Appendix C

Answers to the specific questions
posed by HB 522

1. Why does the insurance industry recognize wireless radiation as a leading risk and has placed exclusions in their policies not covering damages caused by the pathological properties of electromagnetic radiation?

As shared with the Commission, insurers rank 5G, wireless, and electromagnetic radiation as high risk based on their white papers which compare the risk to asbestos where it may take decades to know the full extent of health impacts.

Scarato shared a 2019 report by Swiss Re Institute[53] which classifies 5G mobile networks as an "off-the-leash" "HIGH" risk, meaning a high-impact emerging risk that will affect property and casualty claims in more than three years' time. The Swiss Re report states on page 29:

> To allow for a functional network coverage and increased capacity overall, more antennas will be needed, including acceptance of higher levels of electromagnetic radiation. In some jurisdictions, the rise of threshold values will require legal adaptation. Existing concerns regarding potential negative health effects from electromagnetic fields (EMF) are only likely to increase. An uptick in liability claims could be a potential long-term consequence.
>
> Potential impacts:
>
> - Cyber exposures are significantly increased with 5G, as attacks become faster and higher in volume. This increases the challenge of defense.
> - Growing concerns of the health implications of 5G may lead to political friction and delay of implementation, and to liability claims. The introductions of 3G and 4G faced similar challenges.

[53] Swiss Re Institute, New Emerging Risk Insights, 2019

- Information security and national sovereignty concerns might delay implementation of 5G further, increasing uncertainty for planning authorities, investors, tech companies and insurers.
- Heated international dispute over 5G contractors and potential for espionage or sabotage could affect international cooperation, and impact financial markets negatively.
- As the biological effects of EMF in general and 5G in particular are still being debated, potential claims for health impairments may come with a long latency.

A Business Insurance analysis[54] also examined mass tort exposures that may have the potential to cause major difficulties for commercial policyholders and their insurers. It includes workers' overexposure to radio frequency waves from rooftop wireless transmitters as a potential future claim and states that research "has shown biological effects from lower-level 'nonthermal' exposure, and people exposed at lower levels have reported headache, dizziness, nausea, mood disorders, mental slowing, and memory loss." Most insurance plans do not cover electromagnetic fields (EMF) and they have "electromagnetic field exclusions."

For example the California State University Risk Management Authority (CSURMA) Self Insured Program states:

> We will not pay for loss or damage caused by or resulting from any of the following:
> …
> Artificially generated electrical, magnetic or electromagnetic energy that damages, disturbs, disrupts or otherwise interferes with any: (1) Electrical or electronic wire, device, appliance, system or network; or (2) Device, appliance, system or network utilizing cellular or satellite technology. But if fire results, we will pay for the loss or damage caused by that fire if the fire would be covered under this coverage form. For the purpose of this exclusion, electrical, magnetic or electromagnetic energy includes but is not limited to: (1) Electrical current, including arcing; (2) Electrical charge produced or conducted

[54] BusinessInsurance.com, "The Next Asbestos: Five emerging risks that could shift the liability landscape," May 13, 2011.

by a magnetic or electromagnetic field; (3) Pulse of electromagnetic energy; or (4) Electromagnetic waves or microwaves.

Even AT&T Mobile Insurance[55] excludes loss from pollutants. Their policy states, "Pollutants" means: 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."

Crown Castle states in their 2020 Annual Report:

> 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.
>
> 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.
>
> Public perception of possible health risks associated with cellular or other wireless connectivity services may slow or diminish the growth of wireless companies, which may in turn slow or diminish our growth. In particular, negative public perception of, and regulations regarding, these perceived health risks may slow or diminish the market acceptance of wireless services. 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.

[55] AT&T Mobile Insurance Policy, 2014, p. 4

Wireless companies from AT&T[56] to Nokia to T-Mobile to Verizon Wireless have issued similar warnings[57] to their own shareholders.

Contained in Vodafone's 2018 Annual Report are the following statements: "What is the risk? Electro-magnetic signals emitted by mobile devices and base stations may be found to pose health risks, with potential impacts including: changes to national legislation, a reduction in mobile phone usage or litigation" and "EMF health related risks - EMF found to pose health risks causing reduction in mobile usage or litigation." The report also included EMF is a "Principal Risk" rated as high in the graphic on pages 38 – 39.

Additional Insurance Reports that Rank Wireless and Electromagnetic Fields as "High Risk"

- 2016 Austrian Accident Insurance Institute (AUVA) ATHEM Report 2 "Investigation of athermal effects of electromagnetic fields in mobile communications."
- 2014 Swiss Re SONAR Report: New emerging risk insights.
- 2013 AM Best Briefing, Emerging Technologies Pose Significant Risks with Possible Long-Tail Losses.
- 2011 Business Insurance White Paper, "The Next Asbestos: Five emerging risks that could shift the liability landscape."
- 2011 Austrian Accident Insurance Institute (AUVA) ATHEM Report 1, Investigation of athermal effects of electromagnetic fields in mobile radio areas in German
- 2010 Lloyd's of London Report on Electromagnetic Fields
- 2009 Austrian Accident Insurance Institute Report on Health Risks from Cell Phone Radiation "Nonthermal Effects of Electromagnetic Radiation in the Cell Phone Frequency Range."
- 2011 Business Insurance Article "Geisel, Roseanne White. "Insurers exclude risks associated with electromagnetic radiation."

[56] AT&T 2016 Annual Report
[57] EHTrust.org, "Corporate Company Investor Warnings In Annual Reports 10k Filings Cell Phone Radiation Risks."

2. Why do cell phone manufacturers have in the legal section within the device saying keep the phone at least 5mm from the body?

5G will have multiple antennas for 5G as well as 4G, Wi-Fi, Bluetooth, and other technology. All of these antennas emit wireless radiation. Even if you are not on the phone, it has continuous emissions.

Phones are premarket tested for cell phone radiation exposures with a separation distance from the phone and the body phantom. This legal section states the exact separation distance the manufacturers used when testing the phone for compliance. As the 2012 GAO Report "Exposure and Testing Requirements for Mobile Phones Should Be Reassessed" states, "The specific minimum separation distance from the body is determined by the manufacturer. In addition, the U.S. government does not perform independent cell phone compliance testing, allowing each manufacturer to submit their own SAR testing results to the FCC."

