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## **Recommendations for Best Practices for Safe Technology in Schools**

Santa Clara County Medical Association

Environmental Health Committee

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**Purpose:** To educate physicians, school officials and teachers of the complex health risks and potential health hazards of digital and wireless technology in schools, highlighting precautionary measures and recommendations for safer use of this technology.

The support of preventative environmentally-related diseases and public health measures are prime goals and objectives of the Santa Clara County Medical Association (SCCMA). The SCCMA encourages and supports initiatives that promote the health and safety of both students and staff in the school environment. We have previously endorsed healthy school policies to reduce pesticides and protect children from toxic exposures. In 2014 we supported the CMA Resolution CMA Resolution 107-14 “Wireless Communications Safety Standards Reevaluation” to update public standards for exposure to wireless radiofrequency radiation such that it does “not cause human or environmental harm based on scientific research.” In 2016 the SCCMA reprinted a 2014 Sonoma County Medical Association article, “What’s the Diagnosis Doctor?” by hospice physician Dr. Scott Eberle about his electrosensitivity.

Recently we have examined the impacts of wireless and digital devices in the school setting with an SCCMA Webinar “Children and Technology” in 2021, highlighting the psychosocial impacts of social media including learning, addiction and mental health. In 2020 the CMA passed Resolution 105-20 “What is the Internet Doing to Us? Digital Wellbeing in the Modern Age”, supporting research of internet and social media usage to address the “impacts on physical and mental health.” Because of the now ubiquitous and expanding use of digital devices in both informal and formal learning environments, and with new scientific evidence of negative health outcomes and mechanistic links, there is valid concern that this could have significant real-world implications on students in the short and long term, especially neurobiologically (Hu 2021; Hutton 2020; Li 2020; Hutton 2019; Kim 2019; Belpomme 2018; Meo 2018)

### **Health**

Our organization has studied the issue of wireless technology with regard to potential adverse human health impacts of radiofrequency radiation emissions, including neurologic, genotoxic, immunologic, reproductive, hormonal and blue light eye effects, in addition to mental health and psychosocial issues surrounding excessive digital media screen time. Scientific literature indicates that the mechanisms of harm include oxidative injury to critical molecules such as DNA/lipids/proteins (Gerner, Xie), membrane disruption, blood brain barrier disruption, and mitochondrial injury with much of the resultant cellular injury occurring at non-thermal levels which are well below current standards (BioInitiative Report 2022). We have become especially concerned with the dramatic increase in the use of this technology in schools resulting in exponentially higher levels of non-ionizing radiofrequency electromagnetic radiation (EMR) emitted by these wireless devices. This results in increased long-term exposures in children who

spend much of their formative years in school environments (Moon 2020). There is little to no regulation or monitoring of this technology for health effects in children.

Although wireless devices are convenient, this growing robust body of peer-reviewed research has shown that this radiofrequency radiation poses significant short and long-term health risks. (Attah 2022; Butler 2020; Miller 2019). Like tobacco or toxic chemical exposures, it takes decades of exposure, as well as decades of research, to strengthen the link between exposure and harm. Therefore, it takes decades to realize the magnitude of the public health threat before action is taken (NAS 2015). Conversely, considering so many lessons learned late with regards to toxic exposures, science, policy and political will (DDT, endocrine disruptors, flame retardants, BPA, nanotechnology and pesticides), a precautionary approach plays a critical role to manage public health hazards from rapidly emerging environmental exposures from modern innovations. (Gee 2013; EU 2017)

### **Eye Effects**

There are also emerging scientific concerns with regards to eye damage and circadian rhythm disruption from blue light emitted from digital devices (ANES 2019). The reduction in levels of melatonin with blue light exposures effects not only circadian rhythms but is also implicated in oxidative damage to eye structures (Tok 2014), lowering of seizure thresholds (Lopez-Martin 2009; Kouchaki 2016; Cinar 2013; Azmy 2020) and the development of breast cancer due to an imbalance in internal physiologic oxidants and antioxidants (Yang 2021; Mortazavi 2018; Blask 2009).

### **Social Media**

It has also become apparent that the excessive use of digital technology and social media in children can have adverse mental health effects including internet addiction, cyberbullying, deficient social skills, depression and lack of exercise. Uhls (2014) noted that five days at an outdoor education camp without screens improves preteen skills with nonverbal emotion cues. Studies have shown structural brain changes in children with excessive screen time (Hutton 2019), as well as those with internet addiction (Wang 2016; Hong 2013; Wang 2013; Weng 2012; Lin 2011).

### **Privacy**

Privacy concerns of digital technology in schools are also emerging, and create a safety issue for children. A 2022 report “K-12 EdTech Safety Benchmark. National Findings Part 1. Dec 13, 2022. The findings “clearly show personal information safety risks to children and families are present and pervasive in the technology recommended and used by U.S. educational institutions, including: 1) Nearly all apps (96%) share children’s personal information with third parties, 78% of the time with advertising and monetization entities, typically without the knowledge or consent of the users or the schools, making them unsafe 2) School apps (23%) expose kids to digital ads, which creates a risk that personal student data is being sent into advertising networks, with no way for the public to inspect where it goes or how it’s used; more than half of those apps (13%) use retargeting ads, which use cookies, search and site history to serve up targeted advertising; this means even more personal student data is being sent into advertising networks to better serve the advertisers.”

