wireless Radiofrequency Radiation in Schools, November 14, 2013.
(http://www.aaemonline.org/pdf/WiredSchools.pdf)

American Academy of Pediatrics

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 in order to better protect the public, particularly the children. In a letter to the Federal Communications Commission (FCC) and the Food and Drug Administration (FDA), dated August 29, 2013, the AAP states the following:

"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."

Reference: American Academy of Pediatrics, letter dated August 29, 2013 addressed to The Honorable Mignon L. Clyburn, Acting Commissioner, Federal Communications Commission and The Honorable Dr. Margaret A. Hamburg, Commissioner, U.S. Food and Drug Administration.
(http://apps.fcc.gov/ecfs/document/view?id=7520941318)

The Telecommunications Act of 1996, in combination with the FCC's exposure guidelines, empowers the wireless industries to mandate the exposure of the public to levels of radiofrequency radiation already found harmful to health.

The Telecommunications Act of 1996 bars state and local governments from objecting to the placement of cell towers on environmental/health grounds unless the FCC's exposure guidelines would be exceeded. Specifically, the Act provides the following:

> "No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's [FCC's] regulations concerning such emissions."
>
> **Reference:** Telecommunications Act of 1996, Section 704 Facilities Siting; Radio Frequency Emission Standards, page 117.
> (http://transition.fcc.gov/Reports/tcom1996.pdf)

This Act, in combination with the FCC's permissive exposure guidelines, strips state and local governments of the right to protect their own residents from levels of radiofrequency radiation already shown to be harmful to health. In effect, this Act transfers to the wireless industries the right to ***mandate*** the exposure of the public, including those most vulnerable to harm, to radiofrequency radiation without the need for further governmental action. State and local governments can still resist, but to do so they must confront this Act which is designed to frustrate their success. Even so, some governments do heroically resist and some do succeed.

Protecting ourselves and our families

We can act on our own to protect ourselves and our families, but only partially.

Instead of increasing our exposure to cellular radiation, and to the radiation from other digital wireless devices, we can decrease our exposure and improve our chances for good health. Desirable steps in this direction include the following:

- Reduce or stop the use of cell phones. Reserve them for emergencies or other essential uses.
- Replace cordless telephones with corded telephones.
- Establish wired (Ethernet) interconnections between routers and the wireless devices that the routers support. Then turn off the wireless capabilities, such as Wi-Fi and Bluetooth, of them all.
- "Opt out" of the wireless smart meter on your residence, if your state or local electric power company permits. Many states, but not all, have an opt-out provision.
- Alert family members about the health risks posed by wireless devices, particularly for vulnerable groups such as pregnant mothers, unborn children, young and teenage children, adult males of reproductive age, seniors, the disabled, and anyone with a chronic health condition. Everyone is vulnerable, but these groups are more so.

  Reference: For more information on reducing radiation at home, please see Ronald M. Powell, Ph.D., How to Reduce the Electromagnetic Radiation in Your Home, which is document (10) on the list.
  (https://www.scribd.com/document/291507610/)

We can obtain better protection if we work together.

We can contribute our efforts to the hundreds of new organizations that are emerging nationwide to raise awareness about the health risks posed by the radiation exposure from wireless devices in homes, in the workplace, in schools, and in public places, especially where children are present. Through the Internet, look for organizations that address the intersection of health with cell phones, cordless phones, Wi-Fi, smart meters, and wireless desktop computers, laptops, and tablets. These wireless devices are the principal sources of radiofrequency radiation in the home.

Take care for our children. Today's adults grew up in an environment with much less radiofrequency radiation than exists today. Today's children are not so lucky. To have the same chance at a healthy life, they need a lot of help. Unfortunately, the levels of radiofrequency radiation in our environment are rising exponentially as governments and wireless industries continue to promote, and even mandate, the exposure of the public to ever higher levels of radiofrequency radiation, with no limit in sight. That means that many of our children will become chronically ill, and many will die, while still young adults. This is a tragedy in the making. To stop it will require greatly increased awareness of the problem and serious political action at multiple levels of government. That is no small task, but we all can help. We can join with others to become a part of the solution for ourselves and our families, but especially for our children and our grandchildren.

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Schools should be safe environments for children -- Cell towers are not safe on school grounds.

1 message

Helen Schwab <hschwabchaiah@gmail.com> Tue, Sep 13, 2016 at 12:03 AM
To: ematsui@jhmi.edu, rachel.hess-mutinda@maryland.gov, emily@marylandpirg.org, guy.guzzone@senate.state.md.us, amezu@msde.state.md.us, allison@mdehn.org, Angela.Angel@house.state.md.us, benoythomas@gmail.com, brandi.stocksdale@maryland.gov, Varney-Alvarado@dhcd.state.md.us, christina.church@maryland.gov, dbishai@jhsph.edu, dianna.abney@maryland.gov, gdiette@jhmi.edu, lornegarr@msn.com, bgitterman@aol.com, jlcarella@msn.com, julianlevy@comcast.net, megan.latshaw@aphl.org, cliff.mitchell@maryland.gov, nancy.servatius@maryland.gov, nobot@cehn.org, rob.hofstetter@maryland.gov

Dear Maryland Children's Environmental Health and Protection Advisory Council Members,

Schools should be safe environments for children. Currently schools across the state are placing cell towers on school grounds unaware of the many health and safety risks they pose. Cell towers emit radio-frequency radiation and children will be exposed long term to this radiation when cell towers are installed on school grounds. In addition, the tower installation includes diesel tanks, lead acid batteries and thus is considered a HAZMAT area.

Please make a strong recommendation to the State Department of Education that schools PROHIBIT cell towers on school grounds.

Please make a strong recommendation to the General Assembly that schools PROHIBIT cell towers on school grounds.

Please make a strong recommendation to the General Assembly that the Department of Health be allocated funds to do research on electromagnetic radiation and children's health.

See 25 Reasons Cell Towers Have No Business On or Near School Property by The Maryland Coalition To Halt Cell Towers at Schools for a detailed list of health and safety concerns.
http://www.safeschoolspg.org/joint-statement-of-the-maryland-coalition-to-halt-cell-towers-at-schools.html

Thank you so much,

Helen Schwab
Baltimore, MD

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

How to protect children from radio-frequency radiation

1 message

Mark Graham <Mark@freewayblogging.com> Tue, Sep 13, 2016 at 2:13 PM
To: ematsui@jhmi.edu, rachel.hess-mutinda@maryland.gov, emily@marylandpirg.org, guy.guzzone@senate.state.md.us, amezu@msde.state.md.us, allison@mdehn.org, Angela.Angel@house.state.md.us, benoythomas@gmail.com, brandi.stocksdale@maryland.gov, Varney-Alvarado@dhcd.state.md.us, christina.church@maryland.gov, dbishai@jhsph.edu, dianna.abney@maryland.gov, gdiette@jhmi.edu, lornegarr@msn.com, bgitterman@aol.com, jlcarella@msn.com, julianlevy@comcast.net, megan.latshaw@aphl.org, cliff.mitchell@maryland.gov, nancy.servatius@maryland.gov, nobot@cehn.org, rob.hofstetter@maryland.gov, rebeccalruggles@gmail.com, eckardcindy@gmail.com

September 13, 2016

Dear Maryland Children's Environmental Health and Protection Advisory Council Members,

100 years ago we were hardly exposed to radio frequency radiation (RFR). Now with the proliferation of cell phones, cell towers, smart electric meters, and wifi wireless internet systems it is all around us. Children are soaking in RFR the entire time they are in the classroom, 6 hours per day times 180 school days per year, or 1,080 hours every school year.

Most people have no idea of the danger it poses. Parents do not have enough information to protect their children from RFR.

Hundreds of peer reviewed scientific studies from scientists all over the world have shown that RFR causes a wide range of short term and long term health impacts.

For example on May 11, 2015, the ***International EMF Scientist Appeal*** was submitted to
His Excellency Ban Ki-moon, Secretary-General of the United Nations;
Honorable Dr. Margaret Chan, Director-General of the World Health Organization;
Honorable Achim Steiner, Executive Director of the U.N. Environmental Programme;
U.N. Member Nations

The ***International EMF Scientist Appeal*** was initially signed by 190 scientists from 39 nations. All of these scientists have published **peer-reviewed papers on the biological or health effects of non-ionizing radiation**, part of the EMF spectrum that includes Extremely Low Frequency fields (ELF) used for electricity, or Radio Frequency radiation (RFR) used for wireless communications. As of July 25, 2016, the Appeal has 222 signatures from 41 nations.

https://emfscientist.org/

The Appeal said in part:

International Appeal

Scientists call for Protection from Non-ionizing Electromagnetic Field Exposure

We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices. These include–but are not limited to–radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field (ELF EMF).

Scientific basis for our common concerns

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. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.

These findings justify our appeal to the United Nations (UN) and, all member States in the world, to encourage the World Health Organization (WHO) to exert strong leadership in fostering the development of more protective EMF guidelines, encouraging precautionary measures, and educating the public about health risks, particularly risk to children and fetal development. By not taking action, the WHO is failing to fulfill its role as the preeminent international public health agency.

Inadequate non-ionizing EMF international guidelines

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 Appeal page is here:

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

On May 27, 2016 the National Toxicology Program, part of the U.S. National Institutes of Health, published partial findings of its study on cell phone radiation and rats. This study concluded:

"These findings appear to support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR. [radio frequency radiation]" (NTP report, page 5)

A partial release of this study, conducted by U.S. National Institutes of Health's National Toxicology Program is found at http://biorxiv.org/content/early/2016/05/26/055699.

Statement on the U.S. National Toxicology Program that reports cell phones cause cancer by the Advisors to the International EMF Scientist Appeal

"This $25 million study, executed by the U.S. government, provides support for what we are stating in the 'International EMF Scientist Appeal' that precautionary approach should be exercised and lower electromagnetic field exposure guidelines should be set".

Parents are counting on you to make strong recommendations to schools and pediatricians on how to protect children from radio-frequency radiation. Please issue recommendations for safer school environments which include:

1. Installing non-wireless technology for internet connection.
2. Ensuring all cell phones and other wireless devices are turned OFF in classrooms.
3. Teaching students about radio frequency radiation and how they can reduce RF from cell phones and technology by changing how they use the technology so they are safer at home.
4. Teaching students about the fine print warnings in their phones and laptops because they are using devices right up against their bodies with violates these FCC instructions.

Will you respond to this message and commit to taking strong action to protect children?

Thank you.

Mark Graham

Sent from my hard wired desktop computer

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Comments re: WiFi in Schools Report; Children's Exposure to Wi-Fi Radiation in Schools

1 message

Florence Kao <florence.kao@gmail.com>
To: Rachel.hess-mutinda@maryland.gov

Wed, Sep 14, 2016 at 9:54 PM

Dear Maryland Children's Environmental Health and Protection Advisory Council Members,

As a parent of eight-year old twin boys in Montgomery County, I am deeply concerned about their daily exposure to Wi-Fi radiation. At home, I can take measures to reduce such radiation, by using hard-wired computers and limiting the amount of time they use wireless devices such as mobile phones and tablets.

However, like many elementary school students throughout the county, my children are seated in a classroom with a wireless access point right above their heads, which emits Wi-Fi radiation the entire school day. Moreover, when they are using their Chromebooks, the students are exposed to even higher levels of radiation emitted from Chromebook antennae, especially when they are streaming content. Many of these students are permitted to use Chromebooks on their laps or in other ways that are not in compliance with user manuals (which typically instruct that Chromebooks be used on table tops a good distance away from the user's body).

Exposure to Wi-Fi radiation is cumulative. Multiply the number of hours in a school day (6.5 hours) by the number of school days in a year (180 days), by the number of years they will have been using Wi-Fi based technology by the time they graduate (for my own children, it will be 11 years), and you arrive at 12,870 cumulative hours. This is a staggering figure to contemplate. Given the recent push to one-to-one computing in schools, my children will be among the first generation to be exposed to Wi-Fi radiation for this long of a period.

I am writing to urge the Council to support strong recommendations to Maryland schools to reduce children's exposure to Wi-Fi radiation. Students and staff should know that wireless devices emit Wi-Fi radiation and that solutions exist to minimize this exposure. Please issue specific recommendations to schools to decrease exposures to as low as possible.

Technology should be hardwired (not wireless) to significantly reduce radiation exposures in the classroom. At a minimum, Wi-Fi should be shut off in classrooms when not in use. The location of wireless access points should not be located above children's heads and developing brains. Children should be using computers on desks, not their laps, and the equipment should be as far away from their bodies as possible.

We are at a critical juncture. More communities throughout the world are recognizing that unfettered access to Wi-Fi is a health hazard, especially when it comes to children's brain development and growing bodies. Please encourage a safer environment in Maryland schools by issuing recommendations that protect the health of our children.

Sincerely yours,

Florence Kao

Comments regarding WiFi in Schools Report.docx
18K

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Comments on the WiFi Draft Report of the Children's Environmental Health and Protection Advisory Council.

Dafna Tachover <dtachover@gmail.com>
To: rachel.hess-mutinda@maryland.gov

Thu, Sep 15, 2016 at 12:24 AM

Dear Ms. Rachel Hess Mutinda,

I will be coming to the CEHPAC meeting on Monday am and I hope to be able to address the Council.

Please sign me up for comment.

Following in this email are my comments on The Wi-Fi Draft.

Please attach my comments to the Appendix of the final report in the Appendix so it becomes part of the final report.

Comments on the Wi-Fi Draft Report of the

Children's Environmental Health and Protection Advisory Council.

I am writing in strong support of your recommendations to eliminate and/or reduce exposure to radio frequency in schools from cellphones, Wi-Fi and the cell towers being built on school grounds.

I am an attorney in New York and Israel, have an MBA and am the founder of *"We Are The Evidence,"* an advocacy organization working to protect the rights of people who have been injured by wireless technology radiation.

I have been working on the issue of Wi-Fi in schools in Israel where I have communicated with literally hundreds of children harmed by wireless technology radiation.

There are many thousands of peer-reviewed scientific research papers that have proven that the radiation emitted by wireless technology is harmful to almost every system and organ in the body including the DNA, even in levels millions of times and more lower than the current "safety" standards.

However, the most compelling evidence of harm is the rapidly growing numbers of adults and children who are developing severe adverse health effects from this technology. We now have the human evidence that confirms what science has been warning us of for decades.

Unfortunately, children, who are an especially sensitive population, are being injured and there's already an epidemic of sickness amongst children in school. The deployment of Wi-Fi in the school has created an absurdity in which the most sensitive population is exposed chronically to one of the most radiation intense environments.

