For Express Mail 7100 N Rachel Way Unit 6 Eagles Rest Teton Village WY 83025



For U.S. Mail P.O. Box 58 Teton Village WY 83025 www.ehtrust.org

Re: Environmental and Health Effects of Telecommunications Infrastructure

Environmental Health Trust (EHT) is a nonprofit think tank and policy organization, founded in 2007, dedicated to identifying and reducing environmental health hazards. EHT provides independent scientific research and advice on controllable environmental hazards to local, state, and national governments. Today, we write to advise you of the published scientific grounds establishing why and how to avoid major health and environmental impacts from the installation of 5G wireless telecommunications facilities and associated wireless infrastructure in neighborhoods, parks and wilderness.

For 5G to operate for the foreseeable future, this will need to rely on 3G, 4G, and 5G technologies in order to allow existing devices to communicate. At this point, most 3G and 4G towers are located far from densely populated areas, for example at specified heights of tens of meters. A number of the proposed placements of 5G require close proximity to human habitation because the 5G signals cannot penetrate solid structures and are required every hundred meters or less. The transmissions to and from these proposed microwave wireless installations are emissions that are an environmental pollutant known to cause cancer (in both experimental animals and humans), DNA damage, neurological damage and other adverse health and environmental effects (e.g., on birds, bees, and trees) according to internationally recognized authoritative research. The prestigious institutions that have conducted these studies include the U.S. National Toxicology Program, the nation's premier testing institute, and the Ramazzini Institute, a foremost testing center of Italy.

The current guidelines put forth by the self-appointed, self-monitored, minority viewpoint of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), upon which European standards are based are not protective to humans as they are not based on documentation of safety for long term exposure. Furthermore, none of the limits was developed to ensure safety to flora and fauna. As the <u>Natural Resources Defense Council</u> has argued in U.S Courts, an environmental impact assessment should be performed before building out these networks.

Below we explain why more than 400 expert scientists and numerous medical professionals are calling for a halt to 5G and for the immediate reductions in both public exposure to microwave wireless radiation and the densification of wireless infrastructure<sup>12</sup>.

#### ICNIRP and FCC Limits Do not Protect People, Wildlife or the Environment

The exposure guidelines developed by the FCC and ICNIRP, were principally designed to protect against adverse thermal effects *only* and were based on studies of short-term high intensity exposures to animals. FCC and ICNIRP limits were not set after adequate investigations into effects after long term chronic exposure- the type of exposure the public will receive from 5G/4G densification. Research on impacts to the developing brain of children was not factored into the standard setting decisions of these groups decades ago, nor do these groups consider adverse impacts on male and female reproduction or DNA damage that has been shown to occur as a result of chronic non-thermal exposures.

The following is a sampling of counties with cell tower network radiofrequency radiation (RF) limits (maximum permissible limits) below ICNIRP and FCC limits: Belarus, Bulgaria, China, Lithuania, Poland, Russia, Belgium, Chile, Greece, India, Israel, Italy, Liechtenstein and Switzerland<sup>34567</sup>.

Countries such as India, China and Russia have much lower limits than ICNIRP and are considered "science based<sup>8</sup>." These limits are more stringent because they take into account research indicating adverse nonthermal health effects. According to Russian radiation experts, the following health hazards are likely to be faced in the near future by children who regularly use mobile phones: disruption of memory, decline in attention, diminished learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to stress, and increased epileptic readiness. For these reasons, special recommendations on child safety from mobile phones have been incorporated into the current Russian mobile phone standard."<sup>9</sup> China's cell tower limits are based on science showing effects which include behavioral, neurological, reproductive abnormalities, and DNA damage<sup>10</sup>. In 2011 the Parliamentary Assembly of the Council of Europe issued <u>Resolution 1815: "The Potential Dangers of Electromagnetic</u>

<sup>&</sup>lt;sup>1</sup> "Small Cell Towers, Mini Cell Towers, Wireless Facilities and Health: Letters from Scientists on the Health Risk of 5G," Environmental Health Trust, last modified September 20, 2017, <u>https://ehtrust.org/small-cells-mini-cell-towers-health-letters-scientists-health-risk-5g/</u>.

<sup>&</sup>lt;sup>2</sup> <u>The signatories – 5G Appeal 5G Appeal</u>

<sup>&</sup>lt;sup>3</sup> https://apps.who.int/gho/data/node.main.EMFLIMITSPUBLICRADIOFREQUENCY?lang=en

<sup>&</sup>lt;sup>4</sup> Wu T, Rappaport TS, Collins CM. <u>Safe for Generations to Come.</u> *IEEE Microw Mag.* 2015;16(2):65-84. doi:10.1109/MMM.2014.2377587 <sup>5</sup> China <u>Rationale for Setting EMF Exposure Standards\* Prof. Dr. Huai Chiang</u> as referenced by Wu 2015

<sup>&</sup>lt;sup>6</sup> <u>Comparison of international policies on electromagnetic fields (power frequency and radiofrequency fields)</u>, Rianne Stam, National Institute for Public Health and the Environment

<sup>&</sup>lt;sup>7</sup> Mary Redmayne (2016) <u>International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields</u> (<u>RF-EMF</u>)Electromagnetic Biology and Medicine, 35:2, 176-185, DOI: <u>10.3109/15368378.2015.1038832</u>

 <sup>&</sup>lt;sup>8</sup> Wu T, Rappaport TS, Collins CM. <u>Safe for Generations to Come</u>, *IEEE Microw Mag*, 2015;16(2):65-84. doi:10.1109/MMM.2014.2377587
 <sup>9</sup> Scientific basis for the Soviet and Russian radiofrequency standards for the general public

<sup>&</sup>lt;sup>10</sup> Prof. Dr. Huai Chiang. <u>Rationale for Setting EMF Exposure Standards</u>. Accessed July 8, 2020.

<u>Fields and Their Effect on the Environment.</u><sup>1112</sup>, A call to European governments to "take all reasonable measures" to reduce exposure to electromagnetic fields "particularly the exposure to children and young people who seem to be most at risk from head tumours." Resolution 1815 specifically states that governments "reconsider the scientific basis for the present standards on exposure to electromagnetic fields set by the International Commission on Non-Ionising Radiation Protection, which have serious limitations, and apply ALARA principles, covering both thermal effects and the athermic or biological effects of electromagnetic emissions or radiation."

In 2012, India's National Ministry of the Environment and Forest issued a <u>report</u> on the potential impacts of communication towers on wildlife with a focus on birds and bees, citing hundreds of research studies that found adverse effects. Recommendations from the Ministry include, "Introduce a law for protection of urban flora and fauna from emerging threats like ERM/EMF as conservation issues in urban areas are different from forested or wildlife habitats."<sup>13</sup> This <u>research</u> was published in the journal Biology and Medicine concluding "that out of the 919 research papers collected on birds, bees, plants, other animals, and humans, 593 showed impacts, 180 showed no impacts, and 196 were inconclusive studies." As a result of this research, the government tightened their allowable levels of radiofrequency radiation to 1/10 th of ICNIRP limits<sup>14</sup>.