In 2014, the SCCMA supported the California Medical Association resolution which called for re-evaluation and strengthening of wireless safety standards to consider non-thermal biological effects. (Ref 1) There was enough evidence then to call for precaution, and now even more scientific literature links wireless radiation to health risks. This is especially true for the most vulnerable members of our population, our children. (Moon 2020; Heindel 2015; Landrigan and Goldberg 2011; Weiss 2000). Standards have still not been updated to include biological non-thermal effects or effects on vulnerable populations such as children, pregnant women, the elderly or those with comorbidities.

### **Mitigation Measures**

Legislators, government agencies and organizations are increasingly recommending reducing wireless and digital devices as a preventative health strategy. These include the Parliamentary Assembly Council of Europe, Russian National Committee of Non-Ionizing Radiation Protection, Austrian Medical Association, German Parliament, The Cyprus National Committee on Environment and Children's Health, The Collaborative for High Performing Schools, The New Jersey Education Association and the American Academy of Pediatrics (Ref 22-37).

The development and use of digital technology creates a novel complex risk for children. Considering the burgeoning scientific evidence, outdated standards for radiofrequency radiation and variability of sensitivities in the population, precaution is warranted. Having a safe and healthy environment that promotes learning is essential for the performance and success of students. Positive outcomes in health and education have far reaching benefits and conversely negative outcomes affect all future generations and our society at large.

For these reasons, the SCCMA supports reducing exposures to radiofrequency radiation from wireless devices and encourages establishing safer school technology policies with regard to digital devices and infrastructure in order to promote the physical health, mental health and well-being of students and staff. Healthier children translate into healthier communities and a healthier society.

## **Best Practice Policy Recommendations to Improve Health, Safety and the Learning Environment for Students**

Based on scientific research, attached addendums and references the SCCMA supports the following actions that can, singly or together, help to reduce wireless radiofrequency radiation exposures and create safer healthy learning environments in schools.

1. Create a "Safe Tech in Schools Program" to educate students and staff with materials including informational brochures, posters and/or lectures on potential health effects of wireless devices, how to use devices safely, reduce wireless use in the classrooms and reasons to prefer hardwire connections.

2. Educate students and staff about risks of carrying wireless devices in pockets or next to the body, where wireless radiation levels may exceed even FCC safety guidelines. Here are some examples below.
  - a. Put devices on desks, not laps
  - b. Text rather than call
  - c. Prefer speaker phone
  - d. Put devices in airplane mode when not in use. This suspends EMF transmission by the device
  - e. Carry phones in backpacks, etc., not on the body
  - f. Turn devices on airplane mode when not in use
  - g. Avoid or strictly limit the use of Virtual Reality headsets
3. Educate the school nurse about potential health effects of radiofrequency radiation (RFR) in students, including blue light effects, posture, RFR effects, and in some students, electrosensitivity (headaches, dizziness, etc.) along with creating a monitoring and reporting program
4. Establish and promote school cell phone-free policies as authorized by the California Legislature in 2019. (Muratsuchi AB 272)
5. Promote tech free breaks in classrooms during each class.
6. Use blue light reduction methods such as apps, blue light computer covers or blue light glasses to reduce eye strain
7. Prefer and install hard-wired ethernet devices instead of wireless wherever possible. This includes hardwiring computers, tablets, whiteboards and cordless phones in the classroom. Disable devices so they are on airplane mode when on ethernet.
8. Reduce RF radiation on campus and in classrooms. Some examples to consider are below.
  - a. Purchase Wi Fi routers which have access points that can be easily turned on or off at point of use and at multiple points, to reduce RF emissions, as well as energy use and to achieve ALARA (As Low As Reasonably Achievable) RF levels as per European Council Resolution 1815. Tech Safe Schools. Mitigation Techniques for Reducing RF Radiation in Classrooms.  
[https://www.techsafeschools.org/\\_files/ugd/2cea04\\_9e0eac828f124de9ae4a956d81d1f802.pdf](https://www.techsafeschools.org/_files/ugd/2cea04_9e0eac828f124de9ae4a956d81d1f802.pdf)
  - b. Turn off wireless devices, hotspots, printers “smart TV’s” and routers when not in use in the classroom with easy on-off access buttons or remote.
  - c. Place routers as far away from students as possible and not overhead. Distance reduces RF exposure.
  - d. Decrease the power of the router. Typically the power can be reduced from 100% to 15-20% without interfering with function thus saving energy, as well as

reducing RFR exposure. (c,d,e will likely allow the network to operate more efficiently with no interference and with good connectivity)