In 2012 I submitted a case to the Israeli Supreme Court asking for an injunction that would ban the use of Wi-Fi in schools. While working on this case, I exposed an existing epidemic of Electro-Sensitivity in children after Wi-Fi was installed in their schools. We have submitted evidence of over 200 sick children in 6 schools alone. These children developed severe headaches, nausea, vomiting, concentration and cognitive problems, exhaustion, noise sensitivity, nose bleeds and other symptoms as a result of the radiation in the schools.

My continued efforts in Israel and that of other advocates have led to significant change. Following my lawsuit and my media efforts, we gained the mainstream media's complete support, which led to growing public awareness. This has had significant impact on the stance of government officials: the two leading government officials (Prof. Stelian Gelberg, Head of the Radiation Department in the Israeli Environmental Protection Agency and Prof. Siegal Sadetzki, who is responsible for the policy of the Ministry of Health on the topic), admitted to the harms of non-thermal levels of wireless technology radiation and acknowledged that the current safety standard is irrelevant. Prof. Gelberg has been objecting the installation of Wi-Fi in the schools and admitted that some children have been developing electro-sensitivity.

In addition, the Israeli Health Minister and the Parliament Children's Rights Committee demanded the removal of Wi-Fi from schools. In April 2016, a compelling TV documentary called "How We Are Killing Ourselves - Wireless Radiation" (in which I was involved and featured), created a lot of "buzz;" subsequently, the Mayor of Haifa (the 3rd largest city in Israel and an international hi-tech hub) announced that he will remove the Wi-Fi from schools for health concerns and install wired networks instead. Haifa has become the first city in the world to take such action.

We hope that the Haifa mayor decision mark a change in trend and that other cities will follow his lead and act to protect the children, install wired internet networks and will ensure that the school environment does not expose the children to unnecessary radiation.

Following are some links about my actions in regard to Wi-Fi in schools and for my story. .

Please see my interviews and my story.

TV interview on Channel 1 English News "Parents Fight Wireless Radiation in Schools".

New York Magazine article "What It's Like to Be Allergic to Wi-Fi" featuring Dafna's ES journey.

TV Documentary "How We Are Killing Ourselves – Wireless Radiation".

Time Magazine Movie – "Searching for a Golden Cage" about the difficulties of ES.

Radio interview with KBOO about the Wi-Fi case.

My Bio:

We Are The Evidence Founder, **Dafna Tachover**, is an attorney both in New York and Israel, and received her degree in the UK. She also has an MBA and has had a diverse international legal and business career. She gained a technical understanding of wireless networks and infrastructures as a Communications and Computer Officer in the Israeli Defense Forces, where she was the Commander of the computer center in the Israeli Defense Force's Operations Center and Headquarters.

In 2009, she developed Electromagnetic Sensitivity from wireless technology radiation. Since then, she has dedicated herself to exposing the epidemic of sickness caused by this technology; to protecting the rights of the injured; to eradicating the misrepresentation that wireless technology is safe; and to pursue those who betrayed the public's trust. She also has been fighting the deployment of Wi-Fi in schools. Her work includes public speaking engagements, educating the medical profession, generating media initiatives and interviews, lobbying, consulting and litigation. She has been one of the leading advocates on this topic globally.

Thank you,

Dafna

--
Dafna Tachover, CEO

We Are The Evidence
Wireless Technology Injured Advocacy Group

Attorney (NY, Israel), MBA
US Number: (845) 377 0211
Israeli Number: 03-763 9673

WeAreTheEvidence.org
EHS Fight Back

Sent from my WIRED internet connection

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Comments for the Council Meeting Monday - please acknowledge receipt

1 message

Susannah Goodman <susannah.goodman64@gmail.com>
To: rachel.hess-mutinda@maryland.gov

Fri, Sep 16, 2016 at 11:25 AM

Dear Members of the Maryland's Children's Environmental Health and Protection Advisory Council:

I am a mother of a 5 year old child. We live in Chevy Chase MD. I really applaud the Council for drafting such an important report and I support its recommendations.

As a parent I protect my child from known and even possible harms. I do this with a state of the art car seat, by putting away harmful soaps and detergents, getting rid of all the asbestos and lead paint in our house, by buying bicycle helmets and by countless other means. And yet, sending her to kindergarten this year I realized I was putting her in harm's way. We have one of the best public elementary schools in the county two doors away. But the school has no regulation on wifi and the children are not protected from the harmful impacts of non ionizing radiation.

More literature is evolving every day which details the impact of wifi on our biological systems. For example, Dr. Martha Herbert is a Harvard Medical School pediatric neurologist and neuroscientist who has extensively reviewed the medical literature pertaining to the link between exposure to nonionizing radiation and neurodevelopmental disorders. After her extensive review of the literature and publication of peer reviewed studies on the matter she wrote to Montgomery County Public Schools. Below is an excerpt from her 8 page letter. She wrote:

"Radiofrequency electromagentic 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 I the first place."

That is why I am so grateful to this Council for courageously taking on this issue so we as parents can know we are doing the best for our kids by sending them to schools in our own neighborhoods paid for with our own tax dollars. It is my hope that this study will lead to a safer environment for all of our kids and that in the future Montgomery county school children will benefit from access to technology without being harmed by radiation exposure.

The International Agency for Research on Cancer has concluded that radiofrequency radiation is a possible human carcinogen along with lead. We regulate lead exposure in schools. We should regulate radiofrequency radiation. This report is a necessary first step.

Thank you

Susannah Goodman

Chevy Chase, MD

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

No cell towers in school grounds

1 message

Nadia Azumi <nadia@absolutejapan.com> Sat, Sep 10, 2016 at 4:48 PM
To: ematsui@jhmi.edu, rachel.hess-mutinda@maryland.gov, emily@marylandpirg.org, guy.guzzone@senate.state.md.us, amezu@msde.state.md.us, allison@mdehn.org, Angela.Angel@house.state.md.us, benoythomas@gmail.com, brandi.stocksdale@maryland.gov, Varney-Alvarado@dhcd.state.md.us, christina.church@maryland.gov, dbishai@jhsph.edu, dianna.abney@maryland.gov, gdiette@jhmi.edu, lornegarr@msn.com, bgitterman@aol.com, jlcarella@msn.com, julianlevy@comcast.net, megan.latshaw@aphl.org, cliff.mitchell@maryland.gov, nancy.servatius@maryland.gov, nobot@cehn.org, rob.hofstetter@maryland.gov
Cc: theodorams@aol.com

Dear Maryland Children's Environmental Health and Protection Advisory Council Members,

Schools should be safe environments for children. Currently schools across the state are placing cell towers on school grounds unaware of the many health and safety risks they pose. Cell towers emit radio-frequency radiation and children will be exposed long term to this radiation when cell towers are installed on school grounds. In addition, the tower installation includes diesel tanks, lead acid batteries and thus is considered a HAZMAT area.

Please make a strong recommendation to the State Department of Education that schools PROHIBIT cell towers on school grounds.

Please make a strong recommendation to the General Assembly that schools PROHIBIT cell towers on school grounds.

Please make a strong recommendation to the General Assembly that the Department of Health be allocated funds to do research on electromagnetic radiation and children's health.

Although health issues have not been established (which I am certain they have) this is very detrimental to the health of growing children. I have been an advocate against cell towers for over 10 years, and strongly suggest that you REALLY look into the side effects of radiation.

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Please recommend a prohibition of cell towers on school grounds

1 message

Amelia McGhee <acmcghee@verizon.net> Sat, Sep 10, 2016 at 10:45 PM
To: ematsui@jhmi.edu, rachel.hess-mutinda@maryland.gov, emily@marylandpirg.org, guy.guzzone@senate.state.md.us, amezu@msde.state.md.us, allison@mdehn.org, Angela.Angel@house.state.md.us, benoythomas@gmail.com, brandi.stocksdale@maryland.gov, Varney-Alvarado@dhcd.state.md.us, christina.church@maryland.gov, dbishai@jhsph.edu, dianna.abney@maryland.gov, gdiette@jhmi.edu, lornegarr@msn.com, bgitterman@aol.com, jlcarella@msn.com, julianlevy@comcast.net, megan.latshaw@aphl.org, cliff.mitchell@maryland.gov, nancy.servatius@maryland.gov, nobot@cehn.org, rob.hofstetter@maryland.gov

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See 25 Reasons Cell Towers Have No Business On or Near School Property by The Maryland Coalition To Halt Cell Towers at Schools for a detailed list of health and safety concerns. http://www.safeschoolspg.org/joint-statement-of-the-maryland-coalition-to-halt-cell-towers-at-schools.html and this recent Washington Post article which highlights the need for tougher standards nationwide. http://www.washingtonpost.com/wp-dyn/articles/A35421-2004Dec29.html

Many thanks,

Amelia McGhee

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

Please Read about Cell Towers on School Ground

Liz Doonan <doonanz9@gmail.com> Sun, Sep 11, 2016 at 4:56 PM
To: ematsui@jhmi.edu, rachel.hess-mutinda@maryland.gov, emily@marylandpirg.org, guy.guzzone@senate.state.md.us, amezu@msde.state.md.us, allison@mdehn.org, Angela.Angel@house.state.md.us, benoythomas@gmail.com, brandi.stocksdale@maryland.gov, Varney-Alvarado@dhcd.state.md.us, christina.church@maryland.gov, dbishai@jhsph.edu, dianna.abney@maryland.gov, gdiette@jhmi.edu, lornegarr@msn.com, bgitterman@aol.com, jlcarella@msn.com, julianlevy@comcast.net, megan.latshaw@aphl.org, cliff.mitchell@maryland.gov, nancy.servatius@maryland.gov, nobot@cehn.org, rob.hofstetter@maryland.gov

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Thank you so much,
Elizabeth Doonan
412 Whitestone Rd.
Silver Spring, MD
20901

MARYLAND

Rachel Hess-Mutinda -DHMH- <rachel.hess-mutinda@maryland.gov>

The NTP report findings for the Wi-Fi Report

1 message

theodorams@aol.com <theodorams@aol.com> Mon, Sep 12, 2016 at 1:33 PM
To: cliff.mitchell@maryland.gov, rachel.hess-mutinda@maryland.gov

Dear Dr. Cliff Mitchell,
Please see the document by esteemed scientist Dr. Adlkofer on the NTP study and please include this in the Council WiFi Report. Please share this with the Council so they have answers to their questions about the findings of the NTP study. If they are relying on analysis by the media (as stated in the last meeting) for their information they will be misinformed.

Also- the report should be on all radiofrequency radiation exposures in classrooms- not just Wi-Fi specific. The technology prgrams in schools are utilizing various RF frequencies.

Thank you, Theodora Scarato

NTP Study Adlkofer_Pandora.pdf
159K

News from the NTP Study

Franz Adlkofer
Pandora – Foundation for Independent Research

In May 2016, after a considerable delay, first results were published of a study by the U.S. National Toxicology Program (NTP) on the effects of long-term exposure of rats to mobile phone radiation. They confirmed what the mobile phone industry and its mercenaries in science have disputed as preposterous to reason until today: that a carcinogenic potential is inherent to mobile phone radiation. The authors of the NTP study openly admit that they themselves were surprised by this outcome of their research on mobile phone radiation.

In the NTP study rats were exposed – starting in the uterus of the pregnant animals and after birth for two years – to either CDMA or GMS mobile phone radiation that was common in the United States 17 years ago when the study was planned. Exposure with SAR values of 0.0, 1.5, 3.0, and 6.0 W/kg was carried out in cycles of 10 minutes on and 10 minutes off. During their 18-hours stay in the exposure cages – 9 hours under radiation – the animals could freely move around. After evaluating the study, the authors claimed that malignant glioma in the brain and benign schwannomas in the heart could only be detected in a small percentage of the male rats.

On June 8, 2016, during the BioEM2016 in Ghent, Belgium, the results of the NTP study were presented.

In his report for the Pandora Foundation and the Competence Initiative Dariusz Leszczynski summarizes his impressions[1] of the evaluation's current state as follows:

The most anticipated event of the BioEM2016 was the last moment addition of the presentation of the US NIEHS National Toxicology Program study on effects of cell phone radiation in rats and mice. The 8 am Wednesday plenary session, provocatively titled, "Hot Topic Plenary: The US NTP Study: A Real Game Changer or Just Another Study?" presented by Myles Capstick of the IT'IS Foundation and Michael Wyde of the US NIEHS NTP.

Myles Capstick presented briefly the exposure set up for the NTP study. If anyone wishes to do replication using the same exposure equipment may forget it. The equipment was already dismantled and in some way disposed. The exposure chambers do not exist anymore. It was too costly to keep them after the exposure of animals was over. Of course, it is necessary to remember that due to a rapid technological development over the period of the execution of the NTP study the chambers, with all associated electronics, has become obsolete. Furthermore, the chambers were built for the 2G technology exposures vanishing from the consumer market, replaced by the 3G, 4G and soon the 5G.

The results of the NTP study were presented by Michael Wyde. In essence, all that Michael presented was already known from the NTP Study Draft.

However, there was some additional information, the results of the comet assay, indicating the possible DNA damage caused by the RF-EMF exposure for rats and mice (see the table).

MALE						
Rats	CDMA	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
	GSM	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
Mice	CDMA	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
	GSM	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
FEMALE						
Rats	CDMA	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
	GSM	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
Mice	CDMA	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
	GSM	Frontal cortex	Cerebellum	Hippocampus	Liver	Blood
	statistically significant trend and pairwise SAR-dependent increase					
	statistically significant trend or pairwise increase					
	no significantly different but increase in two or more groups					

[1] https://betweenrockandhardplace.files.wordpress.com/2016/07/bioem2016_report-_dl_final1.pdf

At this point, without more detailed information on experimental results, it is not possible to say whether the statistically significant effects are real or a chance-finding.

There are numerous misconceptions and misrepresentations of the NTP study and its outcome. However, one thing is certain, this is the best animal study that can be done with the existing technical and financial limitations. Even with the $25 million funding, scientists cannot do all what they would like and need to do, in order to thoroughly address all issues and answer all questions.

I can't more agree with Christopher Portier, who said:

> "*This is by far—far and away—the most carefully done cell phone bioassay, a biological assessment. This is a classic study that is done for trying to understand cancers in humans. There will have to be a lot of work after this to assess if it causes problems in humans, but the fact that you can do it in rats will be a big issue. It actually has me concerned, and I'm an expert.*"

Further on, he continued:

> "*The NTP does the best animal bioassays in the word. Their reputation is stellar. So if they are telling us this was positive in this study, that's a concern.*"

... [Christopher Portier is a retired head of the NTP who helped launch the study.]