As part of this letter, we are also submitting to you the July 8, 2020 letter to EHT Director Theodora Scarato from the Environmental Protection Agency's Director of the Radiation Protection Division and Office of Radiation and Indoor Air, Lee Ann B. Veal, that confirms that the EPA has never reviewed the impact of microwave radiation on birds, bees, or trees. Nor has any U.S. federal health agency ever set safety limits for trees, birds, or bees or the physical environment. No agency has a funded mandate to ensure our flora and fauna are safe from cell tower radiation. In other words, it is a gaping hole in federal accountability. The U.S. Department of the Interior sent a letter in 2014<sup>15</sup> reviewing several research studies showing harm to birds and concluding that "The electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."

A now-retired U.S. Fish and Wildlife Service wildlife biologist, the former lead on telecommunications impacts, Dr. Albert Manville, has <u>written to the FCC</u> on impacts to birds and on <u>higher frequencies to be</u>

<sup>&</sup>lt;sup>11</sup> Committee on the Environment, Agriculture and Local and Regional Affairs, Resolution 1815: "The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment," Doc. 12608, May 6, 2011, <u>https://pace.coe.int/en/files/13137/html</u>.

<sup>&</sup>lt;sup>12</sup> Parliamentary Assembly of the Council of Europe, Resolution 1815 Final Version, May 27, 2011, <u>http://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-en.asp?fileid=17994&</u>.

<sup>&</sup>lt;sup>13</sup> Expert Committee, Ministry of Environment and Forest, Government of India, <u>Report on Possible Impacts of Communication Towers on</u> <u>Wildlife Including Birds and Bees</u>, Constituted on 30th August, 2010.

<sup>&</sup>lt;sup>14</sup> S. Sivani and D. Sudarsanam, "Impacts of Radio-Frequency Electromagnetic Field (RF-EMF) from Cell Phone Towers and Wireless Devices on Biosystem and Ecosystem – A Review," *Biology and Medicine* 4, no.4 (January 2013), https://www.biolmedonline.com/Articles/Vol4 4 2012/Vol4 4 202-216 BM-8.pdf.

<sup>&</sup>lt;sup>15</sup> Washington DC, Veenendaal ME. Department of Interior Letter. United States Department of the Interior OFFICE OF THE SECRETARY.

used in 5G. Dr. Manville authored numerous publications detailing research showing harm to birds.<sup>16,17,18</sup> "The race to implement 5G and the push by FCC to approve the related 5G license frequencies to industry are very troubling and downright dangerous."

Scientists have not developed a safety standard that stipulates a "safe level."

#### **Documented Impacts to Wildlife and the Environment**

- "A review of the ecological effects of RF-EMF" reviewed 113 studies finding RF-EMF had a significant effect on birds, insects, other vertebrates, other organisms, and plants in 70% of the studies (Cucurachi 2013). Development and reproduction in birds and insects were the most strongly affected. As an example of the several studies on wildlife impacts, a study focusing on RF from antennas found increased sperm abnormalities in mice exposed to RF from GSM antennas (Otitoloju 2010).
- "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz" published in Scientific Reports is the first study to investigate how insects (including the Western honeybee) absorb the higher frequencies (2 GHz to 120 GHz) to be used in the 4G/5G rollout. The scientific simulations showed increases in absorbed power between 3% to 370% when the insects were exposed to the frequencies. Researchers concluded, "This could lead to changes in insect behaviour, physiology, and morphology over time...."
- Studies on bees have found behavioral effects (Kumar 2011, Favre 2011), disrupted navigation (Goldsworthy 2009, Sainudeen 2011, Kimmel et al. 2007), decreasing egg laying rate (Sharma and Kumar, 2010), and reduced colony strength (Sharma and Kumar, 2010, Harst et al. 2006).
- Research has also found a high level of damage to trees from antenna radiation. For example, a field monitoring study spanning 9 years involving over 100 trees (Waldmann-Selsam 2016) found trees sustained more damage on the side of the tree facing the antenna.
- A study on Aspen trees near Lyons, Colorado entitled "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings" published in the International Journal of Forestry found adverse effects on growth rate and fall anthocyanin production, concluding that "results of this preliminary experiment indicate that the RF background may be adversely affecting leaf and shoot growth and inhibiting fall production of anthocyanins associated with leaf senescence in Trembling Aspen seedlings. These effects suggest that exposure to the RF background may be an underlying factor in the recent rapid decline of Aspen populations. Further studies are underway to test this hypothesis in a more rigorous way."<sup>19</sup>
- An analysis of 45 peer-reviewed scientific publications (1996–2016) on changes in plants due to the non-thermal RF-EMF effects from mobile phone radiation entitled "Weak radiofrequency radiation exposure from mobile phone radiation on plants" concludes, "Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show

<sup>17</sup> Albert M. Manville Ph.D. Former U.S. Fish and Wildlife Service Senior Biologist. Memorandum on the Bird and Wildlife Impacts of Non-ionizing Radiation. Environmental Health Trust. Accessed July 8, 2020. <sup>18</sup> Manville AM. Collisions, Electrocutions, and Next Steps-Manville <u>BIRD STRIKES AND ELECTROCUTIONS AT POWER LINES</u>,

<sup>&</sup>lt;sup>16</sup> ECFS Filing Detail. https://www.fcc.gov/ecfs/filing/1060315601199. Accessed July 8, 2020.

COMMUNICATION TOWERS, AND WIND TURBINES: STATE OF THE ART AND STATE OF THE SCIENCE B NEXT STEPS TOWARD <u>MITIGATION 1</u>; 2002. <sup>19</sup> Katie Haggerty, "<u>Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings: Preliminary Observations</u>," *International* 

Journal of Forestry Research, vol. 2010, Article ID 836278, 7 pages, 2010. doi.org/10.1155/2010/836278.

physiological and/or morphological effects (89.9%, p < 0.001). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies...<sup>20</sup>

#### **Electromagnetic Fields Alter Animal and Insect Orientation**

<u>The European Scientific Committee on Health, Environmental and Emerging Risks</u> states "The lack of clear evidence to inform the development of exposure guidelines to 5G technology leaves open the possibility of unintended biological consequences."

*Science of the Total Environment* published environmental scientist Alforso Balmori's "<u>Anthropogenic</u> radiofrequency electromagnetic fields as an emerging threat to wildlife orientation," which states, "Current evidence indicates that exposure at levels that are found in the environment (in urban areas and near base stations) may particularly alter the receptor organs to orient in the magnetic field of the earth. These results could have important implications for migratory birds and insects, especially in urban areas, but could also apply to birds and insects in natural and protected areas where there are powerful base station emitters of radio frequencies. Therefore, more research on the effects of electromagnetic radiation in nature is needed to investigate this emerging threat."<sup>21</sup>

Multiple research studies have documented how animals' magnetoreception can be disrupted by external electromagnetic fields, from <u>mice</u><sup>22</sup> to <u>cows</u> to <u>dogs</u> to <u>birds</u>.<sup>23</sup> Electromagnetic exposure is especially disruptive to migratory birds.<sup>24</sup> Electromagnetic fields have been shown to disrupt the magnetic compass orientation used by birds to navigate.<sup>25,26</sup> Researchers have suggested this disruption of magnetoreception is due to cryptochrome photoreceptors that allow birds to use built-in receptors as a biological compass.

A <u>2017 report to UNESCO</u><sup>27</sup> by botanist Mark Broomhall details the association between increasing amounts of electromagnetic radiation from cellular antennas on the Mt. Nardi tower complex and species disappearance and exodus from the Mt. Nardi area of the Nightcap National Park World Heritage Area

<sup>&</sup>lt;sup>20</sup> Malka N. Halgamuge (2017) <u>Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants</u>, *Electromagnetic Biology and Medicine*, 36:2, 213-235, DOI: 10.1080/15368378.2016.1220389.