- e. Disable 2.4 GHz Wi Fi and use only 5GHz for classrooms. This reduces energy use.
  - f. Increase the beacon frequency of the router so the signals are farther apart. This will also reduce energy use, as well as reduce interference with nearby routers. For beacon frequency one can increase from a default of a signal every 100ms to a signal every 1000ms or more without affecting connectivity.
  - g. Have timers on routers which can turn off routers at night and when not in use to reduce energy consumption
  - h. Choose routers which are only on-demand and are silent unless in use. These can also be controlled by teachers using their laptops.
  - i. Consult with an RF professional who can measure radiofrequency radiation (RFR) from Wi Fi, Bluetooth, cell phone frequencies, cell tower frequencies (600 MHz to 7 GHz and possibly select 5G millimeter bands). This includes peaks/maximum levels of radiation which are the most biologically active, not average exposures. It will be important to perform before and after Wi Fi adjustments, or before buying equipment. It is recommended that each school also purchase a professional grade EMF meter(s) to test for exposures. The teachers and students can measure and confirm the reduction in exposure. See Reducing Wireless Radiation. Safe Tech Schools Webinar for recommendations.  
<https://www.techsafeschools.org/webinars>
9. Consider a Wi Fi Dead Zone on campus with signs posted to turn off phones
  10. Reduce wireless radiation and distractions in students by having them download materials first, then disable applicable wireless antennas (Bluetooth, GPS, cellular, and Wi Fi) by using airplane mode as much as possible.
  11. Consider using books instead of computers or tablets whenever possible for improved learning and less distraction
  12. Keep tablets and computers at least 8 inches from the body and on a table (not lap) when used as per Federal Communications Commission recommendations.
  13. Keep children's heads away from routers, screens and antennas as much as possible.
  14. Avoid installation of smart meters on school premises. (Lamech 2014)
  15. Consider a policy to restrict installation of cell towers on school property. The recommendation is at least 1640 feet (500meters) distance from a cell tower to a school. (Balmori 2022; Pearce 2020)
  16. Consider placing fiberoptic cables for broadband access as it is faster, safer, more reliable and cheaper in the long run, with no radiofrequency radiation emissions risks

17. Sponsor pilot demonstrations of the use and feasibility of safer technologies in classrooms, especially the feasibility of using fully hard-wired technologies without wireless function or devices in classroom settings.
18. Develop and distribute state-level policies and/or guidance for schools on wireless radiation and technology safety.
19. Give teachers flexibility with regards to use of technology and books

Sincerely,

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## **Addendum #1**

### **Reasons to Support Safe Technology in Schools**

- a) **Proliferation of wireless devices in Classrooms:** The use of wireless devices in classrooms has mushroomed in the last 10 years. Devices that emit RFR now include computers, tablets, cell phones, cordless phones, virtual reality headsets and whiteboards. In addition, some children are wearing wireless watches and air buds that also emit radiation close to the body and are a distraction to students.
- b) **Wireless devices are placed closer to the body.** Wireless devices such as laptops, tablets and cell phones are portable thus often used close to the body with increased exposure to reproductive organs and the brain (Fernandez 2018; Morgan 2014, Gandhi 2012). Some studies suggest that the levels of radiation may be close to or exceed ICNIRP guidelines (Belleini 2012) which have not been updated in over 20 years.
- c) **Research links manmade wireless exposures to many health risks.** Mobile communications devices transmit and receive radiofrequency radiation to transfer data. Wireless radiation is invisible but passes through walls, windows and living bodies. Current standards only regulate thermal (heat) levels. Numerous studies show that non-thermal levels of wireless radiation exposure can create oxidative stress in the body, which can cause damage to DNA, lipids, proteins and cell membranes (BioInitiative Report 2022). This oxidative stress can lead to cellular and internal organ inflammation. Research has demonstrated a clear link connecting radiofrequency radiation (RFR) to cancer, neurological decline, sleep and memory disruption, cardiovascular harm, reproductive failure and immune dysfunction. (Attah 2020; Miller 2018) Studies also suggest that these health risks are cumulative, increasing with increased RF exposure. Professor Tom Butler, author of **On the Clear Evidence of the Risks to Children from Non-Ionizing Radio Frequency Radiation: The Case of Digital Technologies in the Home, Classroom and Society**, describes the science and need for precaution. (Butler 2020)

- d) **Children are more vulnerable.** Children are more vulnerable to wireless radiation's adverse neurological effects due to their thinner skulls and developmentally immature brains. (Morgan 2014; Fernandez 2018; Gandhi 2012). Pregnant women are also at risk due to the vulnerability of the developing fetus (Li 2017) with associations found in animal and epidemiologic studies between prenatal exposures and ADHD and behavior (Divan 2008; Sudan 2012; Li 2020). Humans are now exposed from pregnancy to childhood and through adulthood, a full lifetime of exposure.
- e) **Neurologic effects identified:** The brain and nervous system are considered by many scientists to be the most sensitive target organ for microwave radiation as brain functioning depends on complex minute electrical signals. It is well established that neural development is complex and fragile. Prenatal toxic exposures to the brain can cause permanent and lifelong learning, memory and behavior disorders (Lanphear 2015; Landrigan 2011; Weiss 2000). The variable and sometimes subtle effects of toxins on the brain may not be evident until the child is older. Epidemiologic studies have shown prenatal exposure to wireless radiofrequency radiation causing postnatal neurologic changes. (Divan 2008; Sudan 2012; Li 2020).

