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Scientific Documentation in Support of the Testimony Given by David O. Carpenter, MD Concerning the OHA Report on Wireless Radiation (SB 384)

Children's Vulnerability

I co-authored a paper published in *Environmental Pollution* entitled "Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective" describing how the standards set by most national and international bodies are not protective of human health. **This is a particular concern in children, given the rapid expansion of use of wireless technologies, the greater susceptibility of the developing nervous system, the hyperconductivity of their brain tissue, the greater penetration of radiofrequency radiation relative to head size and their potential for a longer lifetime exposure.**

I joined with a group of scientists to send a letter to the U.S. Secretary of Education calling for immediate reductions in school wireless exposure due to the current body of science.

This paper, the letter and several others were submitted to you for the record.

Children, and especially fetuses, are more vulnerable than adults for most environmental exposures (Sly and Carpenter, 2012). This is because their cells are rapidly dividing and their organ systems are not mature. As a result, events that perturb cellular function early in life can result in abnormalities later. There is a building body of evidence indicating that exposure to RF-EMFs has adverse effects on cognition and neurobehavior, especially in children and adolescents (Belpomme et. al, 2018).

Scientific modeling finds the younger brains of children absorb proportionally more wireless radiation in the eyes and brain–grey matter, cerebellum and hippocampus compared to adults (Fernandez et al. 2018, Christ et al., 2010, Mohammed 2017). Stem cells are more sensitive to microwave radiation, and children have more active stem cells (Belyaev 2010, Williams et al. 2006). Government regulations were based on a 220-pound man's head and body, not a child's head and body. This is one of the numerous reasons why the American Academy of Pediatrics has repeatedly written to the FCC and FDA calling for more protective regulations (Ghandi 2012, AAP 2012 & 2013).

Research on animals (Examples include Bas et al., 2009; Deshmukh et al., 2015; Shahin et al., 2017; Megha et al., 2015; Aldad et al., 2012; Zhang et al., 2015) shows impacts from RFR to the brain such as alterations in neurodevelopment and behavior of offspring, impaired learning and spatial memory, a deleterious impact on hippocampal, pyramidal or cortical neurons and induced markers of oxidative stress and inflammation in the brain. Human data is consistent with these animal studies as they have found higher cell phone radiation associated with behavioral problems and memory damage (Divan et al., 2012; Birks et al. 2017; Foerster et. al., 2018).

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The research showing impacts from radiofrequency on the brain again highlights the importance of reducing exposure to children and pregnant women.

Cancer

As of 2020, several expert independent scientists have published their evaluation that the scientific evidence has increased and radiofrequency radiation should be classified as a proven human carcinogen (Belpomme et al., 2018, Miller et al., 2018, Hardell and Carlberg 2019).

The 2011 World Health Organization International Agency for Research on Cancer WHO/IARC classification of RF-EMFs as a"possible" human carcinogen was based primarily on evidence from human studies that long-term users of mobile phones held to the head resulted in an elevated risk of developing brain cancer. One major reason that the IARC rating was not at "probable" or "known" was the lack of clear evidence from animal studies for exposure leading to cancer in 2011. The evidence has increased.

In 2018, the US National Institute of Environmental Health Sciences National Toxicology Program's (NTP) Studies of Cell Phone Radiation released their findings that chronic exposure to RFR was associated with "clear evidence" of cancer in RFR-exposed male rats (NTP, 2018). In addition, exposed animals had significantly more DNA damage, heart damage and low birth weight (Smith Roe et al., 2020). Similar results in rats have been reported in an independent large scale animal study from the Ramazzini Institute with levels of exposure far lower than the NTP study and similar to those from a mobile phone base station (Falcioni et al., 2018). This evidence, in conjunction with the human studies, demonstrates conclusively that excessive exposure to RF-EMF results in an increased risk of cancer. In light of this new evidence for cancer in rodents in response to prolonged exposure to mobile phone frequencies, the IARC rating should be raised at least to "probable" (Group 2A) if not"known" (Group 1).

Due to the large scale animal studies as well as additional published research since 2011, the WHO/IARC advisory group published their recommendation that IARC should evaluate non-ionizing radiofrequency radiation as a "high priority" in the next five years.

Documentation can be found at IARC Monographs on the Identification of Carcinogenic Hazards to Humans Report of the Advisory Group to Recommend Priorities for the IARC Monographs during 2020–2024 on page 148.

FCC Limits are Not Protective

The Environmental Working Group published a study in *Environmental Health* analyzing the findings of tumor and heart damage from the National Toxicology Program study and concluded that FCC limits should be strengthened by 200 to 400 times to protect children according to current risk assessment guidelines (Uche 2021).