<sup>&</sup>lt;sup>21</sup> Alfonso Balmori, <u>Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation</u>, *Science of The Total Environment*, Volumes 518–519, 2015, Pages 58-60, ISSN 0048-9697, doi.org/10.1016/j.scitotenv.2015.02.077.

<sup>&</sup>lt;sup>22</sup> Malkemper, E.P., et al. <u>"Magnetoreception in the wood mouse (Apodemus sylvaticus): influence of weak frequency-modulated</u> radio frequency fields." *Scientific Reports*, vol. 4, no. 9917, 2015.

<sup>&</sup>lt;sup>23</sup> Wiltschko Roswitha, Thalau Peter, Gehring Dennis, Nießner Christine, Ritz Thorsten, Wiltschko Wolfgang. <u>Magnetoreception</u> in birds: the effect of radio-frequency fields.12. Journal of The Royal Society Interface.

<sup>&</sup>lt;sup>24</sup> Engels, Svenja, et al. <u>"Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird."</u> *Nature* 509.7500 (2014): 353-356.

<sup>&</sup>lt;sup>25</sup> Wiltschko, Roswitha, et al. <u>"Magnetoreception in birds: the effect of radio-frequency fields."</u> *Journal of The Royal Society Interface* 12.103 (2015): 20141103.

 <sup>&</sup>lt;sup>26</sup> Schwarze, S., et al. <u>"Weak Broadband Electromagnetic Fields are More Disruptive to Magnetic Compass Orientation in a Night-Migratory Songbird (Erithacus rubecula) than Strong Narrow-Band Fields.</u> *Front Behav Neurosci.* 10.55 (2016).
 <sup>27</sup> Broomhall, Mark. <u>"Report detailing the exodus of species from the Mt. Nardi area of the Nightcap National Park World</u>"

Heritage Area during a 15-year period (2000-2015.)<sup>2</sup> United Nations Scientific and Cultural Organization (2017).

during a 15-year period (2000–2015). He estimates "in both volume and species that from 70 to 90% of the wildlife has become rare or has disappeared from the Nightcap National Park within a radius of the Mt. Nardi tower complex. This statement can be summarised with concrete data: 3 bat species once common have become rare or gone, 11 threatened and endangered bird species are gone, 11 migratory bird species are gone, 86 bird species are demonstrating unnatural behaviours, 66 once common bird species are now rare or gone." The Report concludes, "With these short explanations of events we can appreciate that the effects of this technology and its application on Mt. Nardi over the last fifteen years, affect not only the top of the life chain species but they are devastating the fabric of the continuity of the World Heritage, causing genetic deterioration in an insidious, massive and ever escalating scale. To truly understand what these studies reveal is to stare into the abyss."

It is very important that in considering antenna placement, there be a full environmental assessment on migratory animal patterns (from the smallest to the largest) and not simply on birds and mammals like the pronghorn but also on impacts to amphibians and insects. In addition, studies also indicate that low levels of radiation can impair processes critical to the growth and development of plants, trees, (reference Malka Halgamuge and me, 2020)

#### Wireless Radiation is a Public Health Issue

Human health effects include impaired reproduction, increased incidence of brain cancer, DNA breaks, oxidative stress, immune dysfunction, altered brain development, sleep changes, hyperactivity, and memory and cognitive problems.<sup>28</sup> Since the WHO/IARC <u>classified EMF as a Group 2B Possible</u> <u>Carcinogen</u> in 2011, the peer-reviewed research connecting wireless exposure to cancer has significantly strengthened and several scientists have published documentation that the weight of current peer-reviewed evidence supports the conclusion that radiofrequency radiation should be regarded as a human carcinogen.<sup>29,30,31</sup>

 The 10-year \$30 million National Institute of Environmental Health Sciences National Toxicology Program's (NTP) <u>"Studies of the Toxicology and Carcinogenicity of Cell Phone</u> <u>Radiation</u>"<sup>32,33</sup> found that RFR was associated with "clear evidence" of cancer due to the increased malignant schwannomas found in RFR-exposed male rats. The brain (glioma) cancers and tumors in the adrenal glands were also considered evidence of an association with cancer. In

<sup>&</sup>lt;sup>28</sup> For more information on acute health symptoms, see, e.g., Martin Pall, Microwave Frequency Electromagnetic Fields (EMFs) Produce Widespread Neuropsychiatric Effects Including Depression, 75 *J. Chemical Neuroanatomy* 43-51 (Sept. 2016); Response of residents living in the vicinity of a cellular phone base station in France ; Electromagnetic Fields: A Hazard to Your Health?, Healthy Children.

<sup>&</sup>lt;sup>29</sup> Adams, Jessica A., et al. <u>"Effect of mobile telephones on sperm quality: a systematic review and meta-analysis."</u> *Environment International*, 70, 2014, pp. 106-112.

 <sup>&</sup>lt;sup>30</sup> Deshmukh, P.S., et al. "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation." *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.
 <sup>31</sup> Aldad, T.S., et al. "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects"

<sup>&</sup>lt;sup>31</sup> Aldad, T.S., et al. <u>"Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects</u> <u>Neurodevelopment and Behavior in Mice.</u> *Scientific Reports*, vol. 2, no. 312, 2012.

<sup>&</sup>lt;sup>32</sup> National Toxicology Program, <u>Cell Phone Radio Frequency Radiation</u>

<sup>&</sup>lt;sup>33</sup> High exposure to radio frequency radiation associated with cancer in male rats

addition, exposed animals had significantly more DNA damage, heart damage, and low birth weight.

- The Ramazzini Institute published its findings<sup>34</sup> that animals exposed to very low-level RFR developed the same types of cancers as reported by the NTP.
- Long-term research on humans who have used cell phones has found increased tumors-schwannomas and glioblastomas-the same cell type as found in the NTP and Ramazzini Institute studies. Persons who started using cell phones under age 20 had the highest risk 35
- A 2015 Jacobs University study (replicating a 2010 study) found that weak cell phone signals significantly promote the growth of tumors in mice and that combining a toxic chemical exposure with RF more than doubled the tumor response.<sup>36,37</sup>
- A study published in Electromagnetic Biology and Medicine, "Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base station," compared people living close and far from cell antennas and found that people living closer to cell antennas had higher radiation levels in the homes and several significant changes in their blood predictive of cancer development."38
- A 2019 study of students in schools near cell towers found their higher RF exposure was associated with impacts on motor skills, memory, and attention (Meo 2019).<sup>39</sup> Examples of other effects linked to cell towers in research studies include neuropsychiatric problems.<sup>40</sup> elevated

```
<sup>35</sup> https://www.pathophysiologyjournal.com/article/S0928-4680(14)00064-9/fulltext
```

<sup>38</sup>Zothansiama & Zosangzuali, Mary & Lalramdinpuii, Miriam & Jagetia, Ganesh & Siama, Zothan. (2017). Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. Electromagnetic Biology and Medicine. 36. 1-11. 10.1080/15368378.2017.1350584.

<sup>39</sup> Meo, S. A., Almahmoud, M., Alsultan, O., Alotaibi, N., Alnaiashi, I., & Haijar, W. M. (2019), Mobile Phone Base Station Tower Settings Adjacent to School Buildings: Impact on Students' Cognitive Health. American Journal of Men's Health. doi.org/10.1177/1557988318816914.