**Foerster et al (2018)** published a prospective Swiss study of 700 adolescents over one year looking at **memory performance** and individual dose of RF radiation from wireless emissions. Their study found "that cumulative RF-EMF brain exposure from mobile phone use over one year may have a negative effect on the development of figural memory performance in adolescents, confirming results of their 2015 study. Other scientific research has shown consistent neurologic harm from RFR at non-thermal levels. **Ra et al (2018)** performed a longitudinal study examining the use of digital media in 2587 teens (15 and 16 year-olds) without attention-deficit/hyperactivity disorder (ADHD), in 10 Los Angeles schools, and found a significant increase in the development of ADHD symptoms over a 24 month period associated with higher digital media use.

**Meo et al (2018)** examined 300 students at 2 high schools over 2 years with different ambient RFR from cell tower radiation. One cell tower emitted 5-fold higher radiation than the other. The researchers found "a significant impairment in Motor Screening Task (MOT;  $p = .03$ ) and Spatial Working Memory (SWM) task ( $p = .04$ ) was identified among the group of students who were exposed to high RF-EMF produced by MPBSTs[mobile phone base stations]."

**Deniz et al (2017)** looked at the effects of cognitive performance as well as hippocampus structural changes in 60 medical students who use cell phones in the last 5 years a) less than 30 minutes a day versus b) Greater than 90 minutes a day. They found, "There was also no significant difference in terms of hippocampal volume between the groups ( $p > 0.05$ ). In contrast, the results of the stroop and digit span (backward) neurocognitive tests of high exposure group for evaluating attention were significantly poorer from low exposure group". They concluded that, "a lack of attention and concentration may occur in subjects who talk on mobile phones for longer times, compared to those who use phones relatively less."

## Cell Tower Neurologic and Cancer Effects

Dozens of international studies show neurologic and other health effects in residents who live in proximity to cell towers. This is dependent on the distance from the towers, with symptoms including:

- Headaches
- Insomnia
- Dizziness
- Irritability
- Fatigue
- heart palpitations
- nausea
- loss of appetite
- feeling of discomfort
- loss of libido
- poor concentration
- memory loss

**Santini (2002)** looked at a multitude of symptoms and distance from the tower. The most common symptom was fatigue followed by insomnia, headache, poor concentration, memory loss, irritability, heart palpitations and skin effects. These symptoms were noted when cell towers were within 200- 300 meters to homes. A follow up study Santini in 2003 revealed that older subjects reported more symptoms and were more sensitive. The authors noted that the duration of exposure of 1 to 5 years did not have an effect on frequency of symptoms but after 5 years there was a significant increase in irritability reported.

**Other studies point to longer term health problems** which can occur but would not be recognized for several years after towers are placed. This would require rigorous monitoring and surveys. The newest article by A. Balmori, (2022), **Evidence for a health risk by RF on humans living around mobile phone base stations: from radiofrequency sickness to cancer**, reviews the previous studies highlighting both short-term and long-term health effects of living near cell towers. Balmori concludes, “Overall results of this review show three types of effects by base station antennas on the health of people: radiofrequency sickness (RS), cancer (C) and changes in biochemical parameters (CBP). Considering all the studies reviewed globally (n = 38), 73.6% (28/38) showed effects: 73.9% (17/23) for radiofrequency sickness, 76.9% (10/13) for cancer and 75.0% (6/8) for changes in biochemical parameters...**Of special importance are the studies performed on animals or trees near base station antennas that cannot be aware of their proximity and to which psychosomatic effects can never be attributed.**”

**Dodd (2011)** performed a 10-year study (1996-2006) examining the distance from cell towers and cancer clusters. He and his colleagues found a highly significant increase in cancers in those living within 500 meters of the cell tower. They noted “The largest



density power was 40.78  $\mu\text{W}/\text{cm}^2$ , and the smallest was 0.04  $\mu\text{W}/\text{cm}^2$ .” The current guidelines are about 1000  $\mu\text{W}/\text{cm}^2$ . The authors conclude “Measured values stay below Brazilian Federal Law limits that are the same of ICNIRP. The human exposure pattern guidelines are inadequate. More restrictive limits must be adopted urgently.”

**Shinjyo and Shinjyo (2011)** in an independent cell tower study from Japan, looked at health effects of residents living in a condominium complex from 1998-2009. The authors surveyed the resident health symptoms before placement of cell towers, during cell tower functioning and after removal of different antennas on the rooftops. They found a significant development of symptoms with placement of the cell towers and a significant reduction in symptoms after removal.

**Zothansiamma (2017)** studied DNA damage and antioxidant status of those residing within a perimeter of 80 meters of mobile base stations and found “significantly ( $p < 0.0001$ ) higher frequency of micronuclei when compared to the control group, residing 300 m away from the mobile base station/s. The analysis of various antioxidants in the plasma of exposed individuals revealed a significant attrition in glutathione (GSH) concentration ( $p < 0.01$ ), activities of catalase (CAT) ( $p < 0.001$ ) and superoxide dismutase (SOD) ( $p < 0.001$ ) and rise in lipid peroxidation (LOO)”

**Pearce (2019)** looked at health effects of cell towers, publishing a peer reviewed industry paper, **Limiting liability with positioning to minimize negative health effects of cellular phone towers**, which recommends a 500 Meter buffer recommended around schools, hospitals and homes to limit liability.