FCC limits are not protective and thus any comparison to these limits has no relevance to impacts on health and the environment. The current weight of scientific evidence refutes the prominent claim that the deployment of wireless technologies poses no health risks at the currently permitted non-thermal radiofrequency exposure levels. Instead, the evidence supports the International EMF Scientist Appeal by 244 scientists from 41 countries who have published on the subject in peer-reviewed literature and

collectively petitioned the WHO and the UN for immediate measures to reduce public exposure to artificial electromagnetic fields and radiation (Bandara and Carpenter, 2018).

“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” (Kelley et al., 2015).

The various agencies setting safety standards including the FCC have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF. Reliance on FCC limits does ensure safety.

Radiofrequency radiation has been found to interact with other toxic exposures and have synergistic reactions.

Early life exposure to lead has long been known to harm children and impact their ability to pay attention. Two studies have shown that prenatal (Choi et al., 2017) or postnatal (Byun et al., 2017) mobile phone exposure results in greater neurobehavioral effects in children with elevated lead levels than those seen with elevated lead alone. These results indicate that EMFs can have synergistic actions with other environmental contaminants known to cause a reduction in intelligence quotient (IQ).

In addition, replicated results from animal studies show co-carcinogenic and tumor promoting effects from RF-EMF when RF is combined with a known carcinogen (Tillmann et al., 2010; Lerchl et al., 2015). The studies used a very low level of radiofrequency radiation and yet found increases in tumors from the combined exposures.

Wireless radiofrequency radiation is one of numerous types of environmental exposures in the educational setting and it is critical that the OHA consider the synergistic effects of exposure to multiple environmental stressors

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A Sampling of Recent Research

European Parliament requested a research report “Health Impact of 5G” released in July 2021 concluding that commonly used RFR frequencies (450 to 6000 MHz) are probably carcinogenic for humans *and* clearly affect male fertility with possible adverse effects on the development of embryos, fetuses and newborns.

Scientists of the National Institute of Environmental Health Sciences National Toxicology Program published a study finding “significant increases in DNA damage” in groups of male mice, female mice and male rats after just 14 to 19 weeks of exposure to RFR (Smith-Roe et al., 2020).

Yale researchers published a study supported by the American Cancer Society linking thyroid cancer to cell phone use in people with a type of common genetic variation (Luo et al., 2020).

A meta analysis of 300 peer-reviewed scientific publications (1990-2015) describing 1127 experimental observations in cell-based in vitro models on RFR published in *Environmental Research* found less differentiated cells such as epithelium and spermatozoa are more sensitive to RF (Halgamuge et al., 2020).

A review on real world exposure to 5G published in *Toxicology Letters* found that 5 G will have systemic effects as well as adverse effects to the skin and eyes (Kostoff et al., 2020).

A systematic review and meta-analysis of case-control studies found evidence that linked cellular phone use to increased tumor risk (Choi et al., 2020).

A 4G study found kidney inflammation and damage to the testes in mice (Hasan et al., 2021).

The Switzerland Institute of the Environment expert published review found increased oxidative stress in the majority of animal studies and cell studies with exposures within regulatory limits (Schuermann et al., 2021).

An international consensus report calls for the acknowledgement of electrohypersensitivity as a distinct neuropathological disorder and for inclusion in WHO Int. Classification of Diseases (Belpomme et al. 2021).

Systematic reviews found harm to sperm (Sungjoon et al, 2021, Yu et al., 2021).

A review on impacts to the thyroid found RFR might be associated alterations in thyroid hormone levels, with a possible disruption in the hypothalamic-pituitary-thyroid axis (Alkayyali et al., 2021)

2400 MHz affects the structural integrity of the hippocampus in mice (Hasan et al., 2021).

A review summarizes the effects of EMR on the neurotransmitters in the brain (Hu et al., 2021).

A review on RFR and the brain published in the International Journal of Radiation Biology found the threshold for an effect in EEG is far lower than the level deemed safe by the U.S. FCC (Hinrikus et al. 2021).

A systematic review on the effects of RFR to male reproductive hormones found that wireless can decrease testosterone (Maluin et al, 2021).

A review on the genetic effects of non-ionizing electromagnetic fields found DNA strand breaks, micronucleus formation, and chromosomal structural changes (Lai 2021).

A systematic review published in the Annals of the New York Academy of Sciences found that neuronal ion channels are particularly affected (Bertagna et al 2021).

A review in the International Journal of Oncology describes how EMFs lead to dysfunction of ion channels which lead to reactive oxygen species/free radical overproduction providing " a complete picture" of how exposure may indeed lead to DNA damage and related pathologies, including cancer," (Panagopoulos et al. 2021).

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Yours sincerely,

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