



A 5G WIRELESS FUTURE

WILL IT GIVE US A SMART NATION OR CONTRIBUTE TO AN UNHEALTHY ONE?

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It would greatly extend FCC's current policy of the mandatory irradiation of the public without adequate prior study of the potential health impact and assurance of safety. It would irradiate everyone, including the most vulnerable to harm from radiofrequency radiation: pregnant women, unborn children, young children, teenagers, men of reproductive age, the elderly, the disabled, and the chronically ill." —Ronald Powell, PhD, Letter to FCC on 5G expansion (7)

BRAVE NEW WORLD OF COMMUNICATION

The use of mobile wireless technologies continues to increase worldwide. A new faster 5th generation (5G) telecommunication system has recently been approved by the Federal Communications Commission (FCC) with new antennas already being installed and tested in Palo Alto and Mountain View. While it may give us uber automation and instantaneous "immersive entertainment" a lot of questions remain with regards to public health and safety of wireless devices. Will the adoption of this new 5G technology harm directly or indirectly the consumers and businesses it hopes to attract?

5G is the new promised land for wireless technology. It could connect us in our homes, workplaces and city streets to over a trillion objects around the world. (96) The Internet of Things (IoT) is primed to give us self-driving cars, appliances that can order their own laundry soap, automation hubs that pay your bills, not to mention fast movie downloads and virtual reality streaming from anywhere when you are on the go. Companies are already asking local cities and counties to move forward to create "Smart Cities" which have comprehensive digital connectivity by installing a massive wireless sensor network of almost invisible small cell antennae on light posts, utility poles, homes and businesses throughout neighborhoods and towns in order to integrate IoT with IT. They state it will improve services, the economy and quality of life. This communication network will

form an expanded electromagnetic microwave blanket above each city and county, permeating the airspace and providing seamless connectivity where people and things will exchange data.

Former Federal Communications Commission (FCC) chair Tom Wheeler called this a “National Priority” and thus ushered in approval for the addition of this new pervasive network of high frequency short wave millimeter broadband for commercial use first planned in urban areas.

DEVELOPING A “SMART” WORLD?

Engineers and physicists are busy working out the details of carrier frequencies and the architecture of the new network. Manufacturing industries are already developing commonly used products that feature wireless integration that will connect to the densely clustered antennas. Marketing companies are now pushing ads for “smart” devices for “smart” people in “smart” cities. Even the healthcare industry is anticipating using some of these wearable devices for patients with cardiac conditions or to do remote surgery in other parts of the world. Opening up 5G Spectrum access hopes to drive an explosion of new products. The economic opportunities are obvious and business will be booming in the tech industry.

Concerns continue to rise however about the basic safety of our current use of wireless technologies not to mention adding layers of newer microwave frequencies that have not been tested for short term or long term safety. Important questions have not been addressed while industry and government policy have already moved forward.

- Why is the FCC streamlining permitting of 5G high frequency when they have not completed their investigation on health effects nor updated safety limits for low-intensity radio frequency radiation?
- Is the widespread “deployment” of this pervasive higher frequency small cell distributed antennae system in our cities and on our homes safe for humans and the environment?
- Will it add to the burden of chronic disease that costs our nation over a trillion dollars annually? (105)
- Are we already digitally over connected, outsourcing our grey matter and becoming a dysfunctional addicted nation because of it? (136,137,138)
- How will this affect our privacy, cyber security and the security of medical records?
- Will we as physicians be able to recognize the emerging adverse health effects of new millimeter technology and wearable technology let alone that of current wireless devices?

A GOOD READ: FEDERAL COMMUNICATIONS COMMISSION 5G LETTERS

Letters to the FCC in 2016 responding to the 5G roll out with the addition of new high frequencies were mixed. Industry generally applauded the FCC for its efforts and discussed the growing demand for this technology along with a need for flexible regulation to implement it. Some expressed concerns about interference with other satellite systems. Some felt there should be maximum spectrum usage opening up even higher frequencies that are only experimental now in order to help “the underserved”. Others argued about opening this up to licensed versus unlicensed uses. Industry did not mention any potential public or environmental health hazards regarding the use of these new frequencies.

RAISING A RED FLAG TO PUSH THE PAUSE BUTTON ON 5G

Private citizens and Phd’s, however did raise a red flag at the FCC, recommending a halt to infrastructure plans and more testing for health and environmental reasons. They questioned the current FCC standards

which are outdated and not protective of human health. They asked “How will it affect children, pregnant women and the elderly who are the most vulnerable in our population?” While scientists gave ample evidence that precaution should prevail, I found the most compelling letters were from those who describe their fear as electro-sensitive people in an already dangerously high electromagnetic environment for them.