### **Critical Windows of Neurodevelopmental Toxicity**

It has been known since the 1900’s that children are also particularly vulnerable to neurotoxic exposures, as seen with lead poisoning from paint, followed by mercury, arsenic and PCBs (Lanphear 2015). Lanphear notes a 17% increase in developmental disabilities in the last 2 decades and writes, “By the end of the twentieth century the “new morbidities of childhood”—attention deficit hyperactivity disorder (ADHD), autism, asthma, obesity, and preterm birth—had emerged. Learning disabilities and mental disorders are now two of the most prevalent morbidities in children.” We now know there are critical windows of neural development making different parts of the brain more susceptible to injury, continuation of brain development postnatally in the mid-twenties, and lifelong exposures to a host of toxins that may have synergistic effects (Li 2021). It appears wireless exposure is also a neurotoxin and could act synergistically with other toxic exposures (BioInitiative 2022; Kim 2018; Consales 2012; Balmori 2022; Bouji 2020; Shahain 2018; Othman 2017; Aldad 2012; Sudan 2012; Hu 2012; Pritchard:2015; Golomb 2019; Karimi 2018; Zhou 2007; Salford 2003).

### **Mechanisms**

Basic science and epidemiologic studies show an array of adverse effects on the nervous system and brain function from RFR. Wireless radiofrequency radiation has been shown to increase the permeability of the blood brain barrier, impair intracellular calcium homeostasis, alter neurotransmitter regulation, cause oxidative stress, and cause neuronal

loss, especially in the hippocampus which is the initial memory center of the brain (Karini 2018; Fragopoulos 2018; Shahain 2018)

### **Seizure Threshold and Cognitive Decline**

There is some evidence that Wi Fi radiation exposure can reduce the threshold for seizures. (Azmy 2020; Kouchaki 2016; Cinar 2013; Goldberg-Stern H 2012; Lopez-Martin 2006 & 2009) Cell tower studies show cognitive decline closer to cell towers (Balmori 2022; Meo 2018). A paper on industry liability considered the health effects of cell towers and recommended a 500 meter (1640 ft) distance between a cell tower and schools, hospitals and homes (Pearce 2020).

### **Prenatal Effects**

With regards to prenatal effects, a study was performed by Dr. Hugh Taylor, Chair Obstetrics, Gynecology, and Reproductive Sciences at Yale School of Medicine, on fetal radiofrequency exposure to pregnant mice. Dr. Taylor found that prenatal exposure to cell phone radiation resulted in behavioral effects in their offspring. (Aldid T et al. Nature. Scientific Reports 2013). Dr. Taylor, in an interview, emphasized the obligation of physicians to identify potential insults to the developing fetus. The study was well-designed and removed confounding factors. The researchers had cell phones muted and silenced or on active mode for variable amounts of time. Cell phones in one group were on and over the cage and in the control group were off and on the cage. They tested the offspring after maturity. The mice exposed to cell phones had decreased memory and were more likely to be hyperactive. There was a clear dose response effect noted in this study.

**Nervous system effects** from microwave radio frequency radiation which have been demonstrated in studies include:

- Oxidative Stress
- Hippocampus alterations (memory center)
- Alternation of neurotransmitters
- Hormonal changes
- Neurodegeneration
- Opening of the Blood brain barrier
- Memory loss
- Demyelination of nerves
- Reduction in Seizure threshold

### **f) Reproductive Effects Identified**

An enlarging body of research shows effects on sperm, ovaries, embryos, miscarriage, as well as neurologic postnatal effects on the fetus. A systematic review of the literature on effects of RFR during pregnancy supported an association with miscarriage, fluctuations in the fetal temperature and heart rate variability (Jaffar 2022). Magras in 1997 published his study of his long-term healthy lab mice which his lab has been successfully reproducing and studying for decades. He placed these mice in an isolated area of cell tower antennas and found, “A progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility.” The study ended as there was ultimately complete reproductive failure.

### **Sperm Damage**

Almost all studies of sperm and RFR exposure have found harmful effects. Kesari (2018) noted the increasing rate of infertility and reviewed the research on radiofrequency radiation from wireless devices and sperm damage. Dr. Kesari concludes that, “the RF-EMF may induce oxidative stress with an increased level of reactive oxygen species, which may lead to infertility. This has been concluded based on available evidences from in vitro and in vivo studies suggesting that RF-EMF exposure negatively affects sperm quality.”

### **Ovary Effects**

Ovarian effects of RFR have also been studied with oxidative injury found. Saygan looked at the impact of electromagnetic radiation (2.45 GHz, Wi-Fi) on the female reproductive system and the role of vitamin C to protect the cells from oxidation. The authors conclude, “These results indicate that prolonged EMR exposure induced pathophysiological changes in the ovarian, fallopian tubal, and uterine tissues due to oxidative damage. Under the conditions of this study, Vitamin C may have protective effects on female reproductive system against oxidative damage.” Alchalabi (2017) performed a similar study with variable times of exposure revealing abnormalities in the ovaries including lipid peroxidation, decreased antioxidant enzyme activity, micronuclei formation, vacuolation, degeneration and impaired folliculogenesis, all indicating impaired ovarian function.

### **Fertilization**

A study by Chen (2017) showed reduced “fertilization rate in mice, and reduce the blastulation rate, thus reducing the possibility of embryo implantation.” Several studies have shown similar results.