There have been complaints that (i) the radiation dose was very high and (ii) the whole body was exposed. But we need to remember that this is toxicology research, where animals are intentionally exposed to very high doses of the tested compounds; doses so high that humans will never encounter such exposures in real life. This is the way to determine whether the tested compound causes health problems to animals; if it does, it means that it is possible that also human health might be affected. It does not prove that human health will be affected in the same way, but it shows that the possibility exists and that humans should be careful.

The approach to use very high doses of cell phone radiation in the NTP study followed from the two tests performed before the actual 2-year test began (a 5-day pilot and 28-day pre-chronic toxicology study). These tests looked for the highest possible dose tolerated by the animals. Even the highest of the selected doses were tested to be tolerated by the animals - not increasing the body temperature more than the ICNIRP's recommended 1°C.

The whole body exposure of the animals has been criticized for the reason that humans get predominantly head exposure. Exposing only heads of rats and mice would require, as in some previous studies, a Ferris wheel type set-up. This would involve lots of handling of the animals by the personnel and would limit the time available for exposures. Housing free animals in cages allows longer exposures (up to 9 hours/day) and causes less stress due to the handling of animals (no frequent putting in and removing as when using the Ferris wheel).

Of course, also freely moving rats and mice, normally living in packs, experienced e.g. social stress of living lifetime alone in single-housed cages.

A commonly misunderstood issue is the transfer of knowledge gained with animals to humans. We cannot perform experiments on humans. Information obtained from animal studies is not directly transferable to human situation. However, animal studies have no such purpose - to provide information directly applicable to human health. Animal studies provide information whether the health of a complex living organism is affected by the examined agent. Such information is then used, in combination with epidemiological studies and laboratory in vitro studies, to determine the human health risk. Animal studies used as a supportive evidence.

Therefore, the outcome of the NTP study should be considered in the context of all the evidence from the to-date performed epidemiological, animal and in vitro studies. The combination of all the elements suggests that cell phone radiation possibly (or probably) affects human health because

- three case-control epidemiological studies (Interphone, Hardell's group, CERENAT) have shown increased risk of developing glioma in avid, long-term users of cell phone (30 min/day for 10+ years)

- several animal studies have shown increased health risk in exposed or co-exposed animals (e.g. Chou et al., Tillman et al, Lerchl's group, NTP-study).

Lack of the knowledge of the mechanism does not mean that a certain event doesn't happen. In the context of the recent study by Schmid & Kuster showing that the cell culture experiments were under-exposing cells to radiation, it is probable that the majority of the in vitro studies have shown a weak effect or lack of effects because of this under-exposure. Higher doses, as suggested by Schmid & Kuster, would certainly lead to more robust effects in vitro. Replication of some of the in vitro experiments with higher exposures might bring out some evidence of mechanism(s).

Epidemiological cohort studies, like the Danish Cohort or Million Women study, are of poor quality and cannot be used as a reliable proof of no effect.

We still do not have the definite proof that cell phone radiation causes cancer or increases risk of developing brain cancer. However, combination of the evidence from the case-control and animal studies indicates that the health risk is possible or even probable. The NTP study strengthens the evidence for the "probable health risk".

The conclusion of the "probable health risk" strengthens the call for the implementation of the Precautionary Principle in the use of cell phones. It seems that the human health risk might not only be possible rather probable; in the IARC classification, cell phone radiation could be upgraded from group 2B to group 2A.

My remarks

Based on the results of the NTP study Dariusz Leszczynski rightly demands that mobile phone radiation rather soon be upgraded from "possibly carcinogenic (2B)" to "probably carcinogenic (2A)" within the IARC's classification system. For him, however, a final proof that mobile phone radiation causes brain tumours in humans is still pending. Yet, I am of the opinion that research already provides the highest grade of certainty it is able to for the causality of a link between mobile phone radiation and the development of brain tumours also in humans. Still open to me is only the question of how high the brain tumour risk really is. For the time being the question hangs over us like a sword of Damocles.

Here are my reasons:

1) A review article by Phillips et *al.* [1] and a report from the BioInitiative [2] both show, it was discovered already many years ago that *in vitro* research could prove the genotoxic potential of radiofrequency radiation. Yet, the results did not receive the importance they deserved as they could not always be replicated in follow-up studies – either intended or because of incompetence or for biological reasons – or as in case of the REFLEX study when fabrication was wrongfully claimed in order to get rid of its findings. The REFLEX study showed that GMS-modulated mobile phone radiation causes DNA strand breaks in isolated human fibroblasts and granulosa cells from rats and proved this with the Comet Assay [3]. Similar results were obtained with UMTS-modulated mobile phone radiation, the genotoxicity of which seems to be even higher than that of GSM [4]. Using the same assay, the NTP study has now shown similar DNA damages in the radiation-exposed male and female rats.
2) The authors of the NTP study euphemistically describe the observed numbers of tumours in the rats as being very low. However, if we add the percentage of hyperplasia of the cell types from which the detected glioblastoma and schwannoma originated the tumour rate increases to a remarkable 8.5% [5]. The existence of pre-carcinogenic alterations – and these are the hyperplasia – allows the conclusion that tumour incidence would have been higher in case the study had been prolonged by several months. Yet, the NTP researchers decided against a prolongation. Furthermore it is important to know that, based on the selected statistical procedure, the probability to expect a significantly increased tumour rate was rather low from the beginning. The fact that nevertheless this did occur lends additional weight to the study.
3) The NTP study is not the only extensive one in which rats showed tumours after exposure to radiofrequency radiation. As Joel Moskowitz reports, the U.S. Air Force carried out a first study

between 1980 and 1982 – probably within the secret Pandora Project of the U.S. Government – in which 18% of the 100 male rats, exposed for two years to radiofrequency radiation of low intensity, showed tumours. While in the sham-exposed group of also 100 rats only 5% developed cancer, the relative cancer risk for the exposed group was 4.46. The course of the study was documented in nine technical reports. Ten years later Chou et *al.* summarized the results and published them in the scientific journal *Bioelectromagnetics* [6]. Even if the sites of the tumours were quite different compared to the NTP study – probably depending on the different types of radiation: here radar, there mobile phone radiation – the carcinogenic potential of radiofrequency radiation is substantiated with this study, too.

4) While Dariusz Leszczynski generally mistrusts the reliability of epidemiological studies because of the rather inadequate dosimetry, I am of the opinion that the vague measurement of the radiation intensity must even be seen as a confirmation that a brain tumour risk does exist. There is no doubt, that the members of the study group of long-term and frequent users of mobile phones in which compared to the not or at least less exposed control group the increased brain tumour risk was found are not at all exposed to the same radiation intensity. This Intensity might have differed by a factor of 20 or even more depending on the model of the mobile phone used, the way of how it was used and the location of where it was used. From this it can be assumed that the calculated average brain tumour risk of the study group is exclusively caused by the much higher brain tumour risk of its heavily radiation-exposed members. Based on the fact that in several epidemiological studies an increased brain tumour risk was indeed detected, the often repeated statement '*if there is any brain tumour risk, this must be very low*' is a quite questionable one.

5) There is yet another reason to assume a causality of the relation between exposure to mobile phone radiation and brain tumours detected in epidemiological studies; because conspicuous is the fact that the epidemiological studies showed in long-term and frequent users of mobile phones among the many possible tumour types nearly concurring with an increase of malignant glioma and acoustic neurinoma. That the originating cells of these tumour types are identical with the ones from which also the brain and heart tumours of the exposed rats in the NTP study developed might be coincidence. However, regarding the numerous cells in humans and in rats which were exposed to an obviously identical kind of radiation and which did not react like glioma and schwannoma cells, this seems much less likely to me than the hypothesis that there is a specific process leading to the same result for humans and for rats.

6) The strongest argument, widely used by the scientific mercenaries of the mobile phone industry in order to on principle exclude a brain tumour risk of mobile phone users, is the claim that despite an increase of up to 6 billion users in the meantime the brain tumour rate to a great extent has remained the same worldwide. However, this claim seems to be based mainly on unreliable national cancer statistics [5]. Regarding glioblastoma, one of the most malignant tumours in humans, the year-by-year increase was 3.1% in the Netherlands between 1990 and 2010, while the total brain tumour rate did not increase. There seems to be a comparable trend in the United States. In addition, it turns out there that glioblastoma developed mainly in the frontal lobes of the brain, which are most intensely exposed to mobile phone radiation. In Sweden the number of people, who died because of a brain tumour of unknown nature between 2008 and 2013, rose by 157% [6]. In Denmark a previous report on an increase of brain tumours in humans now seems to be kept under lock and key [8].

A risk assessment applying scientific criteria has to consider the results of the triad *in vitro*-research, animal studies and epidemiology. If these so clearly point to the same direction as they do with mobile phone radiation, we are confronted with the question what still has to happen until this radiation is acknowledged as carcinogenic to humans and until it is classified in the IARC's system accordingly. **In the opinion of Karl Friedrich von Weizsäcker (a famous German scientist and philosopher) there is no problem which could not be solved by our common ability to reason, yet our political system, our social situation, and our mental state make it nearly impossible.** To me this lack of a common ability to reason is especially conspicuous when it comes to health and environmental topics, where as a rule industry and its economic interests are generally conceded more reason than organizations that care for the protection of mankind and nature [9].

How the mobile phone industry is dealing with science so far is an example for this misconception. The many scientists secretly or openly tied to the mobile phone industry all over the world together with certain especially cash-hungry media will most probably prevent that the public is truthfully informed about the biological effects of mobile phone radiation and that it is in no way protected against the obvious health risks. When some day the increase in health damages cannot be denied anymore, politics and mobile phone industry will probably fall back on an apparent solution already used in the case of the tobacco industry. By printing a warning on mobile phones such as '*using mobile phones is a hazard to your health*' it would be achieved that the affected ones themselves are made responsible for their illness and that, in addition, the mobile phone industry is released from any product liability. And business could go on blithely ...

References

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3. Diem E, Schwarz C, Adlkofer F, Jahn O, Rüdiger H: Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro. Mutation Research (2005) 583 178–183
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Recommendations to the Maryland Children's Environmental Health and Protection Advisory Council

On the Children's Health and Radiofrequency Exposures Report

Clifford S. Mitchell, M.D.
Maryland Children's Environmental Health and Protection Advisory Council
% Rachel M. Hess-Mutinda
Maternal & Child Health Bureau
Prevention & Health Promotion Administration,
Dept. of Health & Mental Hygiene
Herbert R. O'Conor State Office Building,
201 West Preston St.,
Baltimore, MD 21201 - 2399

September 12, 2016

Dear Dr. Clifford S. Mitchell;

We are writing you in strong support of the Maryland Children's Environmental Health and Protection Advisory Council's recommendations to reduce children's exposure to radiofrequency radiation, in the Council's draft report. We offer this information and our recommendations to include in your final report.

Children and Radiofrequency Radiation

Radiofrequency radiation constitutes a significant environmental exposure for children in schools and at home. Schools are rapidly integrating cell phones and wireless technology into classrooms. The radiofrequency electromagnetic (RF--EMF) radiation environment in classrooms is significant because of the high numbers of radiation emitting devices (laptops, tablets, cell phones, ceiling mounted access points, virtual reality) in use for long periods of time in each classroom.

As the US EPA has detailed, FCC regulations were set intending to protect from thermal effects only and not intending to protect from non-thermal effects from long-term chronic exposures. Since, the World Health Organization's International Agency for the Research on Cancer classified radiofrequency radiation as a Class 2 B Carcinogen in 2011, evidence has significantly increased that long-term radiofrequency radiation exposure causes cancer. It has been scientifically demonstrated that adverse biological effects can occur at non-thermal levels of radiofrequency fields. A recent animal study performed by the National Toxicology Program in the United States found an increased incidence of cancer and increased DNA damage in rats with prolonged exposure to radiofrequency fields that were too weak to increase temperature. FCC regulations do not provide adequate protection for children as the regulations do not account for biological effects at these *non-thermal* levels.

The American Academy of Pediatrics states children are more vulnerable to radiofrequency radiation exposures due to their unique anatomy and physiology, and rapid development. Considering that children will have a lifetime of exposure, it is critically important to reduce childhood RF exposures in schools where children spend most of their daytime childhood hours.

Recommendations to the Department of Health

The Department of Health should advise the public on ways to reduce radiofrequency exposure from cell phones and wireless devices, with special emphasis on protecting children. For example, the Connecticut Department of Health **issued specific recommendations to reduce exposure to cell phone radiation**

stating, *"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 Department of Health should create and maintain a webpage with information on how to reduce exposure, just as the Connecticut Department of Health and San Francisco and Burlingame in California have done.

> Note: The governments of France, Belgium, Canada, Austria, the United Kingdom (UK) , India, Australia, Germany, Switzerland, Israel, Finland, Greece, Russia, Switzerland, Cyprus, Singapore, Turkey and the Council of Europe all have online public resources specifically recommending that children's exposure should be reduced or minimized, and governments provide resources detailing how the public can reduce exposure to radiofrequency radiation. As the UK ministry states, *"Government advice is to be on the safe side and limit mobile phone use by children."*

Countries such such as France, Israel, Germany, and the state and local governments of Ghent Belgium, Navarra, Vitoria, and the Basque Parliament of Spain, South Tyrol Borgofranco d'Ivrea, Piemonte and Turin Italy, specifically recommend against Wi-Fi or have outright banned Wi-Fi in daycare centers, kindergartens and/or schools. When the plan to remove Wi-Fi from all Haifa Israel schools was announced, Haifa Mayor Yona Yahav was quoted stating, "*When there is a doubt, when it comes to our children, there is no doubt.*"

The Department of Health should provide resources that inform doctors and other clinicians about advising patients how to reduce exposure *and* how to clinically assess Radiofrequency (RF) exposure during patient visits. The Department of Health can create a Factsheet for Parents and a Factsheet for Clinicians that includes interview questions to ask during patient visits.

The Department of Health should provide information to obstetricians and gynecologists so they can provide information to patients about how to reduce exposures during clinic visits. Please see the BabySafe Project for examples of resources to share with pregnant women.

Recommendations to Schools

Reduce Radiofrequency Field Technology ALARA (As Low As Reasonably Achievable)

In order to reduce classroom RF exposures schools should install Low RF-EMF technology and reduce radiofrequency radiation exposures according to ALARA (As Low As Reasonably Achievable) principles. To reduce children's RF exposure in classrooms, schools can:

- Install corded (non-wireless) LAN systems in classrooms so that teacher and student computers (portable and desktop) connect to the internet without RF radiation exposures.
- Install corded (not cordless) telephones in all classrooms for voice communication and security.
- Choose non-wireless options for all other technology communication such as printers, security, mouse, keyboard, video cameras, HVAC, speakers, headphones, microphones and other accessories.
- Include information on FCC fine print warnings in the Bring Your Own (Mobile) Device (BYOD) Policy.
- Provide adaptors and accessories for personal devices so that devices can be used without radiation emissions in classrooms when needed as classroom tools.
- Post reminder notices in classrooms instructing device users to turn off Wi-Fi, Bluetooth, and any other wireless settings on devices and accessories that connect non-wirelessly.
- Prohibit cell towers near and on school buildings and grounds.