If phones are used in positions closer than this manufacturer's stated distance, the cell phone user could potentially receive excessive cell phone radiation SAR levels which violate the FCC regulatory limits. Several reports in the US and internationally have confirmed that when phones are tested at body contact, the measured SAR will exceed FCC limits.[58, 59, 60, 61] Theodora Scarato presented this information to the Commission including an analysis by Professor Om Gandhi which examined data from 450 cell phone models from the French government agency, ANFR, the national radiation assessment bureau, indicating that phones can emit 11 times over the US FCC limit and 3 times over European/ICNIRP limits.

FCC Does Not Require Body Contact Tests for Cell Phone Radiation

As stated in the 2012 GAO report, "Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit." The GAO report also directed the FCC to review their cell phone testing protocol because they found these protocols could

[58] Gandhi, O. P. (2019). "Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body." *IEEE Access*, 7, 47050-47052. doi:10.1109/access.2019.2906017

[59] Gandhi, Om P., and Gang Kang. "Inaccuracies of a plastic" pinna" SAM for SAR testing of cellular telephones against IEEE and ICNIRP safety guidelines." *IEEE Transactions on Microwave Theory and Techniques* 52.8 (2004).

[60] Gandhi, Om P. "Yes the children are more exposed to radiofrequency energy from mobile telephones than adults." *IEEE Access* 3 (2015): 985-988.

[61] Kang, Gang, and Om P. Gandhi. "SARs for pocket-mounted mobile telephones at 835 and 1900 MHz." *Physics in Medicine and Biology* 47.23 (2002): 4301.

allow for consumers to receive SAR levels that possibly exceed the "on the body" exposure guidelines.

Cell phone manufacturers are not required by the FCC to test cell phones for cell phone radiation compliance in positions which mimic direct contact between the phone and the body. In the USA, manufacturers can set distances of up to 25 mm when they perform SAR radiation testing for their phones and they are still within the law.

In contrast, in Europe the law has changed to ensure phones are tested at least at 5 mm and no more. This happened after France ANFR released radiation measurements for hundreds of cell phones tested independently by the government of France. The ANFR found the radiation levels were so high that most tested phones exceeded European cell phone radiation limits, showing radiation levels up to three times higher than the limits! ANFR has posted the information on their website.

Several phone models have been taken off the European market or software updated to reduce the radiofrequency radiation. The first withdrawal of cell phones from the market due to cell phone radiation levels dates back to April 2018, with the 100,000 Hapi 30 phones marketed by Orange, followed by the Neffos X1 TP902 (May 2018), the Echo Horizon Lite (Oct 2019), and the announcement on May 20 of the withdrawal of the Razer Phone 2 devices.

After the release of the ANFR tests that found phones violated limits in body contact positions, a new European Directive 2014/35/UE called RED, applicable from June 2016, changed the regulations so that now all phones in the European Union are SAR tested at a distance no greater than 5 mm.

Furthermore, the French ministries of Health, Ecology and Economy issued a joint press release on October 25, 2019[62] announcing France will ask the European Commission to further strengthen the SAR tests requirements to be carried out in a body contact position of 0mm from the body phantom. This would ensure that tests mimic the way people use cell phones today, touching the body.

[62] Buzyn A. "The Government is taking action to limit exposure to the emissions of certain mobile phones and to better inform the public." *Ministère Des Solidarités Et De La Santé*. Published 2019. Accessed July 8, 2020.

FCC SAR Limits

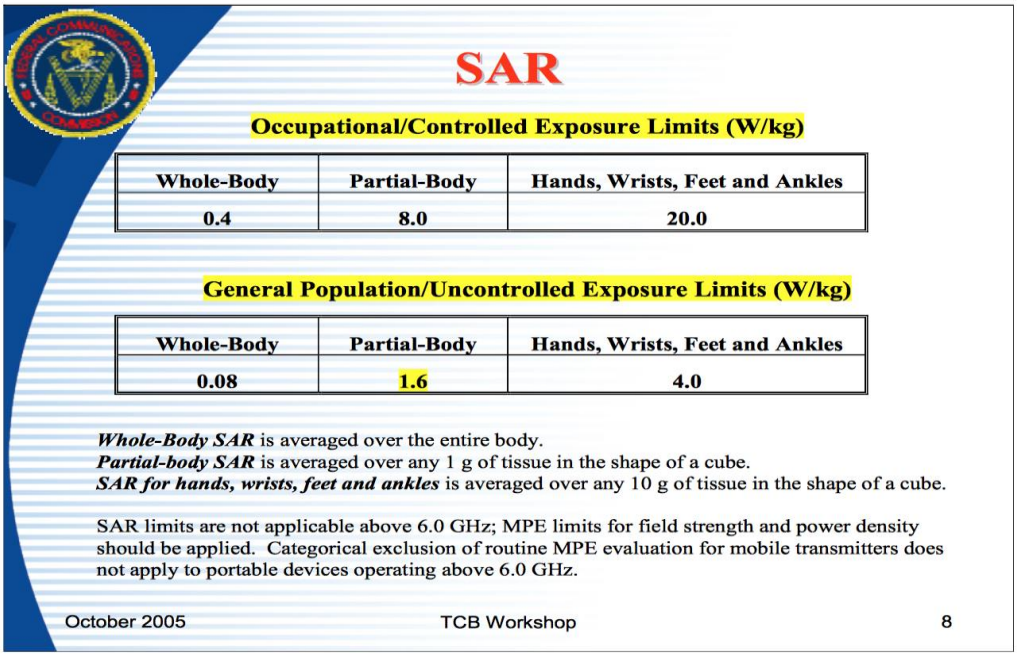
The FCC regulates RF energy emitted from FCC-regulated transmitters and has implemented a certification program to ensure that all mobile phones and wireless devices sold in the United States comply with the agency's limit on RF radiation exposure.

Before a cell phone model is permitted to go on the market for sale, its manufacturer performs Specific Absorption Rate (SAR) tests to evaluate the radiation levels. SAR values are expressed in terms of watts per kilogram (W/kg) and are intended to measure the amount of cell phone radiofrequency radiation absorbed by the body when using a wireless device.