### **Fetal growth**

Boileau (2020) performed a prospective, longitudinal follow-up study of a cohort from Haute-Vienne looking at intrauterine development to the age of 18 years. He focused on fetal growth in children born between April 2014 and April 2017. The authors found that, “Using a mobile phone for calls for more than 30 min per day during pregnancy may have a negative impact on fetal growth.”

### **Miscarriage**

Dr. DK Li, a Kaiser researcher performed a rigorous prospective study of 913 pregnant women examining the association between high MF exposure and miscarriage risk. This was published in Scientific Reports in 2017. The women had everyday exposures to electromagnetic radiation sources which was measured with an exposometer. He followed these women to term. He found with the highest level of everyday radiation exposure an approximately 3-fold increase in miscarriage, despite the source of the exposure. “Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study”. Dr. Li previously looked at magnetic fields and pregnancy outcomes in 2002, “A population-based prospective cohort study of personal exposure to magnetic fields”. Researchers found, “miscarriage risk increased with an increasing level of maximum magnetic field exposure with a threshold around 16 milligauss (mG).”

### **Placental Effects**

Vafaei (2020) exposed pregnant mice to Wi-Fi signal (2.4 GHz) for 2 and 4 hr. Placenta tissues were examined showing lipid peroxidation, SOD activity (oxidative stress), apoptosis and gene overexpression.

- g) **Electrosensitivity (EHS)** to electromagnetic wireless radiation is increasingly recognized as a disability and environmental illness in both children and adults (Bevington 2019). Variable symptoms which occur in some individuals in the presence of wireless devices include, headaches, fatigue, dizziness, nausea, and heart palpitations. Predisposing factors include chemical sensitivities, prior toxic exposures, infections, impaired immune systems and genetic variation. It is estimated that 5%-30% of the population has mild EHS and 0.65% have a severe disability and cannot work or go to school due to wireless devices and infrastructure present. In the UK a student has recently received accommodation their disability.

Dr. Scott Eberly, a hospice physician, developed EHS after a carbon monoxide poisoning and relates his story and how he finally figured out that he had become sensitive to his wireless devices and how disabling that had been for him. His two articles are **What's the Diagnosis Doctor?** (Eberle 2014), **An underworld journey: Learning to cope with electromagnetic hypersensitivity.** (Eberle 2017). Jeromy Johnson, a Silicon Valley engineer, participated in a 2016 Ted Talk, **"Wireless Wake-up Call"** after he developed electrosensitivity from a bank of Smart Meters placed near his bedroom. While he admits there are wonderful advantages to wireless technology he calmly discusses his own personal story and why it is critical to protect children. A new article by Hardell and Carlberg (2022) discuss the development of Electrosensitivity in 2 individuals after a cell tower was placed.

### **Multiple Chemical Sensitivities and Electrohypersensitivity Links**

Belpomme and colleagues have looked at multiple chemical sensitivities (MCS) and Electrosensitivities (EHS) and found a crossover in symptoms of 30% with MCS and EHS and in 37% of patients MCS preceded EHS. The researchers identified the presence of oxidative inflammatory biomarkers that can be used diagnostically and are common in both conditions.

### **Electrosensitivity as a Disability**

**The United States Access Board (USAB)** recognizes electromagnetic sensitivity as a disability. The USAB, whose role is to advance "Full Access and Inclusion for All", issued a guideline recommending inclusion of both chemical sensitivity as well as electromagnetic sensitivity as disabilities. They stated in a review, "The Board recognizes that multiple chemical sensitivities and electromagnetic sensitivities may be considered disabilities under the ADA if they so severely impair the neurological, respiratory or

other functions of an individual that it substantially limits one or more of the individual's major life activities.”

**The Canadian Human Rights Commission (CHRC)** commissioned a research project, *Accommodation for Environmental Sensitivities*, in 2007, which examined legal assessments of accommodation for environmental sensitivities, including relevance of building codes and standards. The authors note, ““Individuals with environmental sensitivities experience adverse reactions to environmental agents that are prevalent throughout the built environment and include electromagnetic fields and the chemicals found in building materials, furniture, cleaning and copying products, fragrances and pesticides.”

**h) Distraction: Cell Phones and computers can be a distraction to learning in class.**

Studies have shown that cell phones are a distraction when on and even if turned off (Ward 2017). Many K-12 schools have banned cell phones in class with beneficial results in learning and behavior. California passed AB 272 in 2019 to encourage schools to formulate their own bans in classrooms. Schools across the nation have generally found good outcomes from this. San Mateo High School in California invested in a pouch system whereby the kids keep their phone in a locked pouch that can easily and quickly be opened by a device at the front of the room when kids leave. France banned cell phones in classrooms in 2018.

In addition, some college professors and law schools are banning computers during lectures and having students take notes by hand supporting current evidence that learning is improved. When Colorado schools banned cell phones they found 7 years later the student were happier and less stressed.

Veteran teacher Joe Clemens, co-author of **Screen Schooled** has observed with the introduction of digital technology in schools, “a significant difference in the ability of kids to focus, to interact socially, to think critically, to solve problems. They have all taken a noticeable dive over the past five to ten years.”