Partial RF Reduction Measures in Schools

The following measures are not fully protective but may provide a *partial* reduction in radiation exposure. *However, fully wired (non-wireless) systems will eliminate the RF exposure from school technology. With partial or half-measures, children will continue to be exposed to significant RF radiation emitted by wireless devices and by all the building's access points (which transmit radiation continuously) whether exposed as users or bystanders.*

- Ensure all computers, tablets and laptops are used on a table and NOT on a student's lap.
- Ensure students' heads and bodies are at maximum distance from all wireless devices (e.g., children should not lie on the floor with their heads inches from the laptop screen, nor should the lid of the computer behind them be near their back or head.)
- Install a switch for the teacher to turn Wi-Fi routers and access points OFF in classrooms when not in use.
- Plan for wireless download of applications and content onto devices to occur *outside of* school hours. Therefore during the school day the device will be fully loaded and the device's Wi-Fi antennae (and WiFi router or access point) can be turned off while children are using devices.
- Allow students who want to avoid RF to use ethernet and other corded connections for their computers. Most classrooms *already* have an ethernet port on the wall to plug into.
- Ensure that the wireless antennas are always OFF on BYOD Devices.

Note: In several school districts some grades use digital devices in most of their academic classrooms and, thus, partial halfway reductions such as "turn it off when not in use" will have minimal impact as the devices are "in use" for several hours each day. Therefore, the most effective means to reduce exposure for maximum protection is to ensure the school infrastructure is 100% hardwired with ethernet connections.

Educational Curriculum for Schools

- Teach student and teachers *why* and *how* to reduce radiation exposure from technology devices as part of digital citizenship curriculum for students and for staff training.
- Offer educational workshops for parents to learn how to decrease RF exposures at home.
- Post RF reduction "Best Practices" in every classroom.

Manufacturer's Instructions in Cell Phones and Wireless Devices

As digital devices are used as classroom tools, the Department of Education should ensure that students and staff are aware of the FCC instructions for devices they use.

- Students and staff should be informed that wireless devices emit RF radiation and that the device manual specifies separation distances that are necessary between persons and emitting machines in order to avoid exposure that exceeds FCC guidelines.
- Students need to be aware that most laptop instructions specify the separation distance must be at least 20cm (approximately 8 inches) and most cell phone instructions specify a distance under an inch (depending on the make and model). Most districts have (or are moving towards) a Bring Your Own Device Policy, so a variety of models are in use in classrooms.

  Please note that the Queensland Department of Education, Training and Employment issued Your Guide to Safe Technology, a guide that informs students that *all wireless devices emit low levels of electromagnetic radiation and students should follow the manufacturer's usage guideline.*

Recommendations to the General Assembly

The General Assembly should consider:

- Funding a public health education initiative on electromagnetic radiation and health.

- Right To Know Legislation requiring that the public is clearly informed that cell phones and "wireless" devices emit radiofrequency radiation and how the public can reduce exposure.
- Legislation that reduces RF exposures to the public with special consideration for child care centers, schools, community centers, municipal buildings and hospitals and other healthcare settings.

Sincerely,

Devra Davis, PhD MPH
President and Founder Environmental Health Trust
Visiting Professor Hebrew University Hadassah Medical Center

Anthony B Miller, MD, FRCP
Professor Emeritus
Dalla Lana School of Public Health
University of Toronto

Annie Sasco, MD DrPH
Director of Epidemiology for Cancer Prevention
University of Bordeaux, France
Former Unit Chief of Epidemiology for Cancer Prevention at the International Agency for Research on Cancer

Alvaro Augusto de Salles, Ph.D.,
Professor Federal University of Rio Grande do Sul-UFRGS, Porto Alegre, Brazil

Mary Redmayne, PhD.
Adjunct Research Fellow, Victoria University of Wellington, New Zealand.

Meg Sears PhD
Chair, Prevent Cancer Now

Radiofrequency Radiation Exposures to Children in Schools
Comments to the Maryland Children's Environmental Health and Protection Advisory Council
On the Children's Health and Radiofrequency Exposures Report

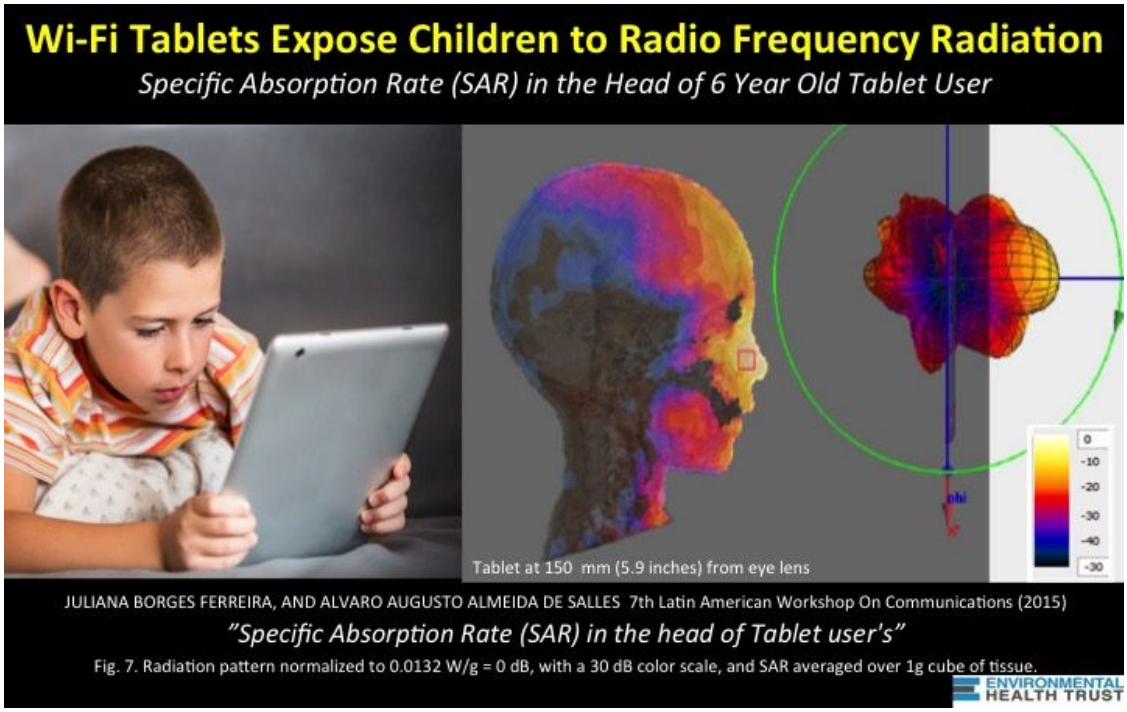
This document contains comments to the Draft WiFi Report to be discussed by the Council on September 19, 2016.

What radiofrequency radiation (RF) exposures are children receiving while in schools?

RadioFrequency exposure to children is cumulative (it adds up over time), involuntary (they are unaware and have no choice) and comes from multiple transmitters in the current classroom environment. Children spend most of their time at home and in schools and that is why school exposures are a critical area of exposure for children.

The school environment is unique in that it has a *high density* of radio frequency transmitters in a *small* space. Sources of radiofrequency radiation in classrooms include WLAN access points, cell phones, fitness trackers, wearables *and* wireless tablets, laptops, computers, clickers, mouse, printer, virtual reality and gaming devices. Many schools have a cell tower on school land with radiation coming into classrooms through windows which face the antennas. In addition, some schools have wireless security systems, speakers, paging systems and video cameras. **None of these exposures existed in classrooms a mere decade ago.** They represent a new daily exposure for children.

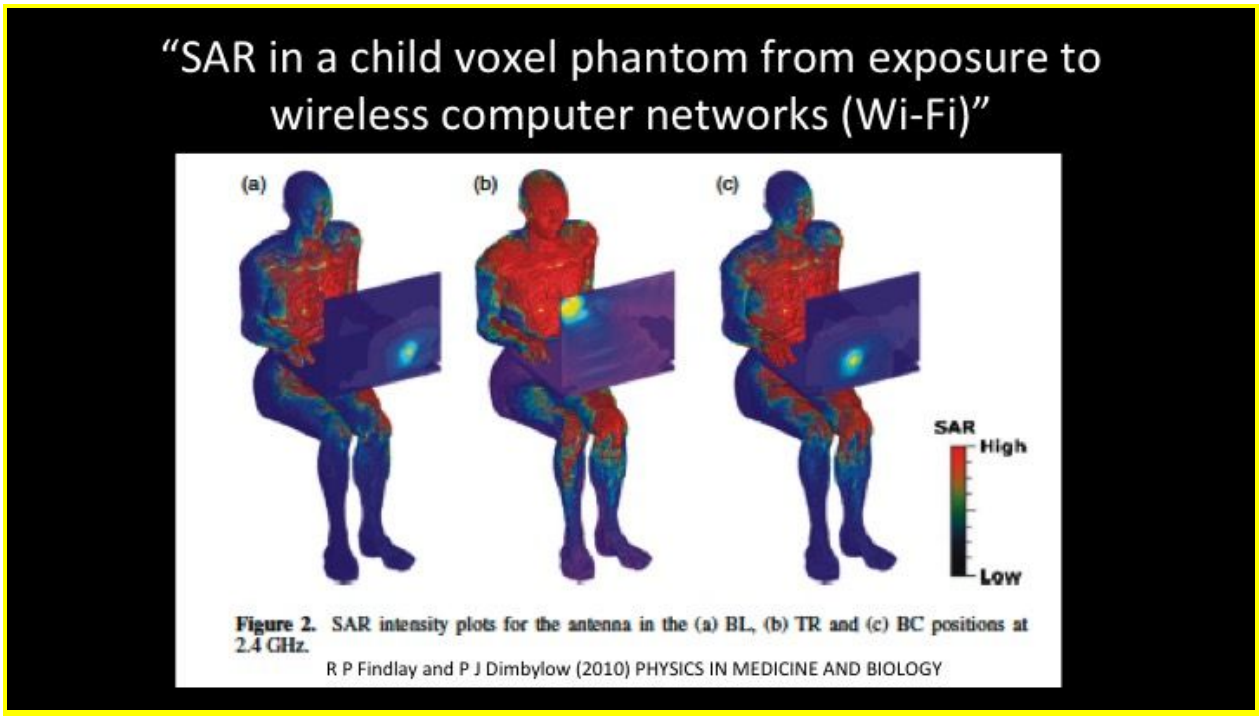
As an example, a classroom of 30 middle/high school children may have radiation from 31 wireless laptops, 31 cell phones, one high density access point, a wireless printer, 30 wireless class clickers, at least ten fitbits or wearable fitness monitors (connecting to the student's cell phone continuously) *at a minimum.* Even preschool and kindergarten children use wireless tablets daily. Younger grades often utilize wireless tablets with a wireless keyboard and by third grade many have cell phones in pockets.



Children are absorbing the highest radiofrequency radiation from ***near field*** exposures- meaning the transmitting devices nearest to them such as their cell phones and the wireless computer they are using *and* the devices in use by students sitting nearest to them. Children receive ***far field*** exposure from devices in use across the room, the Wi-Fi access point mounted on the ceiling and any outside transmitters such as a nearby cell tower.

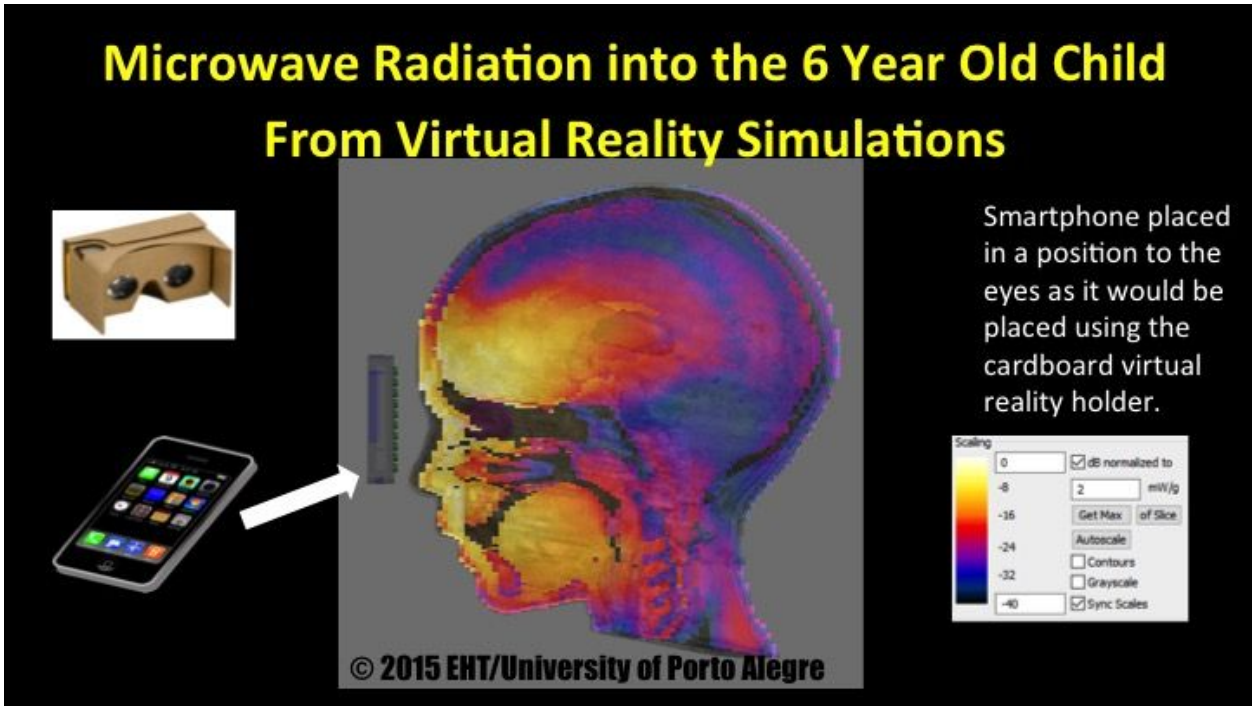
Wi-Fi radiation is not low.
Wi-Fi exposures are erroneously described as "low" because such descriptions are comparing power density levels or SAR measurements to FCC exposure regulations. Indeed, the measurements are low in comparison to FCC regulations or to International guidelines. However, it is all a matter of perspective. In fact, *extremely low levels* of radiofrequency radiation have been shown to have adverse effects. Please see the Bioinitiative 2012 Chart showing examples of published research showing health effects at such low levels of radiofrequency radiation.