Cell Phone Radiation SAR Limits in the USA

The FCC and Health Canada limit for cell phone radiation exposure to the public from cellular telephones is a SAR level of 1.6 watts per kilogram averaged over 1 gram of tissue. For extremities such as the wrists, ankles, hands, ears, and feet, the allowable SAR limit is much higher and is 4.0 W/kg averaged over 10 grams of tissue.[63]

Image from FCC Presentation[64]



[63] Radio Frequency Safety | Federal Communications Commission. Accessed July 8, 2020.
[64] https://transition.fcc.gov/oet/ea/presentations/files/oct05/RF_Exposure_Concepts_Support_KC.pdf

There also is an occupational SAR limit for cell phones, allowing much higher exposures. The US FCC occupational limit is a SAR level of 8 watts per kilogram averaged over 1 gram of tissue. For extremities such as the wrists, ankles, hands, ears, and feet, the allowable SAR limit is much higher and is 10.0 W/kg averaged over 10 grams of tissue.

According to the FCC[65] the "occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure."

Thus, the manufacturer's recommended distance for cell phones is a defined number of millimeters. The specific distances for each phone varies and can be found in the cell phone's instruction/user manual. Furthermore, the recommended distance for wireless laptops, Wi-Fi routers, smart security systems, smart speakers and printers is generally 20 centimeters (approximately 8 inches) as stated in the user manual. The FCC states that "mobile devices are transmitters designed to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons."

The CTIA has argued that "there is no reliable evidence proving that current testing protocols fail to ensure compliance with RF standards." This is stated in the CTIA submission to the US Federal Communications Commission regarding the FCC Proceeding on Human Exposures to Radiofrequency Radiation. CTIA also stated, "a zero-measuring requirement would not accurately mimic real usage or increase safety."

The French data release refutes these CTIA and FCC statements because they found SAR levels were in violation of limits when phones were tested in body contact positions at highest power levels.

[65] Chan K. *Overview of RF Exposure Overview of RF Exposure Concepts and Requirements Concepts and Requirements*. http://grouper.ieee.org/groups/scc34/sc2/wg1/appr_memo.html. Accessed July 8, 2020.

Examples of the Manufacturer's Instructions

Here are some examples of the radiofrequency statement for phones as well as other wireless devices people use every day.

Samsung Health and Safety Information	“Body-worn operations are restricted to belt-clips, holsters or similar accessories that have no metallic component in the assembly and must provide at least 1.5cm separation between the device and the user's body.”
iPhone 11 Pro Max	“During testing, iPhone radios are set to their highest transmission levels and placed in positions that simulate uses against the head, with no separation, and when worn or carried against the torso of the body, with 5mm separation.”
Nokia 8110 4G Phone (2019 Manual)	“This device meets RF exposure guidelines when used against the head or when positioned at least 5/8 inch (1.5 centimetres) away from the body. When a carry case, belt clip or other form of device holder is used for body-worn operation, it should not contain metal and should provide at least the above stated separation distance from the body.”
Safety & regulatory information (Pixel & Pixel XL 2016)	“Body worn operation: Pixel complies with radio frequency specifications when used near your ear or at a distance of 0.4 in (1.0 cm) from your body. Pixel XL complies with radio frequency specifications when used near your ear or at a distance of 0.4 in (1.0 cm) from your body. Ensure that the device accessories, such as a device case and device holster, are not composed of metal components. Keep the device away from your body to meet the distance requirement.”
Samsung 3G Laptop Manual	“Usage precautions during 3G connection: Keep safe distance from pregnant women’s stomach or from lower stomach of teenagers. Body worn operation: Important safety information regarding radiofrequency radiation (RF) exposure. To ensure compliance with RF exposure guidelines the Notebook PC must be used with a minimum of 20.8 cm antenna separation from the body.”

Owlcam Manual with RF Instructions	“Caution exposure to radiofrequency radiation, to comply with FCC RF exposure compliance requirements for mobile configurations, a separation distance of at least 20 cm must be maintained between the antenna of this device and all persons.”
PlayStation 3	“This equipment complies with FCC/IC radiation exposure limits set forth for uncontrolled equipment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65 and RSS-102 of the IC radio frequency (RF) Exposure rules. This equipment should be installed and operated with at least 20 cm (8 in) and more between the radiator and person’s body (excluding extremities: hands, wrists, feet and legs).”
Amazon Echo	“Information Regarding Exposure to Radio Frequency Energy…This device should be installed and operated with a minimum distance of 20cm between the radiator and your body. The remote control meets the RF exposure requirement of low power devices under portable operation. Nevertheless, it is advised to use the Products in such a manner that minimizes the potential for human contact during normal operation.”
Panasonic DECT Home Cordless Phone	“FCC RF Exposure Warning: To comply with FCC RF exposure requirements, the base unit must be installed and operated 20 cm (8 inches) or more between the product and all person’s body.”
HP Printer	“In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20 cm (8 inches) during normal operation.”
Apple Watch	“During testing, Apple Watch radios are set to their highest transmission levels and placed in positions that simulate use against the head, with 10mm separation, and on the wrist, with no separation. When placing Apple Watch near your face, keep at least 10mm of separation to ensure exposure levels remain at or below the as-tested levels.”

Apple iPod Touch	"During testing, iPod radios are set to their highest transmission levels and placed in positions that simulate use near the body, with 5mm separation. To reduce exposure to RF energy, use the supplied headphones or other similar accessories. Carry iPod at least 5mm away from your body to ensure exposure levels remain at or below the as-tested levels."
Nokia 8110 4G Phone (2019 Manual)	"This device meets RF exposure guidelines when used against the head or when positioned at least 5/8 inch (1.5 centimetres) away from the body. When a carry case, belt clip or other form of device holder is used for body-worn operation, it should not contain metal and should provide at least the above stated separation distance from the body."

Apple Has Changed Their Text and No Longer Clearly Instructs Users to Keep the Phone at a Distance But Does Share the Test Distance

In 2015 the Apple iPhone 6 manual had the following statement, "Carry iPhone at least 5mm away from your body to ensure exposure levels remain at or below the as-tested levels." While this sentence was still on their website on March 2, 2017, it was removed by November 9, 2017. Similarly, the iPhone 7 was released in 2016, along with the same online instructions to carry it "5 mm away from your body" which disappeared from the Apple website by November 9, 2017.

Apple's website still includes information that cell phones are tested with a separation distance. However, the text is absent of clear instructions to consumers. Years ago, iPhone 3 filings to the FCC stated "iPhone's SAR measurement may exceed the FCC exposure guidelines for body-worn operation if positioned less than 15 mm (5/8 inch) from the body (e.g. when carrying iPhone in your pocket)." Apple clearly stated, "When using iPhone near your body for voice calls or for wireless data transmission over a cellular network, keep iPhone at least 15 mm (5/8 inch) away from the body."