**i) Increased Digital Media Use Correlates with Increased Mental Health Problems.** Since the release of smartphones, studies have found significant increases in depression and other mental illness symptoms among children and young adults. Between 2008 and 2017, rates of depression, anxiety, psychological distress, low self-esteem and suicidal thoughts increased in these age groups. Those who spent more time on wireless devices and/or social media showed higher risks of such symptoms (Twenge 2006; Twenge 2017; Twenge 2019; Lissak 2018; Boers 2019). In 2017, the American Academy of Pediatrics published a special pediatrics supplement journal discussing the range of issues with digital media. (AAP 2017)

In January 2023 the Seattle School District, the largest in the state with 50,000 students, sued a number of high-profile tech companies including META, Facebook, Instagram, Tik Tok, Google, You Tube for harm to students. The lawsuit alleges that the companies “have successfully exploited the vulnerable brains of youth” to maximize how much time users spend on their platforms in order to boost profits. The actions taken by the platforms,

according to the suit, have “been a substantial factor in causing a youth mental health crisis, which has been marked by higher and higher proportions of youth struggling with anxiety, depression, thoughts of self-harm, and suicidal ideation.”

- j) **Internet addiction affects brain physiology and structure.** Increased use of wireless devices has enabled increased internet addiction, which now spans the globe to affect millions of youths. Studies looking at structural brain changes in internet-addicted teenagers and college students have consistently found atrophy of both the gray and white matter in the brain with shrinkage of tissues on the surface of the brain as well. (Lin 2011; Yuan 2022; Weng 2012; Wang 2013; Hong 2013; Wang 2016)The longer the addiction, the worse the effects. Such brain abnormalities could impair learning, cognition, concentration, memory, and/or emotional control.
- k) **Eye Effects: Wireless and digital devices add to excess blue light exposures and retinal damage.** Studies have found health risks to eyes linked not only to wireless radiation, but also to blue light exposures. Blue light reduces melatonin levels which can cause circadian rhythm disruption and impair sleep. Melatonin is also an important internal antioxidant. Excessive blue light exposure has been found to be a cause of retinal photoreceptor damage and now lens damage due to oxidative stress.[12]. Adults as well as students spend most of the waking day now and much of the night on screens. Homework is done online adding to screen time.

#### **French Report on Blue Light and Eye Health**

In 2014 ANES, the French Agency for Food, Environmental and Occupational Health & Safety, convened a Working Group and later published a report assessing the [effects on human health and the environment of systems using light-emitting diodes \(LEDs\)](#). Their goal was to measure current real life levels of blue light exposure of children, the general public and workers to blue light and then to assess risks. This was in response to policies developed to remove halogen and incandescent lighting to reduce energy consumption. They found that blue light has phototoxic, circadian rhythm and sleep effects. Blue light produces more glare and there is also more variation in light intensity depending on the power supply. Their report found the risks of exposure to blue light to be significant and proven to be related to Age Related Macular Degeneration (ARMD). They also reported that the exposure limits (ELs) selected by ICNIRP for the retinal toxicity of light are not sufficiently protective They recommended limiting exposure of blue light to children, establishing appropriate and effective blue light protective glasses and screens and reducing light pollution.

#### **Virtual Reality Headsets and Excess Exposure to RFR**

Virtual Reality use is rapidly increasing in homes, schools and even hospitals. While it may have limited value in some circumstances, the prolonged exposure of a powerful wireless device close to the eyes increases risks for injury including cataracts. Fernandez et al in 2018 looked at the absorption of FRF into adult and child brains demonstrating much deeper absorption of the RF radiation in the brains and eye of children. The article, **Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality**, concludes, “Age-specific simulations indicate the need to apply

refined methods for regulatory compliance testing; and for public education regarding manufacturers' advice to keep phones off the body, and prudent use to limit exposures, particularly to protect the young.”

**l) Learning: Pro and Cons of Digital Learning versus Book Learning**

Digital technology and internet learning are tools. There are pros and cons to using this technology in schools. While there is easy access to information it is argued by many experts this could lead to poor memory retention, cheating, distraction, access to inappropriate content, lack of movement and poor social interaction.

Evidence suggests that digital technology is processed in the brain differently than books and promotes “skim reading” rather than deep reading. Digital technology may compromise critical analysis, especially in younger grades.

**Australian School Bans Tablets**

In 2019 a private school in Sydney Australia suburbs banned iPads and went back to regular textbooks as the teachers agreed that the iPads did nothing to improve students skills. In the past the school had regularly appeared on the HSC top-ten honors list, the school reported that iPads were found to hinder learning. (Hambleton 2021, This School Banned iPads, Went Back to Regular Textbooks). The Principal felt that searching and note-taking was easier for students with hard copy textbook and this was also backed up by student's responses. The article notes that it is a cost savings to buy books as digital technology needs constant upgrading which is expensive. Concerns about constant student surveillance, privacy, commodification and commercial exploitation concerns have also been raised by parents and other non-profit organizations (Fairplay: Childhood Beyond Brands).