For example, the slide below shows SAR intensity and how the SAR varies depending on the location of the transmitting antennae. The authors clarify how measurements are well below thermally based limits. Thermally based limits ***do not consider*** biological impacts which occur at non-thermal levels. Wi-Fi radiation penetrates the body and laptops clearly expose the head and chest to radiofrequency radiation.



Virtual reality technology in Classrooms is a growing exposure
Virtual reality field trips -whereby transmitting smartphones are placed in cardboard to the eyes of children- are becoming an increasingly classroom experience and this technology exposes children's eyes and brain to cell phone radiation **in the near field.** Last year Google brought this technology to Maryland schools as a special one time event and this year Google is making the technology more available to *schools so they can go on regular "virtual" field trips.* Please see this example of radiofrequency exposure from a smartphone

mounted in a cardboard virtual reality case as is used in many Maryland schools last year and learn more about [this scientific imaging here.]



Variables Impacting Children's Actual Exposures
The amount of radiation a child absorbs is different for each child. Wireless radiation penetrates the body differently depending on the size and unique anatomy of the child. However, research has shown that children absorb proportionately more radiation than adults. “When electrical properties are considered, a child's head's absorption can be over two times greater, and absorption of the skull's bone marrow can be ten times greater than adults “ (Gandhi et al 2011).

Coverage affects a child’s exposure. If the signal is poor in a room, the device increases power to connect. So if a cellphone has only one bar, it will put out significantly more power than if the user has all bars. Likewise, if a tablet or laptop is used wirelessly in an area of spotty coverage, the emissions are higher because more power is used to connect the laptop to the router or access point.

Building construction and room furniture can have a significant impact on total exposure because building materials reflect radiofrequency differently. For example, if a student is working at a desk facing a row of metal cabinets, radiation will be reflected *back* at the child likely increasing exposure to the child.

Due the complex high density electromagnetic environment in schools, any discussion of children’s RF-EMF exposures in schools must consider *not just* exposures from Wi-Fi access points, *but also* exposures from *all the other devices in use* in the room such as laptops, tablets and cell phones *in addition to nearby base stations.*

Radiofrequency exposures in schools constitutes involuntary exposure for children. Parents and staff need to be fully informed of these exposures just as they are for pesticide applications on school grounds.

What health outcomes are linked to radiofrequency exposure?

Scientists are in agreement that radiofrequency radiation (non-ionizing radiation) at high levels can have a heating effect which is damaging to health because the heat damages tissue, causing blindness sterility and other health issues. Current government FCC exposure limits are set to protect against this effect *only* despite research showing a myriad of *other* serious adverse effects from low *non-heating* levels of radiofrequency radiation.

> *"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;"- California Medical Association Wireless Resolution 2014*

Recently a report was released from The National Toxicology Program (NTP) on the largest ever animal study on cell phone RF radiation and cancer finding an increased incidence of glioma and malignant schwannoma in the heart. Thus, the research showing increased cancer risk in humans has significantly strengthened since the IARC 2011 classification as new research has been published in addition to the NTP study which repeatedly shows a significant association after long term RF radiation exposure in addition to tumour promotion after exposures at low levels.

This document will first detail issues related to the *heating effects* of radiofrequency radiation exposures and then detail issues related to the *non-heating* effects with special emphasis on children.

School children are not adequately informed nor protected from heating effects of radiofrequency radiation and are using devices in violation of FCC instructions.

In order to ensure that wireless devices do not cause hazardous heating of tissue, they are pre-market tested for radiofrequency emission levels at various distances mimicking use at a distance from the body. Every device has instructions in the safety manual stating that "in order to meet FCC limits" the cell phone or laptop must be held at a minimum of this distance away from the body. For example, many cell phones are tested at about half an inch and laptops at about 8 inches. However school children are using cell phones, laptops and other wireless tech in classes for classwork **unaware of these distances.**

Typical student mobile device use use *violates* FCC instructions. Children are carrying cell phones in pockets and bras and resting cell phones on their laps as they text or scroll the internet. Laptops are used on laps as children sit cross legged on the floor. Such common practices are seen everywhere, yet they are actually in violation of the FCC instructions and could result in non compliance with FCC radiofrequency limits. In other words, children (and staff) could be getting radiofrequency exposures *far higher* than FCC limits.

Examples of the FCC Instructions

> **Samsung 3G Laptop:** "Usage precautions during 3G connection : 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."
>
> **Blackberry Bold 9930:** "Keep the BlackBerry device at least 0.59 in. (15 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."

iPhone 4: " To be sure that human exposure does not exceed the FCC guidelines, always follow these instructions... keep iPhone at least 15 mm (5/8 inch) away from the body, and only use carrying cases, belt clips, or holders that do not have metal parts and that maintain at least 15 mm (5/8) inch separation between the iPhone and the body." To view the information on your iPhone go to Settings > General > About > Legal > RF Exposure.

HP Chromebook 14 G4
"WARNING! Exposure to Radio Frequency Radiation: The radiated output power of this device is below the FCC radio frequency exposure limits. Nevertheless, the device should be used in such a manner that the potential for human contact is minimized during normal operation of tablet PCs and notebook computers...To avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antennas should not be less than 20cm.

"...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." FCC, BULLETIN 65, 1997

Environmental Health Trust has many more examples of FCC instructions at the EHT website Page on Fine Print.

Schools have a duty of care to the students and should inform students and staff about these instructions to assure the devices- used as classroom tools- are not exposing students to radio frequency radiation *that exceed FCC limits.*

Adverse health effects have been shown to occur at radiofrequency levels below FCC limits.
Peer reviewed research has demonstrated a myriad of adverse biological effects from wireless radiation including reproductive damage, DNA breaks, creation of reactive oxygen species, immune dysfunction, stress protein synthesis in the brain, altered brain development, sleep disturbances, cognitive changes, behavioral issues and increased brain tumors.

These effects have occurred at wireless radiation exposure levels hundreds of times lower than presently legal international limits. These effects have occurred *after* exposure to devices that are government approved and legally sold to the public.

In 2016, Dr. Martha Herbert a Harvard pediatric neurologist 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." (See her slides here). At this professional symposium Yale Chief of Obstetrics Dr. Hugh Taylor discussed risks of cell phone radiation to pregnant women (See his slides here) and Environmental Health Trust' Dr. Devra Davis detailed how children were more vulnerable to radiofrequency radiation (See her slides here). Please see the Appendix for a short compilation on research for several of these health endpoints.

Several recent scientific studies have significantly added to the weight of evidence showing carcinogenic effects at non-heating radio frequency power levels.

- 2016 Results from the National Toxicology Program study found a carcinogenic effect with a dose response at non- thermal levels in male rats exposed for two years.
- 2015 Results of a 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. replicated an earlier experiment that found that weak cell phone signals can promote the growth of tumors in mice.
- 2014 Results from a French study Mobile phone use and brain tumours in the CERENAT case-control study. published in Occup Environ Med. found a statistically significant association in the heaviest users when considering life-long cumulative duration for meningiomas and number of calls for gliomas.

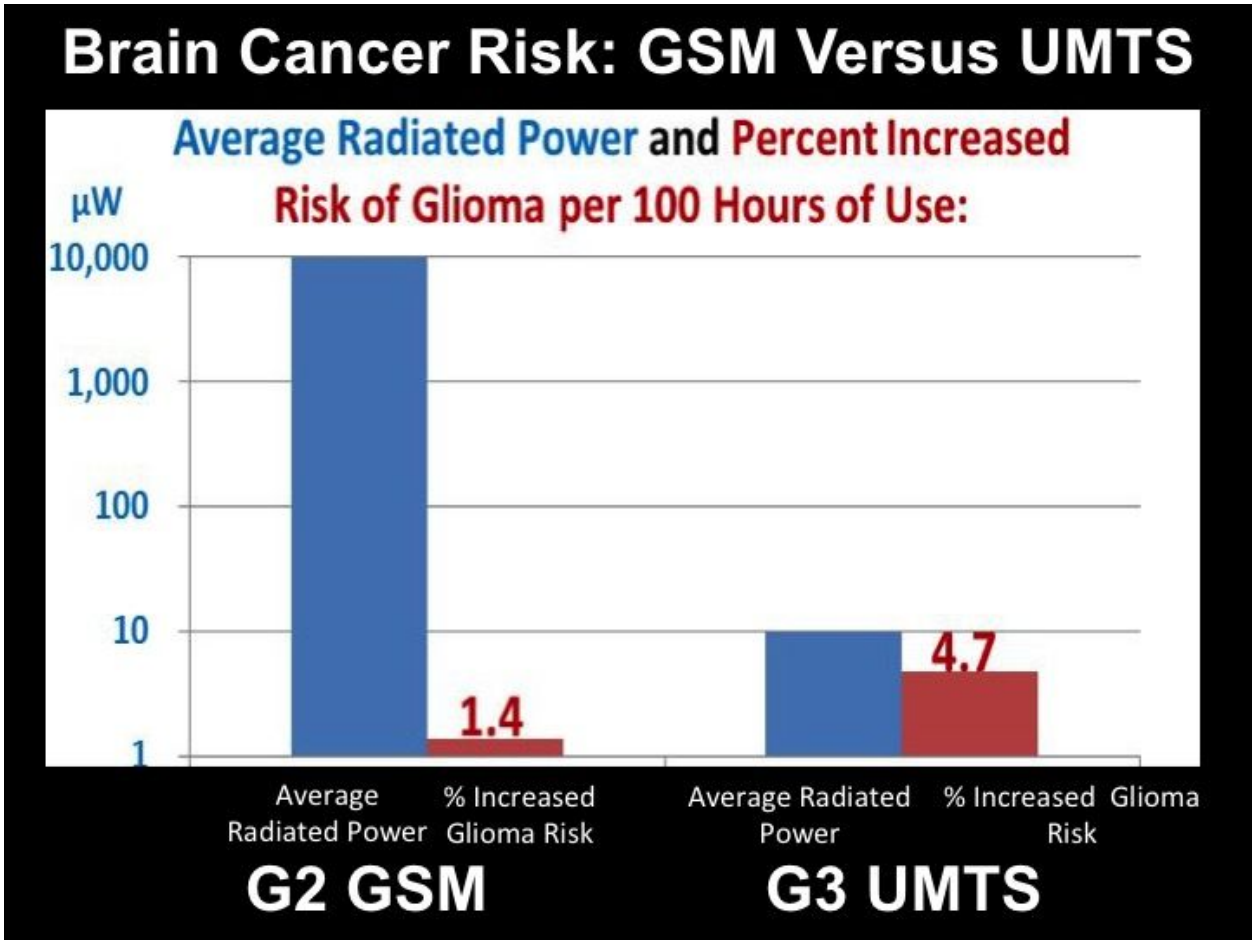
Newer Technology Could be More Dangerous - Even at Seemingly "*Low*" Power Levels.

Many schools have responded to wireless health concerns by taking power density measurements. Usually, the schools find radiofrequency levels in classrooms to be "well below" FCC limits and then school policymakers decide to keep wireless systems with the flawed assumption that radiation levels below FCC limits is equivalent to "safety". This is flawed reasoning. Meeting FCC limits *does not* ensure safety.

In fact significant research suggests *low* power may not mean *low* risk. Several studies show adverse health effects at radiation levels thousands of times lower than FCC limits. The Bioinitiative 2012 RF Color Charts summarize many studies at specific power levels that report biological effects and are relevant to compare with exposures from cell towers, WI-FI, 'smart' wireless utility meters, wireless laptops, baby monitors, cell phones and cordless phones.

As a recent example, consider the recent research that compares 2G (GSM technology) to 3G (UMTS-talk, text, and data- Smartphone technology). People usually assume, the more power you absorb, the higher the risk. However, when scientists reviewed the first ever paper that looks at brain cancer risk by type of phone used- 2 or 3 G- they came to a stunning conclusion. The *lower* power 3G UMTS phones had a higher glioma (a type of brain cancer) risk than the *higher* power 2G GSM phones. Although 3G technology has up to 1000 less power, this technology shows a more than three times for glioma in comparison to 2G. These differences speak to the complexity of understanding wireless communication exposures and how various

signal characteristics, such as modulation and waveform must be considered *in addition to power density.*



Pulsed microwaves have been shown to be more biologically active than continuous radiation of the *same* frequency and *same* power level (Pall 2013). Radiofrequency radiation reports that only document average power density in school buildings and compare the levels to FCC limits are **not** the best way to measure the safety of the electromagnetic environment. Compliance with FCC limits *does not mean* that children are safe in school.

FCC radio frequency exposure limits are inadequate to protect children.

Children are not adequately protected by outdated FCC radiofrequency exposure limits for two reasons. First, FCC regulations are not based on up to date science that considers childrens unique anatomy and vulnerability to radiofrequency. Instead FCC regulations are based on research and test methods that employ an adult male model.