<sup>&</sup>lt;sup>34</sup> L. Falcioni, L. Bua, E. Tibaldi, M. Lauriola, L. De Angelis, F. Gnudi, D. Mandrioli, M. Manservigi, F. Manservisi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Strollo, A. Vornoli, F. Belpoggi, Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. Environmental Research, Volume 165, 2018. Pages 496-503. ISSN 0013-9351. doi.org/10.1016/j.envres.2018.01.037.

<sup>&</sup>lt;sup>36</sup> Lerchl, Alexander, et al. "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans." Biochemical and Biophysical Research Communications, vol. 459, no. 4, 2015, pp. 585-90. <sup>37</sup> Tillmann, Thomas, et al. "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an

ethylnitrosourea mouse model." International Journal of Radiation Biology, vol. 86, no. 7, 2010, pp. 529-41.

<sup>&</sup>lt;sup>40</sup> G. Abdel-Rassoul, O. Abou El-Fateh, M. Abou Salem, A. Michael, F. Farahat, M. El-Batanouny, E. Salem, <u>Neurobehavioral</u> effects among inhabitants around mobile phone base stations, NeuroToxicology, Volume 28, Issue 2, 2007, Pages 434-440, ISSN 0161-813X, doi.org/10.1016/j.neuro.2006.07.012.

diabetes,<sup>41</sup> headaches,<sup>42</sup> sleep problems,<sup>43</sup> and genetic damage.<sup>44</sup> Such research continues to accumulate after the 2010 landmark <u>review study</u> on 56 studies that reported biological effects found at very low intensities of wireless radiation, including impacts on reproduction, permeability of the blood-brain barrier, behavior, cellular changes, and metabolic changes, and increases in cancer risk (Lai and Levitt 2010).<sup>45</sup>

• Published research has found impacts from wireless radiation exposure to <u>reproduction</u> and <u>brain</u> <u>development</u> in addition to a myriad of other adverse effects.<sup>46,47,48,49</sup> Although renowned institutions, such as the Cleveland Clinic, advise men to keep phones and wireless devices away from their reproductive organs, the public remains largely unaware.

Once the towers are erected, they will be upgraded over time with new antennas and soon 5G technology. 5G would use today's wireless frequencies while adding new, higher frequencies to transmit data at faster speeds. These higher frequency sub-millimeter waves are absorbed to a higher degree by the eyes and skin,<sup>50,20,21,22</sup> and have been shown to accelerate bacterial growth.<sup>51</sup> Currently accepted standards are not sophisticated enough to quantify the risks of cumulative exposure.<sup>52,53</sup>Any future applications of these technologies must consider the biological effect of cumulative exposures to these frequencies.

<sup>&</sup>lt;sup>41</sup> SA, Meo & Alsubaie, Yazeed & Almubarak, Zaid & Almutawa, Hisham & AlQasem, Yazeed & Hasanato, Rana. (2015). Association of Exposure to Radio-Frequency Electromagnetic Field Radiation (RF-EMFR) Generated by Mobile Phone Base Stations with Glycated Hemoglobin (HbA1c) and Risk of Type 2 Diabetes Mellitus. International Journal of Environmental Research and Public Health. 12. 14519-14528; 10.3390/ijerph121114519.

<sup>&</sup>lt;sup>42</sup> Hutter, H. P., Moshammer, H., Wallner, P., & Kundi, M. (2006). <u>Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations</u>. *Occupational and environmental medicine*, *63*(5), 307–313. doi:10.1136/oem.2005.020784.

<sup>&</sup>lt;sup>43</sup> R. Santini, P. Santini, J.M. Danze, P. Le Ruz, M. Seigne, <u>Enquête sur la santé de riverains de stations relais de téléphonie</u> mobile: <u>I/Incidences de la distance et du sexe</u>, Pathologie Biologie,

Volume 50, Issue 6, 2002, Pages 369-373, ISSN 0369-8114, doi.org/10.1016/S0369-8114(02)00311-5.

<sup>&</sup>lt;sup>44</sup> Gursatej Gandhi, Gurpreet Kaur & Uzma Nisar (2015) <u>A cross-sectional case control study on genetic damage in individuals</u> residing in the vicinity of a mobile phone base station, Electromagnetic Biology and Medicine, 34:4,344-354, DOI: 10.3109/15368378.2014.933349.

 <sup>&</sup>lt;sup>45</sup> B. Blake Levitt and Henry Lai, <u>Biological effects from exposure to electromagnetic radiation emitted by cell tower base</u> stations and other antenna arrays, Environ. Rev. Downloaded from www.nrcresearchpress.com by 172.58.41.200 on 04/10/19
 <sup>46</sup> Adams, Jessica A., et al. <u>"Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International*, 70, 2014, pp. 106-112.
</u>

<sup>&</sup>lt;sup>47</sup> Deshmukh, P.S., et al. <u>"Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation."</u> *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.

<sup>&</sup>lt;sup>48</sup> Aldad, T.S., et al. <u>"Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects</u> <u>Neurodevelopment and Behavior in Mice.</u> *Scientific Reports*, vol. 2, no. 312, 2012.

<sup>&</sup>lt;sup>49</sup> Sonmez, O.F., et al. <u>"Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz</u> electromagnetic field." *Brain Research*, vol. 1356, 2010, pp. 95-101.

<sup>&</sup>lt;sup>50</sup> A <u>lecture</u> by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the <u>2017 IIAS</u> <u>Conference website</u>. Feldman, Yuri and Paul Ben-Ishai. <u>"Potential Risks to Human Health Originating from Future Sub-MM</u> <u>Communication Systems."</u> *Conference on Wireless and Health*, 2017.

<sup>&</sup>lt;sup>51</sup> Cindy L. Russell, <u>5G Wireless Telecommunications Expansion: Public Health and Environmental Implications</u>, 165 Envt'l Res. 484 (2018).

 <sup>&</sup>lt;sup>52</sup> A lecture by Paul Ben-Ishai, PhD at the Israel Institute for Advanced Studies on this finding can be found on the <u>2017 IIAS</u> Conference website. Feldman, Yuri and Paul Ben-Ishai. <u>"Potential Risks to Human Health Originating from Future Sub-MM</u> Communication Systems." Conference on Wireless and Health, 2017.
 <sup>53</sup> Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. <u>"Circular polarization induced by the three-dimensional</u>"

<sup>&</sup>lt;sup>53</sup> Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. <u>"Circular polarization induced by the three-dimensional chiral structure of human sweat ducts.</u>" *Physical Review E*, vol. 89, no. 042715, 2014.