**Cameras On Adds Stress to Students**

Dr Ann Marcus-Quinn, a lecturer in Technical Communication and Instructional Design at the University of Limerick authored “Technostress: How Covid is straining teaching and learning noted that “Cameras on” policies in some schools exert pressure on teachers and students.” (The Irish Times. April 20, 2021)

**m) Policy Recommendations: Several agencies and organizations recommend reducing wireless exposures.**

Previous advisories and reports from a number of agencies have cautioned about wireless radiation health risks and advised reducing EMF exposures. Among those who have issued advisories and recommendations are the:

- a. European Commission Parliamentary in their 2011 Resolution 1815 Council of Europe has proposed restrictions on the Internet access and cell phone usage in all schools to protect the teenagers from potentially harmful EMFs [
- b. California Department of Health.
- c. American Academy of Pediatrics
- d. The German Federal Government recommended in 2007 report “to prefer conventional wired connections”

- e. The Russian Committee on Non-Ionizing Radiation Protection in 2008 warned that cell phones are unsafe even for short conversations. Children under 16, pregnant women, epileptics, and people with memory loss, sleep disorders and neurological diseases
  - f. Bavaria, Germany’s Parliament recommends against Wi-Fi in schools. [https://www.icems.eu/docs/deutscher\\_bundestag](https://www.icems.eu/docs/deutscher_bundestag).
  - g. Austrian Medical Association
  - h. Collaborative for High Performing Schools : Low EMF Environment (2014)
  - i. The New Jersey Education Association. (2016)
- n) Schools are adopting policies to restrict the use of cell phones including in California schools.** In the findings of Assembly Bill 272, the California Legislature recognized the “growing evidence” of harm associated with “unrestricted use of smartphones” by students at schools. Lower pupil performance, interference with teaching, and increases in depression, anxiety, and suicide were cited. The bill authorized schools to adopt policies that “limit or prohibit” smartphone use by students. **Other schools- Restricting devices works.** Smartphone limits have already succeeded in many schools. When San Mateo High School established a phone-free policy, response was overwhelmingly positive. Schools are having students place their phones in a pouch at the front of the class so they do not have access in the classrooms.
- o) Many believe the U.S. Federal Communications Commission’s wireless safety guidelines are outdated and inadequate.** Current standards are thermally based, however, current robust scientific evidence reveals that there are broad biologic non-thermal effects on human health and the environment. In 2021, a court ruled that the FCC’s decision to continue using outdated wireless safety guidelines was “arbitrary and capricious.” These guidelines were originally written in 1996. Experts believe these standards outdated since they have not incorporated more than 20 years of research documenting wireless radiation health risks and exclude non- thermal effects, sensitive populations such as children, the elderly, those with chronic illness or those who are electrosensitive. A recent publication by **International Commission on the Biological Effects of Electromagnetic Fields** thoroughly examines the flaws in health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation
- p) Schools have an obligation to provide a safe learning environment**
- q) Schools have an obligation to accommodate students who may have sensitivities or limitations to the use of wireless devices.**

**Addendum #2**  
**REFERENCES**

**Note: Reviews are highlighted in each section and may be beneficial for those who are less familiar with the subject. Research in this field as in all other scientific**



issues will continue and can be updated. This list is only an introduction to the vast amount of research available.

## Numbered General Supporting References

1) **CMA Resolution 107-14**

WIRELESS COMMUNICATIONS PUBLIC SAFETY STANDARDS REEVALUATION

**Resolved: That CMA supports efforts to reevaluate microwave safety exposure levels associated with wireless communication devices, including consideration of adverse non thermal biologic and health effects from non-ionizing electromagnetic radiation used in wireless communications; and be it further**

**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.**

2) **SCCMA Environmental Health Webinar Series 2021.**

**Children and Technology: Schools, Screens and Covid 19.** May 6, 2021.

Author and addiction specialist Nicholas Kardaras, PhD, LCSW; integrative Psychiatrist and author Dr. Victoria Dunckley and 2 veteran teachers and authors of “Screen Schooled”, Joe Clement and Matt Miles. 60 min.

<https://www.youtube.com/watch?v=2dWd4OsFsKQ&t=25s>

3) **CMA Resolution 105-20 What is the Internet Doing To Us? Digital Wellbeing in the Modern Age.** Type: Board Action

Date Adopted: 09/13/2021

RESOLVED: That CMA support further research on the health impacts of Internet and social media usage in all demographics; and be it further

RESOLVED: That CMA acknowledge the digital aspects of modern life and support evidence-based guidelines for the supervision of screen time for children; therefore be it

RESOLVED: That CMA support the use of evidence-based clinical and public health interventions such as advertisement campaigns and recommendations, that target social media usage and address its impacts on physical and mental health.

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Review of literature. High quality in vivo Wistar rat studies. 2.4 GHz and above Wi Fi. Of 1870 studies only 36 were included in the review.

“This review identified numerous biological changes in Wistar rats exposed to high RFR including variations in biochemical, cholinergic, genetic, histopathologic, psychological, optical, and dermatological parameters. In this review, studies identified variations in protein and liver enzymes while high RFR was found to induce oxidative stress and cellular damage of exposed wistar rats compared to the unexposed groups. This was seen in the changes in protein, lipids, enzymatic and non-enzymatic antioxidants. Studies also identified changes in expression of genes and neurotransmitters with imbalance in hormones. In addition, this review identified structural changes of cells, tissues and organs indicative of apoptosis, damage and death. Exposed rats were identified to have behavioral changes indicative of anxiety and memory decline while studies identified optical and dermatologic changes in exposed rats compared to the unexposed.”

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