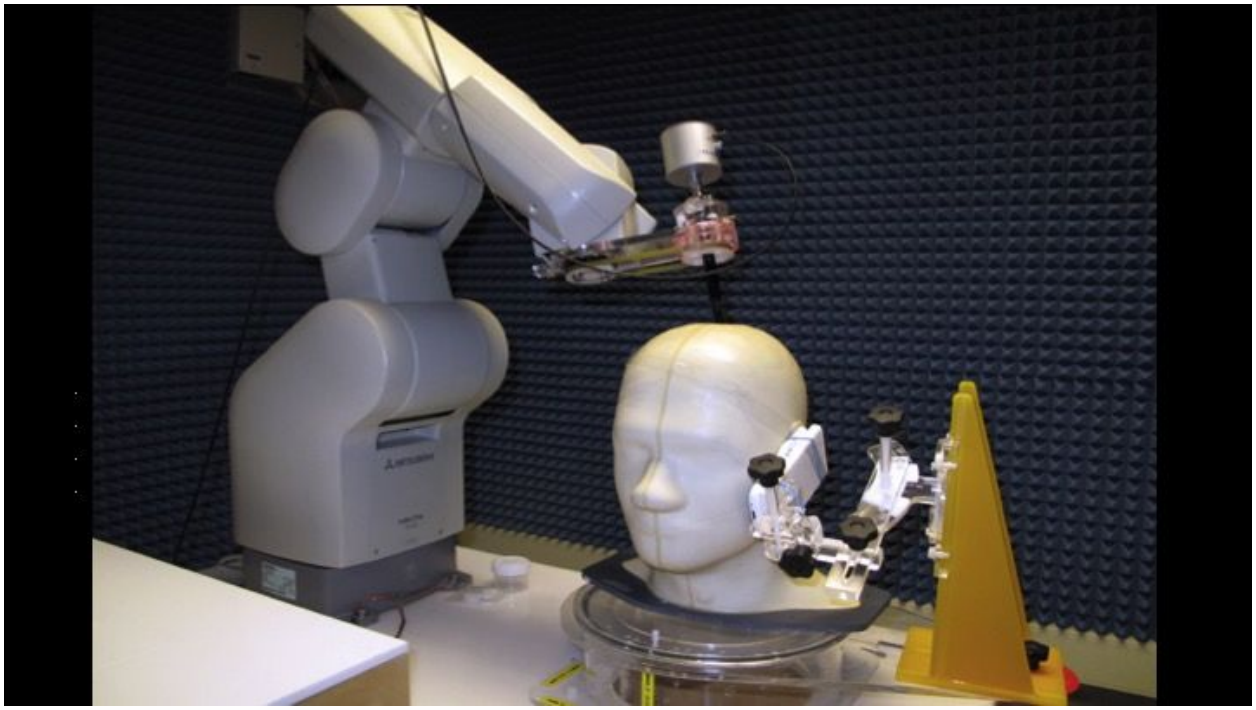
Stem cells are more active in children and research shows that microwaves impact stem cells stronger than other cells.

> *"The strongest microwave effects were always observed in stem cells. This result may suggest both significant misbalance in DSB repair and severe stress response. Our findings that stem cells are most sensitive to microwave exposure and react to more frequencies than do differentiated cells may be important for cancer risk assessment and*

indicate that stem cells are the most relevant cellular model for validating safe mobile communication signals."

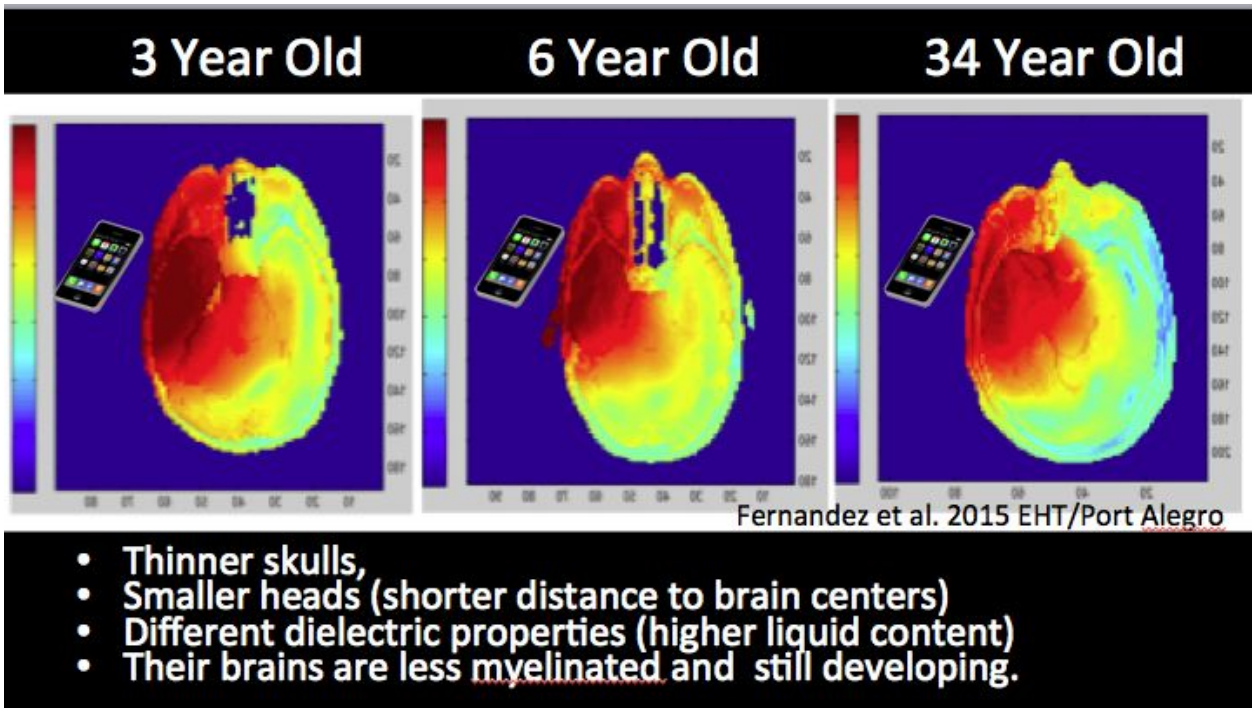
Markovà et al in [Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk,]

See below an example of the large head model used for device certification. Children have thinner skulls and more water in their tissues resulting in deeper RF absorption, yet their anatomy is not considered when such a model is utilized.

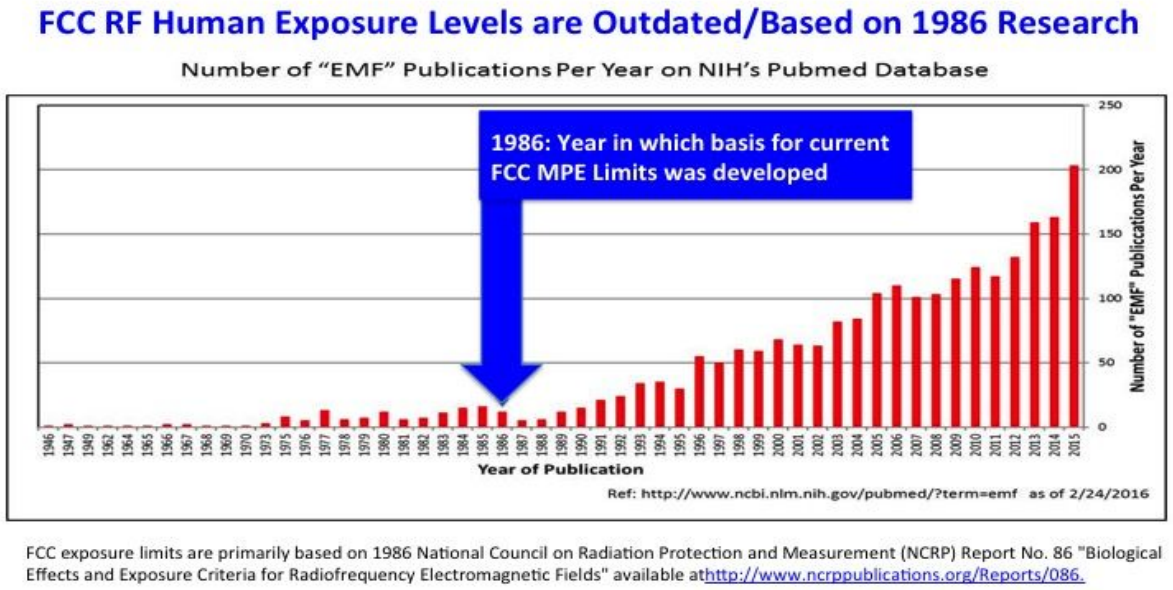


Second, the FCC has not reevaluated FCC exposure limits since 1996 when they were set based on research from a 1986 Report. Therefore, FCC regulations on human exposure to radiofrequency are out of date **by three decades.**

See these images pulled from research from a peer-reviewed paper published in the IEEE/Access entitled "Dosimetric Simulations of Brain Absorption of Mobile Phone Radiation: the relationship between psSAR and age" by Professors Claudio Fernandez and Alvaro de Salles at Federal Universities of Brazil and Devra Davis of Environmental Health Trust detailing how sophisticated computer imaging can simulate exposures of children's brains to cell phones showing children's increased RF exposure.



In the slide below please note the amount of published research (as found in Pub med) since 1986 on radiofrequency radiation.



FCC exposure limits are primarily based on 1986 National Council on Radiation Protection and Measurement (NCRP) Report No. 86 "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields" available at http://www.ncrppublications.org/Reports/086.

US government and other expert groups have repeatedly stated that FCC limits are outdated, not based on current science and have failed to consider effects on children.

In 2012, the Government Accountability Office (GAO) published their report "Exposure and Testing Requirements for Mobile Phones Should Be Reassessed" that calls on the FCC to "*formally reassess and, if appropriate, change its current RF energy (microwave) exposure limit*," and *"The Federal*

Communications Commission's (FCC) RF energy exposure limit may not reflect the latest research, and testing requirements may not identify maximum exposure in all possible usage conditions."

The FCC opened an inquiry on their outdated human exposure limits in 2013.
In response to the GAO Report, the FCC opened a pro*ceeding in 2012 to explore whether it should change 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 since 2013. In other words, nothing has changed since 1996 and no review has been completed. Instead, documents have simply been submitted. It could take years before the agency takes action and actually *reviews* the submitted documents.

" In the Inquiry we ask whether any precautionary action would be either useful or counterproductive, given that there is a lack of scientific consensus about the possibility of adverse health effects at exposure levels at or below our existing limits. Further, if any action is found to be useful, we inquire whether it could be efficient and practical." -The FCC in 2013

Several agencies and health organizations have raised concerns about FCC limits.

- T**he Department of the Interior states** that *"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 Letter.
- **The 2008 National Academy of Sciences (NAS) Report**, Identification of Research Needs Relating to Adverse Health Effects of Wireless Communication, was tasked to identify any inadequacies in the research upon which the current US Radiofrequency radiation (RF) safety guidelines are based. The NAS Report found numerous inadequacies in that research record. The report found significant research gaps in regards to children and identified a priority research area to be to "characterize exposure of juveniles, children, pregnant women, and fetuses, both for personal wireless devices (e.g., cell phones, wireless personal computers, [PCs] and for RF fields from base station antennas including gradients and variability of exposures, the environment in which devices are used, and exposures from other sources, multilateral exposures, and multiple frequencies."

- **The American Academy of Pediatrics** has repeatedly called on the government to update its regulations stating that "Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children." Read their letter to the FCC in 2013 here.
- **The California Medical Association** passed a Wireless Resolution that states :

  Whereas scientists are increasingly identifying EMF from wireless devices as a new form of environmental pollution with a growing body of peer reviewed scientific evidence finding significant adverse health and biologic effects on living organisms with exposure to low levels of non-ionizing microwaves currently approved and used in wireless communication, and

  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 it here . Read a magazine article on their resolution here.

- **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. If the FCC limits are "not outdated" then why would they do this? RADIOFREQUENCY (RF) EVALUATION REPORT Use of Wireless Devices in Educational Settings

Dr. De Kun Li sums up the problem with FCC regulations:
"In summary, we do not currently have scientific data to determine where the safe RF exposure level is regarding the non thermal effects. Therefore, it should be recognized that we are dealing with uncertainty now and most likely for the foreseeable future. The question for government agencies especially those concerned with public health and safety, is, given the uncertainty, should we err on the side of safety and take precautionary measures avoidance measures? *Unknown does not mean safe. "*
Letter from Dr. De-Kun Li, MD, PhD, MPH to the FCC

> "The FCC is not a health and safety agency, we defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe."
> -The Federal Communications Commission in 2013

Scientific authorities and expert groups worldwide have recommended reducing radiofrequency exposures.

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/

What are the policy options to protect children from this risk?

Over a dozen countries officially recommend that cell phone radiofrequency radiation is *reduced* for children and they have enacted policy that protects children.

Haifa Israel has installed Corded connections in all schools and the country of Israel officially recommends wired connections in schools. France has banned Wi-Fi in kindergartens and the Wi-Fi must be turned OFF in schools as the default setting. Belgium has banned cell phones for young children and Wi-fi is prohibited in Ghent.

Several countries have detailed public information on how the public can reduce exposure to cell phones, computers and other wireless devices. Around the world, many private schools are removing the wireless. Please see the Appendix for a full list of International Policy which can serve as useful examples to governments on policy options.

Solutions for schools exist at each level at which radiofrequency exposures are created.

These RF exposures are occurring due to choices made by school policymakers in three ways:

Purchasing: The school decided to purchase a wireless technology system W-LAN plus laptops and/or tablets for internet connectivity and classroom instruction.

Policy: Many schools are creating and passing a Bring Your Own Device Policy allowing a myriad of wireless in the classroom in addition to school issued devices.

School cell tower leasing agreements: School land is increasingly seen as a choice spot to place cell towers because schools are in need of extra funds. Some schools have monopole towers erected (for example, next to ball fields) and other schools have cell antennae directly mounted on buildings. Sometimes cell antennae are mounted near schools and the school is not directly a

decisionmaker but can be a part of the decision making process by commenting on the proposed towers.

Reductions in exposure can occur from actions at each of these levels:

Purchasing: Schools internet connectivity needs can be met by choosing Low EMF technology such as corded connections in the classrooms.

Policy: Schools can develop mobile device policy that minimizes children's exposures such as keeping tablets on tables, not laps, and ensuring cell phones are powered off during classes. .

Leasing agreements: Schools can choose not to lease to cell tower companies where radiation beams will be angled into children's play areas or into classrooms through windows facing the tower.

Recommendations to the Department of Health

The Department of Health should advise the public on ways to reduce radiofrequency exposure from cell phones and wireless devices, with special emphasis on protecting children. For example, the Connecticut Department of Health **issued specific recommendations to reduce exposure stating,** *"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 Department of Health should create and maintain a webpage with information on how to reduce exposure, just as the Connecticut Department of Health and San Francisco and Burlingame in California have done.

Note: The governments of France, Belgium, Canada, Austria, the United Kingdom (UK) , India, Australia, Germany, Switzerland, Israel, Finland, Greece, Russia, Switzerland, Cyprus, Singapore, Turkey and the Council of Europe all have online public resources specifically recommending that children's exposure should be reduced or minimized, and governments provide resources detailing how the public can reduce exposure to radiofrequency radiation. As the UK ministry states, *"Government advice is to be on the safe side and limit mobile phone use by children*."

Countries such such as France, Israel, Germany, and the state and local governments of Ghent Belgium, Navarra, Vitoria, and the Basque Parliament of Spain, South Tyrol Borgofranco d'Ivrea, Piemonte and Turin Italy, specifically recommend against Wi-Fi or have outright banned Wi-Fi in daycare centers, kindergartens and/or schools. When the plan to remove Wi-Fi from all Haifa Israel schools was announced, Haifa Mayor Yona Yahav was quoted stating, "*When there is a doubt, when it comes to our children, there is no doubt."*

The Department of Health should provide resources that inform doctors and other clinicians about advising patients how to reduce exposure *and* how to clinically assess Radiofrequency (RF) exposure during patient visits. The Department of Health can create a Factsheet for Parents and a Factsheet for Clinicians that includes interview questions to ask during patient visits.