Investigations Find Cell Phones Violate Cell Phone Regulatory Limits When the Phone is Tested at Body Contact

Chicago Tribune Cell Phone Radiation Tests
Tests paid for by the Tribune and conducted according to federal guidelines at an accredited lab, produced a surprising result: Radiofrequency radiation exposure from the iPhone 7 — one of the most popular smartphones ever sold — measured over the legal safety limit and more than double what Apple reported to federal regulators from its own testing. These tests measured radio frequency radiation SAR levels at 2mm from the body. Chicago Tribune Cell Phone Test Report

During Commission proceedings the CTIA countered that the FCC tested the phones the Chicago Tribune had reported to exceed SAR levels and released a report that found them to not to violate SAR limits. However, if you go to the FCC report on SAR measurements it shows that the FCC used a separation distance (on page 9)[66]. The Chicago Tribune report specifically investigated phones at a distance of 2mm from the body. The FCC Report did not replicate the Chicago Tribune tests at 2mm but instead used the manufacturers separation distances which vary from 5 mm to 15mm.

Canadian Broadcasting Corporation
A 2017 investigation by the Canadian Broadcasting Corporation found radiation levels higher than government standards after they tested popular cell phones in a US FCC certified laboratory.

French ANFR
Professor Om Gandhi, one of the engineers who developed radiofrequency limits years ago, published an analysis of the data from 450 cell phone models from the French government agency, ANFR, the national radiation assessment bureau, indicating that phones can emit 11 times over the US FCC limit and 3 times over European/ICNIRP limits.

3. Why have 1,000s of peer-reviewed studies, including the recently published U.S. Toxicology Program 16-year $30 million study, that are showing a wide range of statistically significant DNA damage, brain and heart tumors,

[66] FCC. *Results of Tests on Cell Phone RF Exposure Compliance*.; 2019. Accessed July 8, 2020.

infertility, and so many other ailments, been ignored by the Federal Communication Commission (FCC)?

There has not been a scientific review of the research by a US agency for more than two decades.

Just recently in December 2019, the FCC determined that there was no need to review the radiofrequency limits. The FCC based this decision largely on a letter by the FDA. In the spring of 2020, the FDA released a research review, but it was not a systematic full evaluation of health effects, but instead only focused on cancer and criticized studies that found effects. FDA has not done experimental research on impacts to humans, birds, bees, trees, and wildlife. The FDA review does not systematically evaluate RF levels and impacts to birds, bees, and trees.

Most importantly, as the FCC states, there are no federally developed safety limits[67] and there is no US health agency developing such safety limits in the US.

There is not a single health/safety/environmental agency investigating, researching or monitoring impacts to birds, bees, trees, and wildlife. In addition, regulatory limits for exposure to radiofrequency radiation have never been developed for birds, bees, trees, and wildlife. This is why the US Department of the Interior sent a letter to the National Telecommunications and Information Administration in 2014[68] 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 US Fish and Wildlife Service wildlife biologist and former lead on telecommunications impacts, Dr. Albert Manville, has written to the FCC on impacts to birds and higher frequencies to be used in 5G and authored numerous publications detailing research showing harm to birds.[69, 70, 71] "Now as a private

[67] Wireless Devices and Health Concerns | Federal Communications Commission. Accessed July 8, 2020.
[68] Washington DC, Veenendaal ME. Department of Interior Letter. *United States Department of the Interior OFFICE OF THE SECRETARY*.
[69] ECFS Filing Detail. https://www.fcc.gov/ecfs/filing/1060315601199. Accessed July 8, 2020.
[70] 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.
[71] Manville AM. "Collisions, Electrocutions, and Next Step : Bird Strikes And Electrocutions At Power Lines,

wildlife consultant and part-time adjunct professor for Johns Hopkins University, I also continue to study the impacts of radiation on human health, welfare and safety, including impacts from millimeter-wide radiation frequencies on humans from 5G. 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."

He has testified[72] about the impacts of cell towers on birds that "the entire thermal model and all FCC categorical exclusions for all the devices we see today, rests on the incorrect assumption that low-level nonionizing nonthermal radiation cannot cause DNA breaks because it is so low power. The evidence to the contrary is clear and growing laboratory animals and wildlife."

Most recently Manville wrote the FDA regarding the FDA statements of "safety" in regards to cell phone radiation that, "as a certified wildlife biologist and Ph.D. environmental scientist who has studied the impacts of radiation on migratory birds, other wildlife, and humans since the late 1990s, the statement credited to the FDA is preposterous, without any scientific credibility, and at a minimum deserves a retraction by the FDA. There currently are well over 500 scientific, peer-reviewed papers addressing impacts of non-ionizing, non-thermal radiation on laboratory animals — many of the studies directly applicable to human health and safety."[73]

In addition, no "safe" level has been scientifically determined for long term impacts for children or pregnant women. While they are "designed" to address children, the reality is that no such research existed at the time of the limit development that actually considered children's unique vulnerability which includes their developing brain and immune system. The EPA clarified that current FCC limits do not account for long term exposures[74] in 2002 stating, "Federal health and safety agencies have not yet developed policies concerning possible risk from long term, nonthermal exposures." Current FCC human exposure limits "are thermally based, and do not apply to chronic, nonthermal exposure situations" and adequate scientific evaluations of the full impact on sensitive

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Communication Towers, And Wind Turbines: State Of The Art And State Of The Science - Next Steps Toward Mitigation."; 2002.

[72] Manville AM. IPCWB. Declaration of: Albert M. Manville, II, PhD, C.W.B.. Published 2018. Accessed July 8, 2020.

[73] Statement From Dr. Albert Manville On The FDA Report On Cell Phone Radiation. *Environmental Health Trust*. Accessed July 8, 2020.

[74] Washington DC. *United States Environmental Protection Agency*. 2002 http://www.epagov. Accessed July 8, 2020.

populations such as children, pregnant women, and the elderly has yet to be completed.

Background on US FCC Radiofrequency Human Exposure Limits
The FCC is not a health and safety agency and in fact never developed health based federal safety standards as we have with other environmental exposures.