"<u>5G wireless telecommunications expansion: Public health and environmental implications</u>," is a research review published in *Environmental Research*, which documents the range of adverse effects reported in the published literature, from cancer to bacteria growth changes to DNA damage, concludes that "a moratorium on the deployment of 5G is warranted" and "the addition of this added high-frequency 5G radiation to an already complex mix of lower frequencies, will contribute to a negative public health outcome both from both physical and mental health perspectives."<sup>54</sup>

# Radiofrequency radiation exposure is increasing at a rapid pace.

A <u>2018 article</u> published in *The Lancet Planetary Health* points to unprecedented increasing RF exposures, and the abstract concludes, "due to the exponential increase in the use of wireless personal communication devices (eg, mobile or cordless phones and WiFi or Bluetooth-enabled devices) and the infrastructure facilitating them, levels of exposure to radiofrequency electromagnetic radiation around the 1 GHz frequency band, which is mostly used for modern wireless communications, have increased from extremely low natural levels by about 1018 times..."(Bandara and Carpenter, 2018).<sup>55</sup>

Another key finding from <u>Zothansiama 2017</u> was that homes closer to antennas had measurably higher radiation levels—adding to the documentation that antennas increase RF levels. An <u>Australian study</u> also found that children in kindergartens with nearby antenna installations had nearly three-and-a-half times higher RF exposures than children with installations further away (more than 300 meters) (<u>Bhatt 2016</u>).<sup>56</sup>

A 2018 multi-country <u>study</u> that measured RF in several countries found that cell phone tower radiation is the dominant contributor to RF exposure in most outdoor areas exposure in urban areas was higher and that exposure has drastically increased. As an example, the measurements the researchers <u>took</u> in Los Angeles, USA was 70 times higher than the US EPA estimate 40 years ago.<sup>57</sup>

# **Telecommunications Companies Warn Their Shareholders**

In fact, a number of corporations already advise their shareholders that they could face serious financial risks from the health damages due to RF. For instance, Crown Castle's <u>2019 10-K ANNUAL REPORT</u> states that,

If radio frequency emissions from wireless handsets or equipment on our communications infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues.

<sup>&</sup>lt;sup>54</sup> https://doi.org/10.1016/j.envres.2018.01.016

 <sup>&</sup>lt;sup>55</sup> Priyanka Bandara, David O Carpenter, <u>Planetary electromagnetic pollution: it is time to assess its impact</u>, *The Lancet Planetary Health*, Volume 2, Issue 12, 2018, Pages e512-e514, ISSN 2542-5196, doi.org/10.1016/S2542-5196(18)30221-3.
 <sup>56</sup> Bhatt, C. R., Redmayne, M., Billah, B., Abramson, M. J., & Benke, G. (2016). <u>Radiofrequency-electromagnetic field</u> exposures in kindergarten children. *Journal Of Exposure Science And Environmental Epidemiology*, *27*, 497. Retrieved from https://doi.org/10.1038/jes.2016.55.

<sup>&</sup>lt;sup>57</sup> Sanjay Sagar, Seid M. Adem, Benjamin Struchen, Sarah P. Loughran, Michael E. Brunjes, Lisa Arangua, Mohamed Aqiel Dalvie, Rodney J. Croft, Michael Jerrett, Joel M. Moskowitz, Tony Kuo, Martin Röösli, <u>Comparison of radiofrequency</u> electromagnetic field exposure levels in different everyday microenvironments in an international context, Environment International, Volume 114, 2018, Pages 297-306, ISSN 0160-4120, doi.org/10.1016/j.envint.2018.02.036.

The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us. If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters.

Most wireless companies, from AT&T to Nokia to T Mobile to Verizon Wireless, have issued <u>similar</u> <u>warnings</u> to their shareholders. Why are shareholders being warned but not the people living near the equipment? These disclosures show that even corporations cannot assure safety.

Due to these evaluations and the published scientific evidence, cell phone manufacturers cannot insure against health damages from the radiofrequency radiation emitted by their products and networks. In fact, most insurance plans do not cover electromagnetic fields (EMF) and have very clear "electromagnetic field exclusions." In order for insurance companies to cover EMF, one often must purchase additional "Pollution Liability" or "Policy Enhancement" coverage.

According to CFC Underwriting LTD in London, the UK agent for Lloyd's:

"The Electromagnetic Fields Exclusion (Exclusion 32) is a General Insurance Exclusion and is applied across the market as standard. The purpose of the exclusion is to exclude cover for illnesses caused by continuous long-term non-ionising radiation exposure i.e. through mobile phone usage."

Even <u>AT&T Mobile Insurance</u> excludes loss from "pollutants," and its policy defines "Pollutants" as "Any solid, liquid, gaseous, or thermal irritant or contaminant including smoke, vapor, soot, fumes, acid, alkalis, chemicals, artificially produced electric fields, magnetic field, electromagnetic field, sound waves, microwaves, and all artificially produced ionizing or non- ionizing radiation and waste" (pg. 4) <u>AT &T</u> <u>Mobile Insurance Policy, February 2014</u>.

If insurance companies will not insure EMF, and if even telecommunications companies consider EMF as a "pollutant," how can governments allow such an environmental pollutant without also warning their citizens as companies do?

# 5G Will Increase RF Exposures to the Environment and 5G Antenna Beamforming Exposures Cannot Be Accurately Measured

A 2019 European Parliament Report "<u>5G Deployment: State of Play in Europe, USA, and Asia</u>"<sup>58</sup> confirms increased exposure from the 5G/4G Densification, stating, "increased exposure may result not

<sup>&</sup>lt;sup>58</sup> BLACKMAN, C. and FORGE, S. (2019). 5G Deployment State of Play in Europe, USA and Asia. [PDF] European Parliament's Committee on Industry, Research and Energy. Available at:

https://www.europarl.europa.eu/RegData/etudes/IDAN/2019/631060/IPOL\_IDA(2019)631060\_EN.pdf [Accessed 24 Feb. 2020].

only from the use of much higher frequencies in 5G but also from the potential for the aggregation of different signals, their dynamic nature, and the complex interference effects that may result, especially in dense urban areas." The report points out that it currently "is not possible to accurately simulate or measure 5G emissions in the real world," stating,

[T]he 5G radio emission fields are quite different to those of previous generations because of their complex beamformed transmissions in both directions – from base station to handset and for the return. Although fields are highly focused by beams, they vary rapidly with time and movement and so are unpredictable, as the signal levels and patterns interact as a closed loop system. This has yet to be mapped reliably for real situations, outside the laboratory.

A <u>2018 study</u> published in Annals of Telecommunications found increased RF-EMF exposure from small cell LTE networks in two urban cities in France and the Netherlands. Researchers measured the RF-EMF from LTE (Long-Term Evolution), MC (macro cells meaning large cell towers), and SC networks (low-powered small cell base stations) and found that the small cell networks increased the radio emissions from base stations (called downlink) by a factor of 7–46 while decreasing the radio emissions from user equipment exposure (called uplink) by a factor of 5–17. So while the devices themselves could emit less radiation, the cell antennas will increase the ambient environmental levels (Mazloum et al., 2019). This study shows the increased exposures would be involuntary. We can turn our phones off, but we cannot turn off the antennas in the neighborhood. The birds, bees, and trees have no choice.

Thank you for your consideration of this issue. We would like to set up a phone call to discuss this issue further.

Sincerely,

Devra Arvis

Devra Davis, PhD, MPH Fellow, American College of Epidemiology Visiting Prof. Hebrew Univ. Hadassah Medical Center & Ondokuz Mayis Univ. Medical School Associate Editor, Frontiers in Radiation and Health President, Environmental Health Trust

Theodora Scarato Executive Director, Environmental Health Trust

# **Research Studies on Impacts to Wildlife and Trees**

Waldmann-Selsam, C., et al. <u>"Radiofrequency radiation injures trees around mobile phone base stations.</u>" Science of the Total Environment 572 (2016): 554-69.