The Department of Health should provide information to obstetricians and gynecologists so they can provide information to patients about how to reduce exposures during clinic visits. Please see the BabySafe Project for examples of resources to share with pregnant women.

Recommendations to Schools

Reduce Radiofrequency Field Technology ALARA (As Low As Reasonably Achievable)

In order to reduce classroom RF exposures schools should install Low RF-EMF technology and reduce radiofrequency radiation exposures according to ALARA (As Low As Reasonably Achievable) principles. To reduce children's RF exposure in classrooms, schools can:

- Install corded (non-wireless) LAN systems in classrooms so that teacher and student computers (portable and desktop) connect to the internet without RF radiation exposures.
- Install corded (not cordless) telephones in all classrooms for voice communication and security.
- Choose non-wireless options for all other technology communication such as printers, security, mouse, keyboard, video cameras, HVAC, speakers, headphones, microphones and other accessories.
- Include information on FCC fine print warnings in the Bring Your Own (Mobile) Device (BYOD) Policy.
- Provide adaptors and accessories for personal devices so that devices can be used without radiation emissions in classrooms when needed as classroom tools.
- Post reminder notices in classrooms instructing device users to turn off Wi-Fi, Bluetooth, and any other wireless settings on devices and accessories that connect non-wirelessly (even if they are purses or bags).
- Prohibit cell towers near and on school buildings and grounds.

Partial RF Reduction Measures in Schools

The following measures are not fully protective but only provide a *partial* reduction in radiation exposure. *However, fully wired (non-wireless) systems will eliminate the RF exposure from school technology. With partial or half-measures, children will continue to be exposed to significant RF radiation emitted by wireless devices and by all the building's access points (which transmit radiation continuously) whether exposed as users or bystanders.*

- Ensure all computers, tablets and laptops are used on a table and NOT on a student's lap.
- Ensure students' heads and bodies are at maximum distance from all wireless devices (e.g., children should not lie on the floor with their heads inches from the laptop screen, nor should the lid of the computer behind them be near their back or head.)
- Install a switch for the teacher to turn Wi-Fi routers and access points OFF in classrooms when not in use.
- Plan for wireless download of applications and content onto devices to occur *outside of* school hours. Therefore during the school day the device will be fully loaded and the device's Wi-Fi antennae (and WiFi router or access point) can be turned off while children are using devices.
- Allow students who want to avoid RF to use ethernet and other corded connections for their computers. Most classrooms *already* have an ethernet port on the wall to plug into. (Note: if a child is using an ethernet connected computer but is sitting in close proximity to a child on Wi-Fi or is sitting in front of a child using WiFi then the ethernet using child will still be getting radiation exposures from the nearby WiFi users in addition to the Wi-Fi access point.)
- Ensure that the wireless antennas are always OFF on BYOD Devices.

Note: In several school districts some grades use digital devices in most of their academic classrooms and, thus, partial halfway reductions such as "turn it off when not in use" will have minimal impact as the devices are "in use" for several hours each day. Therefore, the most effective means to reduce exposure for maximum protection is to ensure the school infrastructure is 100% hardwired with ethernet connections.

Educational Curriculum for Schools

- Teach student and teachers *why* and *how* to reduce radiation exposure from technology devices as part of digital citizenship curriculum for students and for staff training.

- Offer educational workshops for parents to learn how to decrease RF exposures at home.
- Post RF reduction “Best Practices” in every classroom.

Manufacturer's Instructions in Cell Phones and Wireless Devices

As digital devices are used as classroom tools, the Department of Education should ensure that students and staff are aware of the FCC instructions for devices they use.

- Students and staff should be informed that wireless devices emit RF radiation and that the device manual specifies separation distances that are necessary between persons and emitting machines in order to avoid exposure that exceeds FCC guidelines.
- Students need to be aware that most laptop instructions specify the separation distance must be at least 20cm (approximately 8 inches) and most cell phone instructions specify a distance under an inch (depending on the make and model). Most districts have (or are moving towards) a Bring Your Own Device Policy, so a variety of models are in use in classrooms.

  Please note that the Queensland Department of Education, Training and Employment issued Your Guide to Safe Technology, a guide that informs students that *all wireless devices emit low levels of electromagnetic radiation and students should follow the manufacturer’s usage guideline.*

Recommendations to the General Assembly

The General Assembly should consider:

- Funding a public health education initiative on electromagnetic radiation and health.
- Right To Know Legislation requiring that the public is clearly informed that cell phones and “wireless” devices emit radiofrequency radiation and how the public can reduce exposure.
- Legislation that reduces RF exposures to the public with special consideration for child care centers, schools, community centers, municipal buildings and hospitals and other healthcare settings.

APPENDIX

I. Letters from the American Academy of Pediatrics on Children and Radiofrequency Radiation.
II. Summary of International Policy Actions on Reducing Wireless Exposures to Children
III. Sampling of Research on RF-EMF and Health
IV. US Government Documents on RF Radiation Showing Federal Agency Concerns Over Lack of Protections for Children.

The American Academy of Pediatrics Supports the Right To Know About These Safety Instructions and specifically details these concerns to Congress in 2012 and again to the Federal Communications Commission in 2013 as seen in the attached letters.

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

August 29, 2013

The Honorable Mignon L. Clyburn
Acting Commissioner Federal Communications Commission
445 12th Street SW
Washington, DC 20054

The Honorable Dr. Margaret A. Hamburg Commissioner
U.S. Food and Drug Administration
10903 New Hampshire Avenue Silver Spring,
MD 20993

Dear Acting Chairwoman Clyburn and Commissioner Hamburg:

The American Academy of Pediatrics (AAP), 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 appreciates this opportunity to comment on the Proposed Rule "Reassessment of Exposure to Radiofrequency Electromagnetic Fields Limits and Policies" published in the Federal Register on June 4, 2013.

In the past few years, a number of American and international health and scientific bodies have contributed to the debate over cell phone radiation and its possible link to cancer. The International Agency for Research on Cancer (IARC), part of the United Nations' World Health Organization, said in June 2011 that a family of frequencies that includes mobile-phone emissions is "possibly carcinogenic to humans." The National Cancer Institute has stated that although studies have not demonstrated that RF energy from cell phones definitively causes cancer, more research is needed because cell phone technology and cell phone use are changing rapidly. These studies and others clearly demonstrate the need for further research into this area and highlight the importance of reassessing current policy to determine if it is adequately protective of human health.

As radiation standards are assessed, 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.
- Reflect current use patterns. The FCC has not assessed the standard for cell phone radiation since 1996. Approximately 44 million people had mobile phones when the standard was set; today, there are more than 300 million mobile phones in use in the United States. While the prevalence of wireless phones and other devices has skyrocketed, the behaviors around cell phone uses have changed as well. The number of mobile phone calls per day, the length of each call, and the amount

of time people use mobile phones has increased, while cell phone and wireless technology has undergone substantial changes. Many children, adolescents and young adults, now use cell phones as their only phone line and they begin using wireless phones at much younger ages. Pregnant women may carry their phones for many hours per day in a pocket that keeps the phone close to their uterus. Children born today will experience a longer period of exposure to radio-frequency fields from cellular phone use than will adults, because they start using cellular phones at earlier ages and will have longer lifetime exposures. FCC regulations should reflect how people are using their phones today.

- Provide meaningful consumer disclosure. The FCC has noted that it does not provide consumers with sufficient information about the RF exposure profile of individual phones to allow consumers to make informed purchasing decisions. The current metric of RF exposure available to consumers, the Specific Absorption Rate, is not an accurate predictor of actual exposure. AAP is supportive of FCC developing standards that provide consumers with the information they need to make informed choices in selecting mobile phone purchases, and to help parents to better understand any potential risks for their children. To that end, we support the use of metrics that are specific to the exposure children will experience.

The AAP supports the reassessment of radiation standards for cell phones and other wireless products and the adoption of standards that are protective of children and reflect current use patterns. If you have questions, please contact Clara Filice in the AAP's Washington Office at 202/347-8600.

Sincerely,

Thomas K. McInerny, MD FAAP

President

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

December 12, 2012

The Honorable Dennis Kucinich
2445 Rayburn House Office Building
Washington,
DC 20515

Dear Representative Kucinich:

On behalf of the American Academy of Pediatrics (AAP), 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, I would like to share our support of H.R. 6358, the Cell Phone Right to Know Act.

The AAP strongly supports H.R. 6358's emphasis on examining the effects of radiofrequency (RF) energy on vulnerable populations, including children and pregnant women. In addition, we are pleased that the bill would require the consideration of those effects when developing maximum exposure standards. Children are disproportionately affected by environmental exposures, including cell phone radiation. 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.

In addition, the AAP supports the product labeling requirements in H.R. 6358. These standards will ensure consumers can make informed choices in selecting mobile phone purchases. They will also enable parents to better understand the potential dangers of RF energy exposure and protect their children.

On July 24, the U.S. Government Accountability Office (GAO) published a report on federal cell phone radiation exposure limits and testing requirements. The GAO noted that the Federal Communications Commission's (FCC) most recent data indicates that the number of estimated mobile phone subscribers has grown from approximately 3.5 million in 1989 to approximately 289 million at the end of 2009. Cell phone use behaviors have also changed during that time. The quantity and duration of cell phone calls has increased, as has the amount of time people use mobile phones, while cell phone and wireless technology has undergone substantial changes. Many more people, especially adolescents and young adults, now use cell phones as their only phone line, and they begin using wireless phones at much younger ages.

Despite these dramatic changes in mobile phone technology and behavior, the FCC has not revisited the standard for cell phone radiation exposure since 1996. The current FCC standard for maximum radiation exposure levels is based on the heat emitted by mobile phones. These guidelines specify exposure limits for hand-held wireless devices in terms of the Specific Absorption Rate (SAR), which measures the rate the body absorbs radiofrequency (RF). The current allowable SAR limit is 1.6 watts per kilogram (W/kg), as averaged over one gram of tissue. Although wireless devices sold in the United States must ensure that they do not exceed the maximum allowable SAR limit when operating at the device's highest possible power level, concerns have been raised that long-term RF energy exposure at this level affects the brain and other tissues and may be connected to types of brain cancer, including glioma and meningioma.

In May 2011, the International Agency for Research on Cancer (IARC), the United Nations' World Health Organization's (WHO) agency promoting international cancer research collaboration, classified RF energy as "possibly carcinogenic to humans." In addition, the National Cancer Institute has stated that although studies have not definitively linked RF energy exposure from cell phones to cancer, more research is required to address rapidly changing cell phone technology and use patterns.

This and other research identified by the GAO demonstrates the need for further research on this issue, and makes clear that exposure standards should be reexamined. The GAO concluded that the current exposure limits may not reflect the latest research on RF energy, and that current mobile phone testing requirements may not identify maximum RF energy exposure. The GAO proposed that the FCC formally reassess its limit and testing requirements to determine whether they are effective. The AAP commends the activities proposed under H.R. 6358, as they would address this research gap and improve consumer knowledge and safety. Establishing an expanded federal research program as the basis for exposure standards will ensure that consumer protections incorporate the latest research. Currently, the National Institute of Health (NIH), the only federal agency the GAO identified as directly funding research on this topic, provided approximately

$35 million from 2001 to 2011. Given this previous funding level, the AAP supports the $50 million per fiscal year for seven years that H.R. 6358 would authorize.

The AAP appreciates your recognition of the need for new research and standards for mobile phone radiation, and is pleased to support H.R. 6358.

For further assistance, please do not hesitate to contact Sonya Clay, Assistant Director, Department of Federal Affairs, at 202-347- 8600 or sclay@aap.org.

Sincerely,

Thomas K. McInerny, MD, FAAP

President

These letters can be accessed online:

American Academy of Pediatrics Letter to the FCC
http://apps.fcc.gov/ecfs/document/view?id=7520941318

American Academy of Pediatrics Letter to Congress
http://nebula.wsimg.com/b625b7cc6847a58ab1b7f25d326802d2?AccessKeyId=045114F8E0676B9465FB&disposition=0&alloworigin=1

CNN: Sanjay Gupta discusses the Fine Print Safety Instructions

https://www.youtube.com/watch?v=HF6O8NDaQXY

Consumer Reports November 2015 recommends that consumers be aware of instructions

http://www.consumerreports.org/cro/smartphones/cell-phone-radiation

The Today Show November 2015: Pediatricians on cell phone FCC distances

http://www.today.com/health/pediatricians-new-warning-limit-childrens-exposure-cellphones-t53541

II. Summary of International Policy Actions On Reducing Wireless Exposures to Children
France:
2016 The French National Agency of Health Security of Food, Environment and Labour Report recommends regulatory changes 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."

National Legislation "Law on sobriety, transparency, information and consultation for exposure to electromagnetic waves" passed in 2015. 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.

Belgium
Cell phones and cell phone ads are banned for young children and SAR labeling on phones is mandatory. Official government recommendations to reduce exposures are on the government website. Some municipalities have banned wifi in school for young children.

Spain
Several municipalities have passed resolutions urging the removal of wireless networks in schools and public places and recommending a precautionary approach with children and information campaigns to educate the public.

Canada
The health agency offers”practical advice” to reduce exposure to children. The Parliament issued a Radiofrequency Report recommending action to protect public health. Canadian Parliament Standing Committee on Health of the House of Commons issued a report "Radio Frequency Electromagnetic Radiation and the Health of Canadians"

Australia
The Australian Radiation Protection and Nuclear Safety Agency has issued a 2015 Fact Sheet titled How to Reduce exposure from mobile phones and other wireless devices. 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.” Read it HERE.

Italy
In 2015, the Italian State Parliament of South Tyrol voted to allow the application of the precautionary principle mandating the state government to: To replace existing wireless networks whenever possible with networks that emit less radiation at schools, preschools, hospitals, nursing homes, and other public facilities. The Supreme Court ruled a man’s brain tumor was caused by his cell phone use.

Israel
The Ministry of Health states “Precautions should be strictly enforced with regard to children, who are more sensitive to developing cancer. The Israeli Government created the public education webpage National Information Ctr for Non-Ionizing Radiation. The Israeli Ministry Of Education has issued guidelines limiting WiFi and cell phone use in schools and officially recommends wired networks in schools. The Ministry of Health published Environmental Health in Israel 2014 which states that “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."
Haifa (Israel's third largest city) removes Wi-fi from all schools. Haifa Mayor Yona Yahav said that the city would replace the wireless network with a wired connection that will provide safer options to students." Read the news article here. This action occurred after this news report aired.