Although there used to be a robust research effort in the United States in the '60s, '70s, and '80s, it was defunded. In fact, the US EPA was tasked to develop proper safety standards and was in process of developing two tiered guidelines on both thermal and biological effects in the mid-nineties. However, funding was cut and in 1996 the EPA was fully defunded from work on electromagnetic radiation. Then the FCC promulgated limits for human exposure to radiofrequency radiation based on the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) – ANSI/IEEE C95.1-1992 guidelines and the National Council on Radiation Protection and Measurements (NCRP) NCRP Report 1986. The limits have remained largely unchanged since 1996.

In 2008 the National Academy of Sciences National Research Council Report "The Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices" documented critical research gaps and called for the need to increase understanding of any adverse effects of long term chronic exposure to RF/microwave energy on children and pregnant women.

In 2008 the Congressional hearing "Health Effects of Cell Phone Use" of the US House Oversight and Government Reform Subcommittee on Domestic Policy had testimony from several experts including David Carpenter, Ronald B. Herberman M.D., Robert Hoover, Darrell Issa, and Julius P. Knapp II.[75]

In 2009 a Senate Appropriations Subcommittee held a hearing on the "Health Effects of Cell Phone Use" and had testimony from several experts including John Bucher, Devra L. Davis, Thomas "Tom" Harkin, Dariusz Leszczynski, Olga Naidenko, and Siegal Sadetzki.[76]

[75] 2008 Congressional Hearing: Health Effects of Cell Phone Use
[76] 2009 Hearing link to transcript

A 2012 report by the Government Accountability Office "Exposure and Testing Requirements for Mobile Phones Should Be Reassessed" urged the FCC to "formally reassess and, if appropriate, change its current RF energy (microwave) exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body" because without such a reassessment, the "FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure." The report stated that the FCC RF limits adopted in 1996 did not reflect the way people use their phones, particularly when phones are held against and touching the body. The report led the FCC to launch an official inquiry[77] in 2013 to explore whether it should modify its radiofrequency exposure standards. The FCC noted, "we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children." The FCC docket asked these important questions: Are US cell phone and cell tower radiation limits safe for humans? Do children need special protections? Should companies change the way they test the radiation from phones because phones are tested with a separation distance between the phone and the body? The FCC received over a thousand submissions.[78]

In 2019, the FCC issued a report and order[79] that closed the inquiry. It stated, "First, we resolve a Notice of Inquiry that sought public input on, among other issues, whether the Commission should amend its existing RF emission exposure limits. After reviewing the extensive record submitted in response to that inquiry, we find no appropriate basis for and thus decline to propose amendments to our existing limits at this time. We take to heart the findings of the Food & Drug Administration (FDA), an expert agency regarding the health impacts of consumer products, that "the weight of scientific evidence has not linked cell phones with any health problems."

Scientists are calling for the FDA to retract their report that is now used as proof of safety. Due to the fact that the FDA later in 2020 released a report criticizing studies that found harm and provided no research demonstrating safety, several expert scientists wrote to the FDA.

[77] Review of RF Exposure Policies | Federal Communications Commission
[78] ECFS filings results. Accessed July 8, 2020.
[79] FCC. *FCC 19-126*. https://www.fda.gov/Radiation. Accessed July 8, 2020.

“I find it shocking that the FDA would casually dismiss the carcinogenicity findings from the National Toxicology Program (NTP) studies on cell phone radiation in experimental animals, when it was the FDA that requested those studies in the first place ‘to provide the basis to assess the risk to human health,’ and when an expert peer-review panel carefully reviewed the design and conduct of those studies and then concluded that the results provided “clear evidence of carcinogenic activity,” stated Ronald Melnick PhD who led the design of the $30M NTP study. Melnick sent a letter to the FDA documenting the scientific inaccuracies in their review.

“When I worked as a wildlife biologist for the U.S. Fish & Wildlife Service for 17 years, I collaborated with the late Dr. Ted Litovitz in 2000. Dr. Litovitz and his colleagues studied the impacts of low-level, non-thermal radiation from the standard 915 MHz cell phone frequency on chicken embryos. In their laboratory studies, control/non-treated embryos suffered no effects, but some of the treated/irradiated embryos died — at levels as low as 1/10,000 the normal level of cell phone radiation exposure to humans. This was an eye-opener!” stated Albert M. Manville, II, Ph.D.; retired Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Washington.

“The FDA review omits an evaluation of the science on wireless radiation impacts to trees and wildlife. Electromagnetic radiation is a form of environmental pollution which may hurt wildlife. I have co-published research entitled “Radiofrequency radiation injures trees around mobile phone base stations“ finding harm to trees near base stations (cell antennas) in a long term field monitoring study in two cities, “ stated biologist Alfonso Balmori, BSc who sent a statement to the FDA.

Letters which have been sent to the FDA include:

- Letter calling for a retraction signed by several scientists.
- Ronald Melnick PhD’s letter to the FDA on the National Toxicology Program study
- Albert Manville PhD, retired Senior Wildlife Biologist, Division of Migratory Bird Management, U.S. Fish & Wildlife Service, Wash. DC HQ Office (17 years); Senior Lecturer, Johns Hopkins University

- Prof. Tom Butler of the University College in Cork, Ireland's letter to the FDA
- Igor Belyaev, PhD, Dr. Sc. Head, Department of Radiobiology of the Cancer Research Institute, Biomedical Research Center of the Slovak Academy of Science letter to the FDA
- Paul Heroux PhD, McGill University
- Alfonso Balmori, BSc statement to the FDA
- Additional Statements by Experts

The FCC is considered a Captured Agency with Undue Influence by Telecom
Several experts who provided testimony to the Commission detailing how several FCC Commissioners have industry ties. Several cited the Harvard Press Book "Captured Agency: How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates" by Norm Alster which documents the financial ties between the FCC, Congress and industry and how wireless companies have bought "inordinate access to—and power over—a major US regulatory agency." The investigation puts forward that there is a "revolving door" between industry and regulators, meaning that persons are moving from positions in the wireless industry to positions in government and vice versa. In addition, the book documents the large financial Investment by telecommunications companies into public relations efforts, designing and publishing contradictory science, pushing for minimal regulation, lobbying via "non-profit" associations, and "hyper aggressive legal action and research bullying."

Examples of the revolving door at the Federal Communications Commission include:

- Tom Wheeler: In 2013, President Obama appointed Tom Wheeler to head the FCC. Wheeler, a fundraiser for Obama in the 2008 election, was a lobbyist and head of the Cellular Telecommunications and Internet Association (CTIA). As head of the wireless industry, Wheeler was accused of suppressing science. A 2003 inductee into the Wireless Hall of Fame (yes, there is such a thing), Wheeler laid the groundwork for 5G, pushing through regulations to strip local authority.