GIMME SHELTER: NO ESCAPE FOR ELECTRO-SENSITIVE INDIVIDUALS

Linda K., a Michigan resident, explained how she became increasingly sensitive to EMF after a cell tower was placed within 1000 feet of her house.

Linda K. described her electrosensitivity with increased exposure to wireless transmitters. In 1999, a cell tower was installed in her neighborhood 1000 feet from her home. She began sleeping very poorly but did not associate this with the cell tower. In 2008, when she turned on a new wireless computer, she became dizzy, nauseated, and couldn’t think. Symptoms ceased when the Wi-Fi card was removed. When smart meters were installed in her neighborhood in 2012 (but not on her home), she experienced severe insomnia. A month later she put together that the cell tower had been the cause of her earlier poor sleep. About two years later she noted an intense, uncomfortable feeling when walking by a nearby house and later identified a Wi-Fi hotspot on a wire going from the utility pole to the house. She stopped walking near the house. She wrote about her concerns and that the new frequencies may add to her symptoms and inability to leave her house. (54)

In another letter Veronica Z. noted “This is a notice of survival. What many of us deal with currently is trying to survive in an environment that is hostile to us biologically. We have lost all of our rights, our finances, our homes, our ability to earn a living due to this ubiquitous exposure. We are being tortured every second of every day and have been reduced to simply trying to survive the moments we are alive. Others have been unable to do so and have opted to not stay living on this planet of torture...There is no escape for people with severe sensitivities to this deadly radiation.” (55)

ASK NASA: IS ELECTRO-SENSITIVITY REAL OR IMAGINED?

Are these people telling the truth? Is this just psychological? You may wonder, however, more and more people from all ages, professions and walks of life are relating similar symptoms in the presence of wireless devices. Some children reported these symptoms when their school adopted WiFi.

Dr. Scott Eberle, a well respected Petaluma hospice physician, eloquently described his development of electro-sensitivity in the November 2016 issue of the SCCMA Bulletin. He goes to great lengths to continue his profession, interact with his colleagues and maintain a healthy existence. (67)

We are exposed to increasing levels of microwave EMF in our daily lives. More scientific evidence links biologic effects with increased reports of health related effects including electrosensitivity. In 1971 Russian scientists Gordon and Sadchikova from the Institute of Labor Hygiene and Occupational Diseases described a comprehensive series of symptoms which they called ‘microwave sickness’ and presented this at an international WHO meeting. (109)

In a 1981 NASA report, “Electromagnetic Field Interactions: Observed Effects and Theories” microwave sickness was also described. The symptoms recorded were headaches, eyestrain, fatigue, dizziness, disturbed sleep at night, sleepiness in daytime, moodiness, irritability, unso-ciability, hypochondriac reactions, feelings of fear, nervous tension, mental depression, memory impairment, pulling sensation in the scalp and

brow, loss of hair, pain in muscles and heart region, breathing difficulties, increased perspiration of extremities. (63)

THE SCIENCE OF ELECTRO-SENSITIVITY

Belpomme, in 2015, completed the most comprehensive study of electrosensitivity, investigating 1216 people: 71.6% with EHS, 7.2% with CS, and 21.2% with both. They found an elevation in several reliable disease biomarkers—each occurring within a range of 23% to 40% of all cases—which prompted their conclusion that these sensitivities can be objectively characterized and diagnosed and “appear to involve inflammation-related hyper-histaminemia, oxidative stress, autoimmune response, capsulothalamic hypoperfusion and pathological leakage of the blood-brain barrier, and a deficit in melatonin metabolic availability” (68)

THE SCIENCE OF EMF BIOLOGICAL HARM

The scientific literature abounds with evidence of non-thermal cellular damage from non-ionizing wireless radiation for several decades. There are likely several mechanisms both direct and indirect. Oxidative damage is one that has been well studied. Effects have been demonstrated on cell membranes causing a shift in the voltage gated calcium channels. Sperm studies have consistently found genotoxic, morphologic and motility abnormalities in the presence of cell phone radiation. DNA damage, blood brain barrier effects, melatonin reduction, nerve cell damage, mitochondrial disruption and memory disturbances have been revealed. The Bioinitiative Report (139) has chronicled these effects and a growing wave of PEER reviewed studies is building on that base daily. In 2011, the International Agency for Research on Cancer classified radiofrequency as 2B carcinogen and “possibly carcinogenic to humans”, the same category as DDT, lead and other pesticides.