Breunig, Helmut. <u>"Tree Damage Caused By Mobile Phone Base Stations An Observation Guide.</u>" (2017). You can also download the Tree Observation Guide at: <u>Competence Initiative for the Protection of</u> <u>Humanity, the Environment and Democracy</u>

S Sivani, D Sudarsanam, <u>Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone</u> <u>towers and wireless devices on biosystem and ecosystem ? A review</u>, Volume 4, Issue 4, Pages 202–216, 2012

Haggerty, Katie. <u>"Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings.</u>" International Journal of Forestry Research2010.836278 (2010).

Halgamuge, M.N. <u>"Weak radiofrequency radiation exposure from mobile phone radiation on plants."</u> Electromagnetic Biology and Medicine, vol. 36, no. 2, 2017, pp. 213-235.

Martin Pall. <u>"Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of</u> <u>Calcium Channels via Their Voltage Sensor</u>"Current Chemical Biology, Volume 10, Issue 1, 2016 Shikha Chandel, et al. <u>"Exposure to 2100 MHz electromagnetic field radiations induces reactive oxygen</u> <u>species generation in Allium cepa roots.</u>"Journal of Microscopy and Ultrastructure 5.4 (2017): 225-229. Halgamuge MN, Skafidas E, Davis D. <u>A meta-analysis of in vitro exposures to weak radiofrequency</u> <u>radiation exposure from mobile phones (1990–2015)</u>. Environ Res. 2020;184:109227.

doi:10.1016/J.ENVRES.2020.109227

Halgamuge MN, Davis D. <u>Lessons learned from the application of machine learning to studies on plant</u> response to radio-frequency. Environ Res. 2019. doi:10.1016/j.envres.2019.108634

Gustavino, B., et al. <u>"Exposure to 915 MHz radiation induces micronuclei in Vicia faba root tips.</u>" Mutagenesis 31.2 (2016): 187-92.

Halgamuge, Malka N., See Kye Yak and Jacob L. Eberhardt. <u>"Reduced growth of soybean seedlings after</u> <u>exposure to weak microwave radiation from GSM 900 mobile phone and base station.</u>" Bioelectromagnetics 36.2 (2015): 87-95.

"Tree Damage from Chronic High Frequency Exposure Mobile Telecommunications, Wi-Fi, Radar, Radio Relay Systems, Terrestrial Radio, TV etc." by Dr. Volker Schorpp Lecture (about 31 MB) Shepherd et al., Increased aggression and reduced aversive learning in honey bees exposed to extremely low frequency electromagnetic fields. PLoS One. 2019 Oct 10

Balmori, Alfonso. <u>"Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife</u> <u>orientation.</u>" Science of The Total Environment 518–519 (2015): 58–60.

Balmori, A. <u>"Electrosmog and species conservation."</u> Science of the Total Environment, vol. 496, 2014, pp. 314-6.

Cucurachi, C., et al. <u>"A review of the ecological effects of radiofrequency electromagnetic fields</u> (<u>RF-EMF</u>)." Environment International, vol. 51, 2013, pp. 116–40.

Kumar, Neelima R., Sonika Sangwan, and Pooja Badotra. <u>"Exposure to cell phone radiations produces</u> biochemical changes in worker honey bees." Toxicol Int., 18, no. 1, 2011, pp. 70–2.

Favre, Daniel. "Mobile phone induced honeybee worker piping." Apidologie, vol. 42, 2011, pp. 270-9.

"Briefing Paper on the Need for Research into the Cumulative Impacts of Communication Towers on Migratory Birds and Other Wildlife in the United States." Division of Migratory Bird Management (DMBM), U.S. Fish & Wildlife Service, 2009. "The potential dangers of electromagnetic fields and their effect on the environment." Council of Europe Parliamentary Assembly, resolution 1815, 2011. Engels, S. et al. "Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird." Nature, vol. 509, 2014, pp. 353-6. Balmori A. "Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (Ciconia ciconia)." Electromagn Biol Med, vol. 24, no. 2, 2005, pp. 109-19. Balmori, A. "Mobile phone mast effects on common frog (Rana temporaria) tadpoles." Electromagnetic Biology and Medicine, vol. 29, no. 1-2, 2010, pp. 31-5. Kelley, Elizabeth & Blank, Martin & Lai, Henry & Moskowitz, Joel & Havas, Magda. (2015). International Appeal: Scientists call for protection from non-ionizing electromagnetic field exposure. European Journal of Oncology, Volume 20, pp. 180-182. Bandara P, McCredden J, May M, Weller S, Maisch D, Kelly R, Chandler T, Pockett S, Leach V and Wojcik D. Serious Safety Concerns about 5G Wireless Deployment in Australia and New Zealand. Radiation Protection In Australasia 2020; 37(1):47-54.

# **Cell Phone Regulatory Limits**

O. P. Gandhi, (2019). <u>Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body</u>, in IEEE Access, vol. 7, pp. 47050-47052, 2019. doi:10.1109/ACCESS.2019.2906017

Panagopoulos DJ, Johansson O, Carlo GL <u>Evaluation of specific absorption rate as a dosimetric quantity</u> <u>for electromagnetic fields bioeffects.</u> PLoS One. 2013 Jun 4;8(6):e62663. doi: 10.1371/journal.pone.0062663. Print 2013. Erratum in: PLoS One. 2013;8(11). doi:10.1371/annotation/58c704d9-7cc4-4e4b-873b-214e6e2655ba.

# Literature Reviews and Summaries

Priyanka Bandara, David O Carpenter, (2018). <u>Planetary electromagnetic pollution: it is time to assess its</u> <u>impact</u>, The Lancet Planetary Health, Volume 2, Issue 12, Pages e512-e514, ISSN 2542-5196, doi:10.1016/S2542-5196(18)30221-3.

Anthony B. Miller, L. Lloyd Morgan, Iris Udasin, Devra Lee Davis, (2018). <u>Cancer epidemiology update</u>, <u>following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102)</u>, Environmental Research, Volume 167, Pages 673-683, ISSN 0013-9351, doi:10.1016/j.envres.2018.06.043.

Martin L. Pall, (2018). <u>Wi-Fi is an important threat to human health</u>, Environmental Research, Volume 164, Pages 405-416, ISSN 0013-9351, doi:10.1016/j.envres.2018.01.035.

Jessica A. Adams, Tamara S. Galloway, Debapriya Mondal, Sandro C. Esteves, Fiona Mathews, (2014). Effect of mobile telephones on sperm quality: A systematic review and meta-analysis,

Asl, J.F., Larijani, B., Zakerkish, M. et al. (2019). <u>The possible global hazard of cell phone radiation on</u> <u>thyroid cells and hormones: a systematic review of evidence</u>, Environ Sci Pollut Res. 26: 18017. doi:10.1007/s11356-019-05096-z

Panagopoulos, Dimitris J., Olle Johansson, and George L. Carlo. (2015). <u>Polarization: A Key Difference</u> <u>between Man-Made and Natural Electromagnetic Fields</u>, in Regard to Biological Activity. *Scientific Reports* 5: 14914.

Dimitris J. Panagopoulos, Olle Johansson, and George L. Carlo, (2015). <u>Real versus Simulated Mobile</u> <u>Phone Exposures in Experimental Studies</u>, BioMed Research International, vol. 2015, Article ID 607053, 8 pages, 2015. doi:10.1155/2015/607053.

Dominique Belpomme, Lennart Hardell, Igor Belyaev, Ernesto Burgio, David O. Carpenter, (2018). <u>Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international</u> <u>perspective</u>, Environmental Pollution, Volume 242, Part A, Pages 643-658, ISSN 0269-7491, doi:10.1016/j.envpol.2018.07.019.