- Ajit Pai: In 2017, President Trump appointed Ajit Pai, a former Verizon Lawyer to head the FCC. Pai had already been a member of the commission, having been appointed by President Obama in 2011 — upon the recommendation of Senate Majority Leader Mitch McConnell — to fill a "Republican" seat on the five-member board.
- Brendan Carr: FCC Commissioner Brendan Carr was appointed by President Trump. He too is a former lawyer for Wiley Rein and helped sue the San Francisco over the city's cell phone ordinance. Carr's wife is the staff director for the U.S. House Ways and Means Committee's Oversight Subcommittee.
- Former FCC chairman Julius Genachowski is now a managing director of the U.S. buyout team at Carlyle Group. The team's focus is on acquisitions and growth investments in global technology, media, and telecom, including Internet and mobile.
- Meredith Attwell Baker: Former FCC Commissioner Meredith Attwell Baker is now head of the CTIA - The Wireless Association. She is a former lead lobbyist for Comcast.
- Michael Powell: Former FCC commissioner Michael Powell is now president & CEO of NCTA - The Internet & Television Association.
- Bruce Romano: Former legal chief in the FCC's Office of Engineering and Technology. Bruce Romano is now at the law firm of Wiley Rein, representing the CTIA.
- Thomas M. Johnson, Jr.: Thomas M. Johnson, Jr. is general counsel of the FCC appointed by Ajit Pai and previously worked for the law firm Gibson, Dunn & Crutcher LLP which represented the CTIA - The Wireless Association who sued the City of Berkeley in federal court, seeking to topple the city's recently enacted cell phone right to know ordinance mandating disclosure of possible radiation hazards associated with use of cellphones.

In addition, published research has documented conflicts of interest in the experts that governments refer to.

- The International Journal of Oncology published "World Health Organization, radiofrequency radiation and health – a hard nut to crack

(Review)"[80] in 2017 detailing conflicts of interest with ICNIRP and the WHO EMF Project, both started with industry support.

- The American Journal of Industrial Medicine published "Secret ties to industry and conflicting interests in cancer research"[81] in 2006 about industry funding of studies such as the Danish Cohort cell phone studies that are often put forward as showing no harm.
- Molecular and Clinical Oncology published "Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation"[82] in 2020 details how ICNIRP is referred to as "a private German non-governmental organization. ICNIRP [that] relies on the evaluation only of thermal (heating) effects from RF radiation, thereby excluding a large body of published science demonstrating the detrimental effects caused by non-thermal radiation."

4. Why are the FCC-sanctioned guidelines for public exposure to wireless radiation based only on the thermal effect on the temperature of the skin and do not account for the non-thermal, non-ionizing, biological effects of wireless radiation?

In 1996, just as the EPA was set to release their Phase 1 of safety limits, the EPA's RFR efforts were defunded, halting all EPA research. That year the FCC adopted RFR exposure limits based largely on limits developed by industry/military connected groups (ANSI/IEEE C95.1-1992 and NCRP's 1986 Report).

These FCC limits are only based on protecting against heating (thermal) effects from short-term exposures. They do not account for non-thermal biological effects or the effects of long-term, chronic exposures. Furthermore, adequate scientific data on children's unique vulnerability to RFR was not available at that time. The US still has no federally developed safety limits, and there has been no systematic review of the scientific research to develop safety limits that adequately protect the public from long-term exposures.

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[80] Hardell L. "World health organization, radiofrequency radiation and health - A hard nut to crack (Review)." *Int J Oncol*. 2017;51(2):405-413. doi:10.3892/ijo.2017.4046

[81] Hardell L, Walker MJ, Walhjalt B, Friedman LS, Richter ED. "Secret Ties to Industry and Conflicting Interests in Cancer Research." *Am J Ind Med*. 2006. doi:10.1002/ajim.20357

[82] Hardell L, Nyberg R. "Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation." *Mol Clin Oncol*. 2020;12(3):247-257. doi:10.3892/mco.2020.1984

Due to the lack of evaluation for long term safety and research that linked neurological impacts in firefighters to cell antenna exposure, the International Association of Fire Fighters has long opposed[83] cell antennas on fire stations stating that, "fire department facilities, where fire fighters and emergency response personnel live and work are not the proper place for a technology which could endanger their health and safety. The only reasonable and responsible course is to conduct a study of the highest scientific merit and integrity on the RF/MW radiation health effects to our membership and, in the interim, oppose the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until it is proven that such sitings are not hazardous to the health of our members." The International Association of Fire Fighters passed a resolution[84] that they oppose cell towers on fire stations in 2004 and it remains in effect today.

5. Why are the FCC radiofrequency exposure limits set for the United States 100 times higher than countries like Russia, China, Italy, Switzerland, and most of Eastern Europe?

The following countries have cell tower network radiofrequency radiation limits (maximum permissible limits) below ICNIRP and FCC limits: Belarus, Bulgaria, China, Lithuania, Poland, Russia, Belgium, Chile, Greece, India, Israel, Italy, Liechtenstein and Switzerland.[85] [86] [87] [88] [89]

The exposure guidelines developed by the FCC and International Commission on Non-Ionizing Radiation Protection (ICNIRP) were principally designed to protect against adverse thermal effects and were largely based on studies of short-term exposures to animals at high power levels. However, countries such as India,

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[83] Cell Tower Radiation Health Effects - IAFF. https://www.iaff.org/cell-tower-radiation/. Accessed July 8, 2020.
[84] https://ecfsapi.fcc.gov/file/109281319517547/20-Attachment%2020-%20Firefighters%20Inter%20Resolution%20Against%20Cell%20Towers.pdf
[85] https://apps.who.int/gho/data/node.main.EMFLIMITSPUBLICRADIOFREQUENCY?lang=en
[86] Wu T, Rappaport TS, Collins CM. "Safe for Generations to Come." *IEEE Microw Mag*. 2015;16(2):65-84. doi:10.1109/MMM.2014.2377587
[87] Chiang, Huai. "Rationale for Setting EMF Exposure Standards." Zhejiang University School of Medicine, Microwave Lab, China, as referenced by Wu 2015
[88] "Comparison of international policies on electromagnetic fields (power frequency and radiofrequency fields)." Rianne Stam, National Institute for Public Health and the Environment
[89] 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

China and Russia have much lower limits and are considered "science based." [90] They are well below any thermally significant levels to address their own countries research indicating adverse non-thermal health effects.

