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Comments to FCC Docket No. 19-226, proposed rules regarding human exposure to Radio Frequency Electromagnetic Fields

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I have struggled with sensitivity to Radio Frequency Electromagnetic Fields (RF-EMF) for over 20 years, and have had to become educated about them to reduce my symptoms. I reviewed summaries of published research by leading EMF scientists to understand what is known about effects of RF-EMF on human health. What I have found is that the current FCC guidelines for Maximum Permissible Exposure (MPE) for RF-EMF are dangerously high for a growing segment of the population in the U.S., and the MPE should be lowered, not increased. In 2012, a prominent EMF scientist recognized by peers as an expert in this field estimated that about 35% of the population in Canada, the U.S., and western Europe had moderate electromagnetic sensitivity (EMS) symptoms, and about 3% had severe symptoms; in the U.S., this would be about 120 million adults and children with moderate and 10 million with severe symptoms (**http://magdahavas.com).** Given the exponential growth of cell phones and strength of WiFi since that time, scientists and medical professionals from across the developed world agree that the number of persons with EMS will continue to increase (http://www.emfscientist.org). An appeal to the United Nations signed by 253 EMF Scientists from 44 nations calls for protection of people from non-ionizing electromagnetic field exposure. A link to this appeal is provided on the above website, and contains the following statement; ***"Wireless communication technologies are rapidly becoming an integral part of every economic sector. But there is a rapidly growing body of scientific evidence of harm to people, plants, animals, and microbes caused by exposure to these technologies. It is our opinion that adverse health consequences of chronic and involuntary exposure of people to non-ionizing electromagnetic field sources are being ignored by national and international health organizations despite our repeated inquiries as well as inquiries made by many other concerned scientists, medical doctors and advocates. This constitutes a clear violation of human rights, as defined by the United Nations".***

Table 1 in FCC Bulletin OET 65, in the category that covers exposure to RF-EMF from cell phones, cell towers, wireless internet routers and smart meters (1.5-100GHz), the maximum permissible exposure (MPE) for power density is 1 milliwatt/centimeter squared (mW/cm^2) which, on the surface, appears to be a small number (www.FCC.gov/general/oet-bulletins-line#65). However, when converted to the units most commonly used in other countries and by the scientific community conducting research in this area, this MPE is 10,000,000 microwatts/meter squared (uW/m^2). An example of how this regulation is applied, and its consequences, follows next. The specifications for a wireless transmitter recently installed outside of an office stated *"This device includes a radio transmitter and receiver. It is designed not to exceed the limits for exposure to radio frequency electromagnetic fields as referenced in FCC Part 1.1310 (MPE of 1mW/cm^2) and includes a substantial safety margin designed to insure the safety of all persons, regardless of health".* The power density of this transmitter is 0.6 mW/cm^2, which is 6,000,000 uW/m^2. Compare this to the Maximum Exposure of 100 uW/m^2

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set by the European Parliament and by the International Building Biology Standards, who in addition lowered RF-EMF maximum exposure to 0.1-10 uW/m^2 for sleeping areas! This person developed symptoms of EMS, including burning of the face and disrupted sleep, and was unable to work in her office. My EMS symptoms began with the use of laptop computers and wireless phones. One of my worst episodes occurred after a wireless transmitter was installed across the street from my winter home in Florida. Within a few days of exposure, my symptoms were severe tinnitus, a burning sensation in my mouth and airways, difficulty swallowing, and disrupted sleep. Within two weeks, the symptoms became intolerable and I had to sell the house. I purchased a modular home in a park that has aluminum siding and roof; this park does not have wireless transmitters. Using a TriField EMF meter model TF2, I made changes to reduce the power density for RF-EMF in the house to less than 10 uW/m^2, which included hardwiring computers and TV, and keeping cell phones on airplane mode except for brief periods to download and answer email. With those changes, my symptoms diminished. A prominent building biologist has been measuring the strength of RF-EMF of up to tens to hundreds of thousands of uW/m^2 in client's homes (http://www.createhealthyhomes.com). According to this building biologist, new 4GLTE/low band 5G hybrid antennas are being located in neighborhoods that increase the number of cell signals and information broadcast in the same airspace. They transmit at lower power but are much closer to people's homes to increase coverage and increase data download speeds. The amount of modulation and pulsing that occurs in creating and shaping the signal from these antennas results in homes in a neighborhood being bathed 24/7 with strong, always-on radio frequency radiation (RFR) that easily passes through walls and into our bodies. These advances in deployment of wireless technology have made their RFR more biologically active and potentially harmful to humans.