THE LATEST SCIENCE: NATIONAL TOXICOLOGY PROGRAM STUDY ON CELL PHONES AND CANCER

The most recent and compelling evidence has come from the 2016 National Institutes of Health, National Toxicology Program. Called the NTP Toxicology and Carcinogenicity Cell Phone Radiation Study, the 10 year \$25 million research revealed conclusively that there was a harmful effect from cell phone microwave radiation. (124,125) The frequencies are similar to other wireless devices we commonly use. The studies were robust, collaborative, well controlled and with double the number of rats required to reveal a significant effect, if present. The preliminary results of the study showed that RFR caused a statistically significant increase in two types of brain tumors, gliomas and schwannomas. These were the same two types of tumors shown to increase in human epidemiological studies on long term use of cell phones. Dr. Lennart Hardell and others have demonstrated a consistent pattern of increased incidence of ipsilateral (same side) acoustic neuromas (vestibular schwannomas) and gliomas with each 100 hours of cell phone use. (112-118) Another telling finding was that the control rats had much lower than expected cancer rates. It is believed due to the fact the control rats were in a controlled faraday cage and not exposed to normal ambient EMF that could contribute to cancer.

Ron Melnik, PhD, Senior Toxicologist and Director of Special Pro-

grams in the Environmental Toxicology Program at the National Institute of Environmental Health Sciences (NIEHS) and designer of the study states, “The NTP tested the hypothesis that cell phone radiation could not cause health effects and that hypothesis has now been disproved. The experiment has been done and, after extensive reviews, the consensus is that there was a carcinogenic effect.” (124,125,126,127)

HEALTH EFFECTS OF MILLIMETER 5G WAVELENGTHS

The term “millimeter waves” (MMW) refers to extremely high-frequency (30-300 GHz) electromagnetic radiation. Millimeter Waves (MMW) used in the next-generation of high-speed wireless technologies have shallow penetration thus effect the skin surface, the surface of the eye or on bacteria, plants and small life forms. Surface effects, however, can be quite substantial on an organism as stimulation of skin receptors can affect nerve signaling causing a whole body response with physiological effects on heart rate, heart rhythm, and the immune system.

In a 1998 review article, Pakhomov (123) looked at the bio-effects of millimeter waves. He reviewed dozens of studies and cites research demonstrating profound effects of MMW on all biological systems including cells, bacteria, yeast, animals and humans. Some effects were clearly thermal as millimeter microwaves are rapidly absorbed by water which

is abundant in living organisms. When microwaves are absorbed the energy can cause tissue heating. Many of the millimeter frequency studies however showed effects without heating of tissues and at low intensities. Research was variable and showed both regenerative effects and also adverse effects depending on frequency, power and exposure time.

ARRHYTHMIAS

Chernyakov induced heart rate changes in anesthetized frogs by microwave irradiation of remote skin areas. Complete denervation of the heart did not prevent the reaction. This suggested a reflex mechanism of the MMW action involving certain peripheral receptors.(28)

HEART RATE VARIABILITY

Potekhina found certain frequencies from 53-78 GHz band (CW) changed the natural heart rate variability in anesthetized rats. He showed that some frequencies had no effect (61 or 75 GHz) while other frequencies (55 and 73 GHz) caused pronounced arrhythmia. There was no change in skin or whole body temperature. (69)

TERATOGENIC EFFECTS

One study of MMW teratogenic effects was performed in Drosophila flies by Belyaev. Embryos were exposed to 3 different GHz frequencies for 4-4.5 hours at 0.1 mW/cm². He found that irradiation at 46.35 GHz, but not at 46.42 or 46.50 GHz, caused marked effects including an increase in morphological abnormalities and decreased survival. It was felt the MMW disturbed DNA-protein interactions at that particular frequency.(65)

BACTERIAL AFFECTS AND ANTIBIOTIC RESISTANCE

Bulgakova in over 1,000 studies with 14 different antibiotics showed how MMW exposure of S. aureus affects its sensitivity to antibiotics with

“Over the past century, this natural environment has sharply changed with introduction of a vast and growing spectrum of man-made EM fields.”

Adey (135)

different mechanisms of action. The MMW increased or decreased antibiotic sensitivity depending on the antibiotic concentration. (134)

Pakhomov warns, “Regardless of the primary mechanism, the possibility of significant bio-effects of a short-term MMW irradiation at intensities at or below current safety standards deserves consideration and further study. The possibility of induction of adverse health effects by a local, low-intensity MMW irradiation is of potential significance for setting health and safety standards and requires special attention.” He called for replication of studies especially long term effects of MMW.