- USSR and Russian standards were based on many areas of research including impacts to the nervous system and immune system as documented in the "Scientific basis for the Soviet and Russian radiofrequency standards for the general public." Their exposure limits are set based on protecting against possible biological consequences which is different than limits by the FCC and ICNIRP, which bases their limits on the lowest RF exposure that causes any "established" adverse health effect. Russia limits consider children to be more sensitive to EMFs and in need of "special consideration when developing exposure limits." According to the ICNIRP, the following health hazards are likely to be faced in the near future by children who 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.[91]
- China's cell tower limits are based on science showing effects which include behavioral, neurological, reproductive abnormalities, and DNA damage.[92]
- India dropped their RF limits by 1/10th of ICNIRP after a 2010 Government Report documented the majority of research studies found adverse effects to wildlife, birds and bees.[93] An August 2012 Advisory by the Ministry of the Environment and Forests refers to the "negative effects" and makes a series of recommendations to the government.[94] The findings of the report were later published in the journal Biology and Medicine which concludes that, "based on current available literature, it is justified to conclude that RF-EMF radiation exposure can change neurotransmitter functions, blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium

[90] Wu T, Rappaport TS, Collins CM. "Safe for Generations to Come." *IEEE Microw Mag*. 2015;16(2):65-84. doi:10.1109/MMM.2014.2377587
[91] "Scientific basis for the Soviet and Russian radiofrequency standards for the general public."
[92] Prof. Dr. Huai Chiang. "Rationale for Setting EMF Exposure Standards." Accessed July 8, 2020.
[93] "Report on Possible Impacts of Communication Towers on Wildlife Including Birds and Bees." Ministry of Environment and Forest, Government of India, 2010.
[94] Government of India Ministry of Environment and Forests Office. "Advisory on the use of Mobile Towers to minimize their impact on Wildlife including Birds and Bees." 2012

efflux, and gene and protein expression in certain types of cells even at lower intensities".[95]

Many European countries have RF limits much lower than ICNIRP as part of their precautionary approach to decision-making. In 2011 the Parliamentary Assembly of the Council of Europe issued Resolution 1815: "The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment",[96] 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 tumors." The Resolution calls for member states to:

- Implement "information campaigns about the risk of biological effects on the environment and human health, especially targeting children and young people of reproductive age."
- "For children in general, and particularly in schools and classrooms, give preference to wired Internet connections, and strictly regulate the use of mobile phones by schoolchildren on school premises."

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-Ionizing 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."

6. Why did the World Health Organization (WHO) signify that wireless radiation is a Group B Possibly Carcinogenic to Humans category, a group that includes lead, thalidomide, and others, and why are some experts who sat on the WHO committee in 2011 now calling for it to be placed in the Group 1, which are known carcinogens, and why is such information being ignored by the FCC?

In 2011 wireless radiofrequency radiation was classified as a "Possible Human Carcinogen" by the International Agency for Research on Cancer (IARC) of the WHO based on research that found an increased risk for glioma, a malignant type

[95] Sivani S, Sudarsanam D. "Impacts of Radio-Frequency Electromagnetic Field (RF-EMF) from Cell Phone Towers and Wireless Devices on Biosystem and Ecosystem - a Review." *Biology and Medicine* Vol 4.; 2012. www.biolmedonline.com. Accessed July 8, 2020.
[96] Resolution 1815: *"The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment."*

of brain cancer, associated with wireless phone use.[97] The WHO/IARC Class 2B classification includes wireless radiation from any transmitting source including cellphones, baby monitors, tablets, cell towers, radar, other Wi-Fi, etc. The classification applies to RF-EMF in the range of 30 KHz to 300 GHz emitted from any equipment- not just cell phones. This fact is detailed in the Lancet's published statement and in the related press release in 2011.

Precautions for cell phones were recommended by then IARC Director Christopher Wild in the WHO/IARC press release for the Class 2B Carcinogen classification with quotes from Wild as stating, "Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting."

After the 2011 classification, the WHO/IARC issued a monograph documenting all the research underpinning the 2011 classification.[98]

The 2013 published monograph also references children's higher exposures as compared to adults and states, "the average exposure from use of the same mobile phone is higher by a factor of 2 in a child's brain and higher by a factor of 10 in the bone marrow of the skull."

The reason that scientists are calling for a change to the classification is that since the 2011 classification, the evidence for adverse effects in the published research has increased. Cancer is only one of the issues that have been investigated. Here are some of the studies often mentioned by scientists:

- The National Toxicology Program studies on cell phone radiation in animals found clear evidence of carcinogenic activity, in male rats and DNA damage in the frontal cortex of the brain in male mice, the blood cells of female mice, and the hippocampus of male rats.
- The multicenter case-control study Coureau et al. 2014 found statistically significant positive association between brain tumors and cell phone use in the heaviest cell phone users when considering life-long cumulative duration.

[97] IARC classifies Radiofrequency Electromagnetic Fields as possibly carcinogenic to humans
[98] Monograph on Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields.

- An animal study Lerchl 2015 replicated a previous study that found at very low levels, radiofrequency can promote tumors.
- Falcioni et al. 2018 found a statistically significant increase in the incidence of heart Schwannomas in male rats exposed to radiofrequency radiation at levels below FCC limits.
- Yale research funded by the American Cancer Society[99] found thyroid cancer associated with cell phone use in people with genetic susceptibility.
- Additional Yale research[100] found prenatal radiofrequency radiation exposure led to higher hyperactivity, poorer memory, and altered brain function in mice,[101] corroborating prior published research findings of altered brain development after exposure.
- A 2018 study[102] looking at hundreds of adolescents found memory damage in the brain receiving some of the higher radiofrequency cell phone radiation exposures.
- A 2015 review study[103] found among 93 of 100 currently available peer-reviewed studies dealing with oxidative effects of low-intensity RFR, confirmation that RFR induces oxidative effects in biological systems.

The evaluation by some scientists that wireless is carcinogenic due to this increased body of published research can be found in Hardell and Carlberg 2017 and Miller et al. 2018.