Switzerland

The Switzerland Federal Office for the Environment has issued specific guidelines to reduce exposure and has created factsheets for the public. The Governing Council of Thurgau Canton recommends for schools" to forgo the use of wireless networks when the structural makeup of a given school building allows for a wired network." The Switzerland Federal Office for the Environment FOEN has a webpage on Wi-Fi 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.
The Switzerland Federal Office for the Environment FOEN has a webpage on Cell Phones which details ways to reduce mobile phone radiation. FOEN also has additional EMF factsheets on various EMF sources including on baby monitors where they state that "it is advisable to reduce the infant's exposure to emissions as far as possible."

Germany

The Federal Office for Radiation Protection provides tips for reducing radiation exposure to smartphones, tablets and wireless devices and several states recommend wired rather than wireless installations in schools. "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." Read the precautionary advice here. The FORP recommends landline phone instead of mobile phone base stations and that schools should not connect wirelessly to the internet. Read a 2015 statement here.

Austria

The Public Health Department of Salzburg Region recommends against wireless in schools. No Wi-Fi in Salzberg Schools and many schools are Wi-Fi free. The Austrian Medical Society has issued cell phone safety guidelines. Austria's" Highest Health Council of the Ministry of Health" has a brochure with advice to reduce exposure to cell phone radiation. It states that since the long term research is still not completed, it is advisable to take simple precautions to reduce exposure.

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.
Official cell phone radiation guidelines Precautionary Guidelines for mobile users. Municipal Corporation of Greater Mumbai, the civic body that governs the capital city of Mumbai in Maharashtra (India's richest municipal organization) in 2016 in its new policy on mobile towers, no longer allows cell towers on playgrounds, recreational grounds, gardens and parks. Read news article. 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. Read a Document prepared by Dr. Sharma, Sr. Deputy Director of the Indian Council of Medical Research on Indian Research Studies.

Russia

The Russian National Committee on Non-Ionizing Radiation Protection has issued strong recommendations to reduce exposure to children and issued several reports. The Russian National Committee on Non-Ionizing Radiation Protection in ELECTROMAGNETIC FIELDS FROM MOBILE PHONES: HEALTH EFFECT ON CHILDREN AND TEENAGERS has repeatedly warned about electromagnetic radiation impacts on children and recommended WiFi not be used in schools.

United Kingdom

The UK National Health Service has changed its advice. In 2011 it offered specific Recommendations to reduce cell phone radiation exposure to children. Read the 2011 recommendations which stated, “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.” Then, the National Health service changed the public advice text. Now they state: “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.” Read the new text here.

Cyprus

“Be Precautionary and reduce exposure to phones, Wi-Fi and other wireless devices,” states the Cyprus Government’s National Committee on Environment and Child Health (ECH). 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.) which specifically addresses not just cell phones but all wireless devices. The Cyprus National Committee on Environment and Child Health created a short PSA for citizens about children and wireless radiation. Watch the video translated into english here https://www.youtube.com/watch?v=996vzcCYCnE

Finland

The Radiation and Nuclear Safety Authority officially recommends reduced radio frequency exposure for children (since 2009) and details advice to reduce exposure to the public. “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.”

Singapore

Singapore’s National Environmental Agency specifically advises precautions for the public to reduce exposure while further research is being carried out. Below is the exact text found on the Frequently asked Questions About Radiation Protection.

Taiwan

In 2015 the 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)

Namibia
Namibia's atomic energy review report states that current so called "safety" standards DO NOT protect citizens from long term health effects.

- "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: The Atomic Energy Review

Turkey
The Ministry of Health has issued public information brochures that recommend limiting exposure especially for pregnant women and children (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.) In addition the Ministry is developing regulation on prohibiting phone use for children. The EMF in schools is monitored and the public can get measurements on EMF levels from cell towers and schools at a national site. A Project funded by Ministry of Internal Affairs, accomplished by Temkoder (Prevention, Measurement of Electromagnetic Pollution and Training Organization) resulted in secondary school student training in the safer usage of cellular phones.

Greece
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 Q and A on RF radiation states the following text about children. Read it here on page 32 and 33
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.

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.

2014: The Connecticut Department of Public Health has issued specific recommendations to reduce exposure to cellphone radiation. 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." Read the Connecticut Department of Public Health Cell Phone Q and A about Cell phones here.

2016: Onteora School District in New York State USA: District adopts “Best Practices with Wi-Fi Read the 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, Mass (USA): The District has passed"Best Practices" to turn the WiFi off when not in use and keep devices away from the body Download Slides . Video of parent who initiated this. Video of school board member discussing the process. Read Magazine article on Ashland’s Decision Here.

2014 California, Berkeley: 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." Full text here.

2014 New York: Wireless Router Labeling in all Suffolk Public buildings: 12/2014 The Suffolk County Legislature passed legislation to require 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." Read Press Release.

2014 Maryland, Greenbelt: The Greenbelt Maryland City Council voted unanimously on November 24, 2014 to do the following:
1. 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.
2. To send the FCC Chairman a letter urging the adoption of “radiation standards that will protect human health and safety.”
3. To oppose cell towers on school grounds and write a letter to the local school board and County Executive.

2012 Wyoming: Jackson Hole issued a Proclamation of Cell Phone Awareness
2012 Florida: Pembroke Pines, passed Resolution 3362 expressing 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. Watch the Video of his powerful testimony here.

2010 California, San Francisco: Cell Phone Radiation (How to Reduce Exposures) Webpage launched. Answers on how to reduce exposures to cell phone radiation. The City developed a poster, factsheets and display stickers with public health information.

2010 California: Burlingame California City has cell phone safety guidelines .
2010 Maine, Portland: October declared "Cell Phone Awareness Month"

Research showing Children's Increased Radiofrequency Exposure

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US Government Documents on RF Radiation and inadequacy of FCC limits:

2014: U.S. Department of the Interior Letter (2014) on FCC Guidelines
2002 EPA Letter on the RF Exposure Limits ONLY protecting from Heating Effects
2008: National Academy of Sciences (NAS) Report, Identification of Research Needs Relating to Adverse Health Effects of Wireless Communication,
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- they were never finished. .
1984: US Science Advisory Board Letter that recommends that the EPA develop radiation protection guidance to protect the public (Note: the EPA standards were never issued.)
1983: EPA: Biological Effects Of RadioFrequency Radiation

Recommendations to the Maryland Children's Environmental Health and Protection Advisory Council

On the Children's Health and Radiofrequency Exposures Report

Clifford S. Mitchell, M.D.
Maryland Children's Environmental Health and Protection Advisory Council
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September 16, 2016

Dear Dr. Clifford S. Mitchell;

We are writing you in strong support of the Maryland Children's Environmental Health and Protection Advisory Council's draft recommendations to reduce children's exposure to radiofrequency radiation. We offer this information and our recommendations to include in your final report.

Children and Radiofrequency Radiation

Radiofrequency radiation constitutes a significant environmental exposure for children in schools and at home. Schools are rapidly integrating cell phones and wireless technology into classrooms. The radiofrequency electromagnetic (RF--EMF) radiation environment in classrooms is significant because of the high numbers of radiation emitting devices (laptops, tablets, cell phones, ceiling mounted access points, virtual reality) in use for long periods of time in each classroom.

As the US EPA has detailed, FCC regulations were set intending to protect from thermal effects only and not intending to protect from non-thermal effects from long-term chronic exposures. Since, the World Health Organization's International Agency for the Research on Cancer classified radiofrequency radiation as a Class 2 B Carcinogen in 2011, evidence has significantly increased that long-term radiofrequency radiation exposure causes cancer. It has been scientifically demonstrated that adverse biological effects can occur at non-thermal levels of radiofrequency fields. A recent animal study performed by the National Toxicology Program in the United States found an increased incidence of cancer and increased DNA damage in rats with prolonged exposure to radiofrequency fields that were too weak to increase temperature. FCC regulations do not provide adequate protection for children as the regulations do not account for biological effects at these *non-thermal* levels.

The American Academy of Pediatrics has called for a review of FCC limits because children are more vulnerable to radiofrequency radiation exposures due to their unique anatomy and physiology, and rapid development. Considering that children will have a lifetime of exposure, it is critically important to reduce childhood RF exposures in schools and homes and equally important to address the myriad of ways children are exposed be it from Wi-Fi, tablets and/or cell phones.

Recommendations to the Department of Health

The Department of Health should advise the public on ways to reduce radiofrequency exposure from cell phones and wireless devices, with special emphasis on protecting children. For example, the Connecticut

Department of Health **issued specific recommendations to reduce exposure stating,** *"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 Department of Health should create and maintain a webpage with information on how to reduce exposure, just as the Connecticut Department of Health and San Francisco and Burlingame in California have done.

> Note: The governments of France, Belgium, Canada, Austria, the United Kingdom (UK) , India, Australia, Germany, Switzerland, Israel, Finland, Greece, Russia, Switzerland, Cyprus, Singapore, Turkey and the Council of Europe all have online public resources specifically recommending that children's exposure should be reduced or minimized, and governments provide resources detailing how the public can reduce exposure to radiofrequency radiation. As the UK ministry states, *"Government advice is to be on the safe side and limit mobile phone use by children.*"

Countries such such as France, Israel, Germany, and the state and local governments of Ghent Belgium, Navarra, Vitoria, and the Basque Parliament of Spain, South Tyrol Borgofranco d'Ivrea, Piemonte and Turin Italy, specifically recommend against Wi-Fi or have outright banned Wi-Fi in daycare centers, kindergartens and/or schools. When the plan to remove Wi-Fi from all Haifa Israel schools was announced, Haifa Mayor Yona Yahav was quoted stating, "*When there is a doubt, when it comes to our children, there is no doubt."*

The Department of Health should provide resources that inform doctors and other clinicians about advising patients how to reduce exposure *and* how to clinically assess Radiofrequency (RF) exposure during patient visits. The Department of Health can create a Factsheet for Parents and a Factsheet for Clinicians that includes interview questions to ask during patient visits.

The Department of Health should provide information to obstetricians and gynecologists so they can provide information to patients about how to reduce exposures during clinic visits. Please see the BabySafe Project for examples of resources to share with pregnant women.

Recommendations to Schools

Reduce Radiofrequency Field Technology ALARA (As Low As Reasonably Achievable)

In order to reduce classroom RF exposures schools should install Low RF-EMF technology and reduce radiofrequency radiation exposures according to ALARA (As Low As Reasonably Achievable) principles. To reduce children's RF exposure in classrooms, schools can:

- Install corded (non-wireless) LAN systems in classrooms so that teacher and student computers (portable and desktop) connect to the internet without RF radiation exposures.
- Ensure the wireless emissions are disabled on devices in use by students.
- Install corded (not cordless) telephones in all classrooms for voice communication and security.
- Choose non-wireless options for all other technology communication such as printers, security, mouse, keyboard, video cameras, HVAC, speakers, headphones, microphones and other accessories.
- Include information on FCC fine print warnings in the Bring Your Own (Mobile) Device (BYOD) Policy.
- Provide adaptors and accessories for personal devices so that devices can be used without radiation emissions in classrooms when needed as classroom tools.

- Post reminder notices in classrooms instructing device users to turn off Wi-Fi, Bluetooth, and any other wireless settings on devices and accessories that connect non-wirelessly (even if they are purses or bags).
- Prohibit cell towers near and on school buildings and grounds.

Partial RF Reduction Measures in Schools

The following measures are not fully protective but only provide a *partial* reduction in radiation exposure. *However, fully wired (non-wireless) systems will eliminate the RF exposure from school technology. With partial or half-measures, children will continue to be exposed to significant RF radiation emitted by wireless devices and by all the building's access points (which transmit radiation continuously) whether exposed as users or bystanders.*

- Ensure all computers, tablets and laptops are used on a table and NOT on a student's lap.
- Ensure students' heads and bodies are at maximum distance from all wireless devices (e.g., children should not lie on the floor with their heads inches from the laptop screen, nor should the lid of the computer behind them be near their back or head.)
- Install a switch for the teacher to turn Wi-Fi routers and access points OFF in classrooms when not in use.
- Plan for wireless download of applications and content onto devices to occur *outside of* school hours. Therefore during the school day the device will be fully loaded and the device's Wi-Fi antennae (and WiFi router or access point) can be turned off while children are using devices.
- Allow students who want to avoid RF to use ethernet and other corded connections for their computers. Most classrooms *already* have an ethernet port on the wall to plug into. (Note: if a child is using an ethernet connected computer but is sitting in close proximity to a child on Wi-Fi or is sitting in front of a child using WiFi then the ethernet using child will still be getting radiation exposures from the nearby WiFi users in addition to the Wi-Fi access point.)
- Ensure that the wireless antennas are always OFF on BYOD Devices.

Note: In several school districts some grades use digital devices in most of their academic classrooms and, thus, partial halfway reductions such as "turn it off when not in use" will have minimal impact as the devices are "in use" for several hours each day. ***Therefore, the most effective means to reduce exposure for maximum protection is to ensure the school infrastructure is 100% hardwired with ethernet connections.***

Educational Curriculum for Schools

- Teach student and teachers *why* and *how* to reduce radiation exposure from technology devices as part of digital citizenship curriculum for students and for staff training.
- Offer educational workshops for parents to learn how to decrease RF exposures at home.
- Post RF reduction "Best Practices" in every classroom.

Manufacturer's Instructions in Cell Phones and Wireless Devices

As digital devices are used as classroom tools, the Department of Education should ensure that students and staff are aware of the FCC instructions for devices they use.

- Students and staff should be informed that wireless devices emit RF radiation and that the device manual specifies separation distances that are necessary between persons and emitting machines in order to avoid exposure that exceeds FCC guidelines.
- Students need to be aware that most laptop instructions specify the separation distance must be at least 20 cm (approximately 8 inches) and in fact, most cell phone instructions specify a distance as well which is different for each phone depending on the make and model. Most districts have (or are moving towards) a Bring Your Own Device Policy, so a variety of models are in use in classrooms.

Please note that the Queensland Department of Education, Training and

Employment issued Your Guide to Safe Technology, a guide that informs students that *all wireless devices emit low levels of electromagnetic radiation and students should follow the manufacturer's usage guideline.*

Recommendations to the General Assembly

The General Assembly should consider:

- Funding a public health education initiative on electromagnetic radiation and health.
- Right To Know Legislation requiring that the public is clearly informed that cell phones and "wireless" devices emit radiofrequency radiation and how the public can reduce exposure.
- Legislation that reduces RF exposures to the public with special consideration for child care centers, schools, community centers, municipal buildings and hospitals and other healthcare settings.

Sincerely,

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