His conclusions:

1. Individuals or groups in a population, which would usually be regarded as uniform, may react to MMW in rather different or even opposite ways.
2. There seem to exist unknown and uncontrolled factors that determine the MMW sensitivity of a specimen or a population. Irradiation could increase antibiotic resistivity in one experiment and decrease it in the next one.
3. Increased sensitivity and even hypersensitivity of individuals to MMW may be real. Depending on the exposure characteristics, especially wavelength, a low-intensity MMW radiation was perceived by 30 to 80% of healthy examinees. (123)

CATARACTS

Prost in 1994 studied millimeter microwave radiation on the eye. He noted that microwaves of different wave-lengths can induce the development of cataracts. (13) His research found that low power millimeter waves produced lens opacity in rats exposed to 10mW/cm², a predisposing indicator of cataracts.(74)

IMMUNE SYSTEM

Kolomytseva, in 2002, looked at the dynamics of leukocyte number and functional activity of peripheral blood neutrophils under whole-body exposure of healthy mice to low-intensity extremely-high-frequency electromagnetic radiation (EHF EMR, 42.0 GHz, 0.15 mW/cm², 20 min daily). The study showed that the phagocytic activity of peripheral blood neutrophils was suppressed by about 50% in 2-3 h after a single exposure to EHF EMR.(131)

CHROMATIN EFFECTS

Gapeve in 2003 showed for the first time that low-intensity extremely high-frequency MMH electromagnetic radiation in vivo causes effects on spatial organization of chromatin in cells of lymphoid organs. Chromatin is a complex of DNA and proteins that forms chromosomes within the nucleus of eukaryotic cells. He exposed mice to a single whole-body exposure for 20 min at 42.0 GHz and 0.15 mW/cm². (132)

GENE EXPRESSION

Habauzit in 2013 looked at gene expression in keratinocytes with 60GHz exposure at upper limit of current guidelines and concluded “In our experimental design, the high number of modified genes (665) shows that the ICNIRP current limit is probably too permissive to prevent biological response. (73)

GAPS IN DATA FOR LAUNCHING 5G MILLIMETER DEVICES

Commercial production often precedes research on consumer protection and health effects. We have too many toxins that have escaped premarket safety protocols for too long—lead, asbestos, smoking and our modern unregulated nanoparticles to mention just a few. These affect our long term and short term health in ways we do not even know. If we become ill, we do not question or identify the daily or weekly chemical expo-

sure that could have contributed to that cancer or arthritis or lung disease or Alzheimer’s. We have too many toxins to sort it all out.

Research shows that wireless microwave radiation adds yet another dose of toxic exposure to our daily lives. We cannot hear it or smell it or feel it. Yet it affects our biology and our wellbeing with perhaps subtle affects. If we are electro-sensitive then we are more likely to avoid exposure. Trees are even susceptible to EMF harm and they cannot move away. (128) What about birds and bees and us?

CLOSE ENCOUNTERS: GOOGLE GLASS, VIRTUAL REALITY AND WEARABLE WIRELESS DEVICES

If we are concerned about putting a cell phone to our ears for long periods of time after reading about the NTP study then why aren’t we concerned about other wearable devices? While very cool to use Google Glass and Virtual Reality may have dangerous consequences to our eyes, brain function or immune systems with long term use, especially to children. What are the frequencies in these devices? 3G, 4G, 5G or a combination of zapping frequencies giving us immersive connection and entertainment but at a potentially steep price.

5G RESEARCH AND POLICY

Safety testing for 5G is the same as other wireless devices. It is based on heat. This is an obsolete standard and not considering current science showing cellular and organism harm from non-thermal effects. There is a large gap in safety data for 5G biological effects that has been demonstrated in older studies including military.

NEW RECOMMENDATIONS TO PROTECT PUBLIC HEALTH

1. Do not proceed to roll out 5G technologies pending pre-market studies on health effects.
2. Reevaluate safety standards based on long term as well as short term studies on biological effects.
3. Rescind a portion of Section 704 of the Telecommunications Act of 1996 which preempts state and local government regulation for the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects so that health and environmental issues can be addressed.
4. Rescind portions of The Spectrum Act which was passed in 2012 as part of the Middle Class Tax Relief and Job Creation Act, which strips the ability city officials and local governments to regulate cellular communications equipment, provides no public notification or opportunity for public input and may potentially result in environmental impacts.
5. Create an independent multidisciplinary scientific agency tasked with developing appropriate safety regulations, premarket testing and research needs in a transparent environment with public input.
6. Label pertinent EMF information on devices along with appropriate precautionary warnings.

REFERENCES

A full list of references used in this article are available at www.sccma-mcems.org.