Biological basis of RF-EMF effects on human health

Accumulated international scientific research confirms that RF-EMF from wireless antennas and wireless devices are biologically active in humans and are now considered to be a risk to human health. Included are cellular stress, increase in harmful free radicals, genetic damage, structural and functional changes of the reproductive system, learning and memory deficits, and neurological disorders. Human bodies are bioelectrical systems. Our body functions are regulated by internal bioelectrical signals transmitted through neurons that comprise our nervous system. Some researchers conclude EMS is a neurological syndrome because exposures to EMFs can interact with fundamental biological processes in the human body. An international working group of 29 scientists and public health policy professionals from 10 countries reviewed over 2000 studies and released a report in 2012 on EMF and health, which was last updated in 2014 with over 1800 additional studies (http://www.bioinitiative.org). The research summarized in the Bio-initiative Report shows that EMFs can interfere with normal cardiac and brain function, alter circadian rhythms that regulate sleep, healing, and hormone balance; impair short-term memory, concentration, learning and behavior; provoke aberrant immune, allergic and inflammatory responses in tissues; alter brain metabolism; increase risks for reproductive failure (damage sperm and increase miscarriage risk); and cause cells to produce stress proteins. Exposures now common in home and school environments are likely to be physiologically additive and the effects are particularly serious in the young. They concluded

the following: ***"What is evident is that a growing number of people world-wide have serious and debilitating symptoms that key to various types of EMF and RFR (radiofrequency radiation) exposure. Of this there is little doubt. The continued massive rollout of wireless technologies, in particular the wireless phones has triggered thousands of complaints of ill-health and disabling symptoms".***

Recently, Belpomme et al. (Environmental Pollution volume 242 (2018):643-658) provided a holistic picture of the processes explaining most or all of the adverse effects of EMF exposures. They concluded EMS can be identified as a specific neurological disorder, which they characterized as a disease of the central nervous system. Several mechanisms at the cellular and molecular levels have been reported that may be the basis of the EMF effects on brain function. Consistent with the FCC, their summary of research to date indicated non-ionizing radiation typical of EMFs from electrical circuits and WiFi devices that humans are exposed to, does not have sufficient energy to directly break chemical bonds. However, cellular damage occurs with non-ionizing EMF exposures, primarily a consequence of generation of reactive oxygen species (ROS). ROS are electron-deficient molecules. Because of their electron deficiency, they react with cell components, including cell structural and functional proteins and DNA, and cell membranes. This loss of electrons to ROS can alter the function of or damage these substances or cell parts; this activity is described as oxidative stress. Oxidative stress occurs when there are not enough antioxidants present to give ROS an electron to reduce their damaging effects. There are numerous animal experiments that demonstrate EMFs can cause oxidative stress, particularly in the brain. Oxidative stress is known to play a central role in the development of brain cancer and aging and serves as a signaling agent in the inflammatory response. Bonhomme et al. (2018) published a model to describe the inflammation and oxidative stress-related mechanisms which likely account for EMF-and/or multiple chemical-related health effects in the brain which result in symptoms of EMS.