Cindy L. Russell, (2018). <u>5 G wireless telecommunications expansion: Public health and environmental implications</u>, Environmental Research, Volume 165, 2018, Pages 484-495, ISSN 0013-9351, doi:10.1016/j.envres.2018.01.016.

Adem Kocaman, Gamze Altun, Arife Ahsen Kaplan, Ömür Gülsüm Deniz, Kıymet Kübra Yurt, Süleyman Kaplan, (2018) <u>Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields</u>, Environmental Research, Volume 163, Pages 71-79, ISSN 0013-9351, doi:10.1016/j.envres.2018.01.034.

Miller Anthony B., Sears Margaret E., Morgan L. Lloyd, Davis Devra L., Hardell Lennart, Oremus Mark, Soskolne Colin L. (2019). <u>Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by</u> <u>Cell Phones and Other Wireless Devices</u>, Frontiers in Public Health, 7, Pages 223, ISSN 2296-2565, doi10.3389/fpubh.2019.00223

Igor Yakymenko, Olexandr Tsybulin, Evgeniy Sidorik, Diane Henshel, Olga Kyrylenko & Sergiy Kyrylenko (2016). <u>Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation</u>, Electromagnetic Biology and Medicine, 35:2, 186-202, DOI: 10.3109/15368378.2015.1043557

Pall M. L. (2013). <u>Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects</u>. Journal of cellular and molecular medicine, 17(8), 958–965. doi:10.1111/jcmm.12088

Hardell, L., & Hardell, L. (2019). <u>Comments on the US National Toxicology Program technical reports</u> on toxicology and carcinogenesis study in rats exposed to whole-body radiofrequency radiation at 900 <u>MHz and in mice exposed to whole-body radiofrequency radiation at 1,900 MHz</u>. International Journal of Oncology, 54, 111-127. doi:10.3892/ijo.2018.4606

Michael Carlberg and Lennart Hardell, (2017). <u>Evaluation of Mobile Phone and Cordless Phone Use and</u> <u>Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation</u>, BioMed Research International, vol. 2017, Article ID 9218486, 17 pages. doi:10.1155/2017/9218486.

L. Falcioni, L. Bua, E. Tibaldi, M. Lauriola, L. De Angelis, F. Gnudi, D. Mandrioli, M. Manservigi, F. Manservisi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Strollo, A. Vornoli, F. Belpoggi, (2018). <u>Report of final results regarding brain and heart tumors in Sprague-Dawley rats</u> exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a <u>1.8 GHz GSM base station environmental emission</u>, Environmental Research, Volume 165, 2018, Pages 496-503, ISSN 0013-9351,

doi:10.1016/j.envres.2018.01.037.

Lennart Hardell, Michael Carlberg, (2015). <u>Mobile phone and cordless phone use and the risk for glioma–Analysis of pooled case-control studies in Sweden, 1997–2003 and 2007–2009</u>, Pathophysiology, Volume 22, Issue 1, Pages 1-13, ISSN 0928-4680, doi:10.1016/j.pathophys.2014.10.001.

Carlberg, M., & Hardell, L. (2014). <u>Decreased Survival of Glioma Patients with Astrocytoma Grade IV</u> (<u>Glioblastoma Multiforme</u>) <u>Associated with Long-Term Use of Mobile and Cordless Phones</u>. International Journal of Environmental Research and Public Health, 11(10), 10790–10805. doi:10.3390/ijerph111010790

Coureau, Gaëlle, Ghislaine Bouvier, Pierre Lebailly, Pascale Fabbro-Peray, Anne Gruber, Karen Leffondre, Jean-Sebastien Guillamo, et al. (2014). <u>Mobile Phone Use and Brain Tumours in the CERENAT Case-Control Study</u>. Occupational and Environmental Medicine 71, no. 7: 514. doi:10.1136/oemed-2013-101754.

IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. (2013). <u>IARC monographs on</u> the evaluation of carcinogenic risks to humans. <u>Non-Ionizing Radiation, Part 2: Radiofrequency</u> <u>Electromagnetic Fields.</u> IARC Monographs on the Evaluation of Carcinogenic Risks to Humans/World Health Organization, International Agency for Research on Cancer vol. 102.

Alexander Lerchl, Melanie Klose, Karen Grote, Adalbert F.X. Wilhelm, Oliver Spathmann, Thomas Fiedler, Joachim Streckert, Volkert Hansen, Markus Clemens, (2015). <u>Tumor promotion by exposure to</u> <u>radiofrequency electromagnetic fields below exposure limits for humans</u>, Biochemical and Biophysical Research Communications, Volume 459, Issue 4, Pages 585-590, ISSN 0006-291X, doi:10.1016/j.bbrc.2015.02.151. Cardis, E, B K Armstrong, J D Bowman, G G Giles, M Hours, D Krewski, M McBride, et al. (2011). <u>Risk</u> of Brain Tumours in Relation to Estimated RF Dose from Mobile Phones: Results from Five Interphone <u>Countries</u>." *Occupational and Environmental Medicine* 68, no. 9: 631. doi:10.1136/oemed-2011-100155.

West JG, Kapoor NS, Liao S, Chen JW, Bailey L, Nagourney RA. (2013). <u>Multifocal Breast Cancer in</u> <u>Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones</u>. Case Reports in Medicine. Volume 2013, Article ID 354682.

John G. West, Nimmi S. Kapoor, Shu-Yuan Liao, June W. Chen, Lisa Bailey, and Robert A. Nagourney, (2013). <u>Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones</u>, Case Reports in Medicine, vol. 2013, Article ID 354682, 5 pages. doi:10.1155/2013/354682.

# Reproduction

Atasoy, Halil I., Mehmet Y. Gunal, Pinar Atasoy, Serenay Elgun, and Guler Bugdayci. (2013). <u>Immunohistopathologic Demonstration of Deleterious Effects on Growing Rat Testes of Radiofrequency</u> <u>Waves Emitted from Conventional Wi-Fi Devices</u>. *Journal of Pediatric Urology* 9, no. 2: 223–29. doi:10.1016/j.jpurol.2012.02.015.

Avendaño, Conrado, Ariela Mata, César A. Sanchez Sarmiento, and Gustavo F. Doncel. (2012). <u>Use of</u> <u>Laptop Computers Connected to Internet through Wi-Fi Decreases Human Sperm Motility and Increases</u> <u>Sperm DNA Fragmentation</u>. Fertility and Sterility 97, no. 1: 39-45.e2. doi:10.1016/j.fertnstert.2011.10.012.

Foerster Milena, Thielens Arno, Joseph Wout, Eeftens Marloes, and Röösli Martin. (2018). <u>A Prospective</u> <u>Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation</u> <u>from Wireless Communication</u>. *Environmental Health Perspectives* 126, no. 7: 077007. doi:10.1289/EHP2427.

Aldad, Tamir S., Geliang Gan, Xiao-Bing Gao, and Hugh S. Taylor. (2012). <u>Fetal Radiofrequency</u> <u>Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and</u> <u>Behavior in Mice. Scientific Reports 2</u>: 312.

Volkow, N. D., Tomasi, D., Wang, G. J., Vaska, P., Fowler, J. S., Telang, F., ... Wong, C. (2011). <u>Effects</u> of cell phone radiofrequency signal exposure on brain glucose metabolism. JAMA, 305(8), 808–813. doi:10.1001/jama.2011.186

Kim, Ju Hwan, Da-Hyeon Yu, Yang Hoon Huh, Eun Ho Lee, Hyung-Gun Kim, and Hak Rim Kim. (2017). <u>Long-Term Exposure to 835 MHz RF-EMF Induces Hyperactivity</u>, <u>Autophagy and</u> <u>Demyelination in the Cortical Neurons of Mice</u>. *Scientific Reports* 7: 41129.

Bas, O., Odaci, E., Mollaoglu, H., Ucok, K., & Kaplan, S. (2009). <u>Chronic prenatal exposure to the 900</u> <u>megahertz electromagnetic field induces pyramidal cell loss in the hippocampus of newborn rats</u>. Toxicology and Industrial Health, 25(6), 377–384. doi:10.1177/0748233709106442

Dariusz Leszczynski, Sakari Joenväärä, Jukka Reivinen, Reetta Kuokka, (2002). <u>Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: Molecular mechanism for cancer- and blood-brain barrier-related effects,</u> Differentiation, Volume 70, Issues 2–3, Pages 120-129, ISSN 0301-4681, doi:10.1046/j.1432-0436.2002.700207.x.

Jun Tang, Yuan Zhang, Liming Yang, Qianwei Chen, Liang Tan, Shilun Zuo, Hua Feng, Zhi Chen, Gang Zhu, (2015). <u>Exposure to 900MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats</u>, Brain Research, Volume 1601, Pages 92-101, ISSN 0006-8993, doi:10.1016/j.brainres.2015.01.019.

H. Lai, N.P. Singh, <u>Acute low-intensity microwave exposure increases DNA single-strand breaks in rat</u> brain cells, Bioelectromagnetics 16 (1995) 207–210.

H. Lai, N.P. Singh, <u>Single and double-strand DNA breaks in rat brain cells after acute exposure to</u> radiofrequency electromagnetic radia- tion, Int. J. Radiat. Biol. 69 (1996) 513–521.

C. Fernández, A.A. de Salles, M.E. Sears, R.D. Morris, D.L. Davis, (2018). <u>Absorption of wireless</u> radiation in the child versus adult brain and eye from cell phone conversation or virtual reality, Environmental Research, Volume 167, Pages 694-699, ISSN 0013-9351, doi:0.1016/j.envres.2018.05.013.

Ronald N. Kostoff, Clifford G.Y. Lau, (2013). <u>Combined biological and health effects of electromagnetic fields and other agents in the published literature</u>, Technological Forecasting and Social Change, Volume 80, Issue 7, Pages 1331-1349, ISSN 0040-1625, doi:10.1016/j.techfore.2012.12.006.

Byun YH, Ha M, Kwon HJ, Hong YC, Leem JH, et al., (2013). <u>Mobile Phone Use, Blood Lead Levels</u>, and Attention Deficit Hyperactivity Symptoms in Children: A Longitudinal Study. PLOS ONE 8(3): e59742. doi:10.1371/journal.pone.0059742

Alexander Lerchl, Melanie Klose, Karen Grote, Adalbert F.X. Wilhelm, Oliver Spathmann, Thomas Fiedler, Joachim Streckert, Volkert Hansen, Markus Clemens, (2015). <u>Tumor promotion by exposure to</u> <u>radiofrequency electromagnetic fields below exposure limits for humans</u>, Biochemical and Biophysical Research Communications, Volume 459, Issue 4, Pages 585-590, ISSN 0006-291X, doi:10.1016/j.bbrc.2015.02.151.

Frank M. Clegg, Margaret Sears, Margaret Friesen, Theodora Scarato, Rob Metzinger, Cindy Lee Russell, Alex Stadtner, Anthony B. Miller, (2019). <u>Building science and radiofrequency Radiation:What makes</u> <u>smart and healthy buildings</u>, Building and Environment, 106324, ISSN 0360-1323, doi.org/10.1016/j.buildenv.2019.106324.

# **Regulatory Limits and Policy**

Mary Redmayne, (2016). International policy and advisory response regarding children's exposure to radio frequency electromagnetic fields (RF-EMF), Electromagnetic Biology and Medicine, 35:2, 176-185, DOI: 10.3109/15368378.2015.1038832

Rianne Stam, (2018). <u>Comparison of international policies on electromagnetic fields (power frequency</u> and radiofrequency fields), National Institute for Public Health and the Environment, RIVM

Environmental Health Trust, (2018). International Policy Briefing, EHTrust.org.

# Letter from the EPA

------ Forwarded message ------From: Veal, Lee<br/>
Veal.Lee@epa.gov><br/>
Date: Wed, Jul 8, 2020 at 11:32 AM<br/>
Subject: RE: Letter with specific Questions Related to the FDA review and to the EPA, CDC, NIOSH and<br/>
FDA Jurisdiction on EMFs<br/>
To: Theodora Scarato <Theodora.Scarato@ehtrust.org>

Dear Director Scarato;

Thank you for sending us your questions and references regarding radiofrequency (RF) radiation. Up through the mid-1990s, EPA did study non-ionizing radiation. The Telecommunications Act of 1996 directs the Federal Communications Commission (FCC) to establish rules regarding RF exposure, while the U.S. Food and Drug Administration (FDA) sets standards for electronic devices that emit non-ionizing or ionizing radiation. EPA does not have a funded mandate for radiofrequency matters, nor do we have a

dedicated subject matter expert in radiofrequency exposure. The EPA defers to other agencies possessing a defined role regarding RF. Although your questions are outside our current area of responsibilities, we have provided a response to each one as you requested.

1. What is your response to these scientists' statements regarding the FDA report and the call to retract it?

EPA Response: The EPA does not have a funded mandate for radiofrequency matters, has not conducted a review of the FDA report you cited or the scientists' statements, and therefore has no response to it.

2. To the FDA- What consultants were hired for the FDA review and report on cell phone radiation?

EPA Response: This is not an EPA matter. Please refer this question to the FDA.

3. What US agency has reviewed the research on cell phone radiation and brain damage? I ask this because the FDA only has looked at selected studies on cancer. If your agency has not, please simply state you have not.

EPA Response: EPA's last review was in the 1984 document <u>Biological Effects of</u> <u>Radiofrequency Radiation (EPA 600/8-83-026F)</u>. The EPA does not currently have a funded mandate for radiofrequency matters.

4. What US agency has reviewed the research on damage to memory by cell phone radiation? If so, when and send a link to the review.

EPA Response: EPA's last review was in the 1984 document <u>Biological Effects of</u> <u>Radiofrequency Radiation (EPA 600/8-83-026F)</u>. The EPA does not currently have a funded mandate for radiofrequency matters. 5. What US agency has reviewed the research on damage to trees from cell phone radiation? If so, when was it issued and send a link to the review. <u>Note this study showing damage from long term</u> <u>exposure to cell antennas.</u>

EPA Response: The EPA does not have a funded mandate for radiofrequency matters, and we are not aware of any EPA reviews that have been conducted on this topic. We do not know if any other US agencies have reviewed it.

6. What US agency has reviewed the research on impacts to birds and bees? If so, when and send a link to the review. I will note the latest research showing <u>possible impacts to bees</u> from higher frequencies to be used in 5G.

EPA Response: The EPA does not have a funded mandate for radiofrequency matters, and we are not aware of any EPA reviews that have been conducted on this topic. We do not know if any other US agencies have reviewed it.