Diagnosing Electromagnetic Hypersensitivity

Much progress is being made on identifying specific symptoms and biomarkers for diagnosis and treatment of EMS, which were discussed in Section 24 of the Bio-initiative report cited above in the section "Key Scientific Evidence and Public Health Policy Recommendations". Exposures now common in home and school environments are likely to be physiologically additive and the effects are particularly serious in the young. ***A common symptom reported by those suffering from EMS is disrupted sleep. Disrupted sleep results in interfering with beneficial processes that happen when we sleep, including disruption of the normal sleep cycle during which melatonin is released from the pineal gland. Decreased melatonin adversely affects physiological functions, including our immune, nervous, endocrine and lymphatic systems. Also dopamine and serotonin secretion may be reduced. When melatonin levels remain high during sleep, fibromyalgia, allergies, headaches, insomnia, restless leg syndrome and even chemical sensitivities can be reduced.***

Belphomme et al. (Environmental Pollution volume 242 (2018):643-658) summarized studies in which different biomarkers were measured in the peripheral blood of patients with EMS

compared to values measured in those not having EMS. A marker was identified that can be measured in the urine, since it was decreased in 100% of all EMS cases evaluated to date. Also nearly 80% of the EMS patients had detectable oxidative stress biomarkers; more than 40% had more than one, 20% had more than two, and 15% had all 3 measured. This indicates that in addition to the inflammation biomarkers previously associated with EMS, they are also characterized by exhibiting oxidative stress markers**.**

The University of Toronto Women's College Hospital was the first hospital to officially recognize what they called electro-magnetic hyper-sensitivity syndrome, or "EMS". Their Environmental Health Clinic diagnoses and treats patients with environmental sensitivity, including chemical and EMFs (http://www.womenscollegehospital.ca/news-and-publications/connect/the-effects-of-invisible-waves) . In 2012, they released the following statement; ***"Family doctors must learn to detect the symptoms of exposure to wireless radiation at levels that have caused physiological response. Those symptoms include disrupted sleep, headaches, nausea, dizziness, heart palpitations, memory problems, and skin rashes. These symptoms are now labeled Electromagnetic sensitivity, or EMS".***

The Austrian Medical Association published guidelines for diagnosing and treating patients with EMS (http://www.electromagnetichealth.org/electromagnetic-health-blog/oak-emf-guidelines/):

1. ***History of health problems and EMF exposure [patient questionnaire].***
2. ***Examination and results of laboratory tests of blood and urine).***
3. ***Measurement of EMF exposure.***
4. ***Diagnosis.***
5. ***Treatment; at present prevention or reduction of EMF exposure.***

The third step above, measurement of EMF exposure, is done with an EMF meter to measure the strength of the EMFs in the bedroom and areas where the patient spends substantial time during waking hours, including at a desk with a computer, and at seating used for reading and watching TV. Guidelines for power densities shown below for safe levels of EMF's in these areas published by the International Institute for building biology Healthy Home Standard, page 42 should be used (www.buildingbiologyinstitute.org/free-downloads):

- **Less than 1 mG for AC magnetic fields,**
- **Less than 1.5 mV for AC electric fields, and**
- **Less than 10 uW/m^2) for radio frequency radiation.**

Summary and conclusions

A large body of International scientific research conducted by EMF scientists shows that RF-EMF from wireless antennas and wireless devices is biologically active in humans ,causing cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, and neurological disorders. As more powerful antennas (e.g. 4G/low band 5G hybrid antennas) are installed in neighborhoods to

increase coverage and data download speeds, which increases the number of cell signals and information broadcast in the same airspace, the number of people with EMS symptoms is likely to increase. The amount of modulation and pulsing that occurs in creating and shaping the cell signal from these antennas results in homes in a neighborhood being bathed 24/7 with strong, always-on radio frequency radiation that easily passes through walls. Recent increases in health symptoms in residents living near newly installed small cell antennas in neighborhoods are likely related to the signals they emit. ***The best way to solve this problem is to have FCC regulations that are based on summaries and evaluations of the large body of published research on the effects of RF-EMF on human health, as has been done in other countries.***