Several scientists who were members of the WHO IARC 2011 monograph classification have publicly stated that the evidence on the carcinogenicity of RF has increased and that the classification of "possible carcinogen" is outdated and should be upgraded based on increased evidence of adverse effects.

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[99] Jiajun Luo et al. "Genetic susceptibility may modify the association between cell phone use and thyroid cancer: A population-based case-control study in Connecticut." *Environmental Research* (2019).
[100] Aldad, T., Gan, G., Gao, X., & Taylor, H. (2012). "Fetal Radiofrequency Radiation Exposure From 800-1900 Mhz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice." *Scientific Reports*, *2*(1). https://doi.org/10.1038/srep00312
[101] Cell phone use in pregnancy may cause behavioral disorders in offspring
[102] Foerster, M., Thielens, A., Joseph, W., Eeftens, M., & Röösli, M. (2018). "A Prospective Cohort Study of Adolescents' Memory Performance and Individual Brain Dose of Microwave Radiation from Wireless Communication." *Environmental Health Perspectives*, *126*(7), 077007. https://doi.org/10.1289/ehp2427
[103] Yakymenko, I., Tsybulin, O., Sidorik, E., Henshel, D., Kyrylenko, O., & Kyrylenko, S. (2015). "Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation." *Electromagnetic Biology and Medicine*, *35*(2), 186-202.

- Dr. Lennart Hardell in Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use: "This study confirmed previous results of an association between mobile and cordless phone use and malignant brain tumours. These findings provide support for the hypothesis that RF-EMFs play a role both in the initiation and promotion stages of carcinogenesis."
- Dr. Chris Portier: "A careful review of the scientific literature demonstrates there are potentially dangerous effects from RF," stated Portier, a recently retired CDC Director, Center for Environmental Health and the Agency for Toxic Substances and Disease Registry in his official call for invoking the precautionary principle with wireless radiation in a 2015 conference. See also a poster presentation he penned for the conference here.
- Dr. Igor Belyaev: "There are many publications showing health effects of radiofrequency radiations. Approximately half of all published papers show such effects." (National Press Club, 2012. He has published findings of adverse effects in several publications.)
- Dariusz Leszczynski, WHO IARC expert, former Finnish government researcher stated in 2015 "The IARC-WHO classification of cell phone radiation is misrepresented by the industry. Classification of cell phone radiation as 'a possible carcinogen to humans' means that there are enough studies indicating that it might cause cancer and that we urgently need more research to clarify this issue. The strongest evidence that it might be causing cancer comes from three epidemiological studies. In 2011, only two sets of studies were available – EU's Interphone study and a series of studies from Lennart Hardell's group in Sweden. Recently, CERENAT study from France published in 2014, similarly indicated that persons using cell phones for more than ten years and for half hour per day are at a higher risk for developing brain cancer. In fact now the evidence is sufficient to consider cell phone radiation as a probable carcinogen – Group 2A in IARC's scale of carcinogenicity."
- Ronald Melnick, retired NTP staff scientist has written extensively on this topic and states in Health Physics 2020, "The NTP studies show that the assumption that RF radiation is incapable of causing cancer or other adverse health effects other than by tissue heating is wrong."

- Anthony B. Miller, who served as an editorial reviewer of the IARC monograph, has also written that if an IARC panel were to review the science at this point they would conclude that it should be reclassified as category 1, a human carcinogen.

In 2019, an advisory group of the International Agency for Research on Cancer (IARC) of the World Health Organization, consisting of 29 scientists from 18 countries, released new recommendations to reassess as a "high priority" the cancer risks of radiofrequency radiation between 2020–2024. The recommendations were published in The Lancet Oncology on April 18, 2019.

7. Why have more than 220 of the world's leading scientists signed an appeal to the WHO and the United Nations to protect public health from wireless radiation and nothing has been done?

Over 393 scientists and doctors from 35 countries have signed on to a declaration called the 5G Appeal,[104] sent to officials of the European Commission, calling for a moratorium on the increase of cell antennas for planned 5G expansion because "5G will substantially increase exposure to radiofrequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. for telecommunications already in place. RF-EMF has been proven to be harmful for humans and the environment."

In addition, the 5G Appeal references the 2015 Scientistic Appeal to the United Nations published in the European Journal of Oncology[105] now signed by 253 scientists who have published research on electromagnetic radiation which states that, "numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life."

[104] The 5G appeal – 5G Appeal 5G Appeal. Accessed July 8, 2020.
[105] EMFscientist.org - International EMF Scientist Appeal. Accessed July 8, 2020.

Why has nothing been done?
The Scientific Appeal states that "the various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF." The International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines do not cover long-term exposure and low-intensity effects, yet they are used by many governments as safety limits. The EMF scientists contend that the ICNIRP guidelines are insufficient to protect public health.

Dr. Lennart Hardell published a paper entitled, "Appeals that matter or not on a moratorium on the deployment of the fifth generation, 5G, for microwave radiation" explaining how ICNIRP is a private German non-governmental organization of 13 people that "relies on the evaluation only of thermal (heating) effects from RF radiation, thereby excluding a large body of published science demonstrating the detrimental effects caused by non-thermal radiation." He contends that ICNIRP has disregarded research and that their safety guidelines are obsolete and protect the industry, not health. Hardell describes the communications between decision makers and the scientists and concludes that "the majority of decision makers are scientifically uninformed on health risks from RF radiation." In addition, they seem to be uninterested in being informed by scientists representing the majority of the scientific community, i.e., those scientists who are concerned about the increasing evidence or even proof of harmful health effects below the ICNIRP guidelines (www.emfscientist.org). Instead, they rely on evaluations with inborn errors of conflicts, such as ICNIRP.

8. Why have the cumulative biological damaging effects of ever-growing numbers of pulse signals riding on the back of the electromagnetic sine waves not been explored, especially as the world embraces the Internet of Things, meaning all devices being connected by electromagnetic waves, and the exploration of the number of such pulse signals that will be created by implementation of 5G technology?

There are extensive data gaps regarding human exposure to wireless devices and the complexity of the waves we are exposed to. Most studies have not adequately explored all of these characteristics but instead only focus on power density.

"Adverse Health Effects of 5G Mobile Networking Technology Under Real Life Conditions"[106] published in Toxicology Letters states "the typical incoming EMF signal for many/most laboratory tests performed in the past consisted of single carrier wave frequency; the lower frequency superimposed signal containing the information was not always included. This omission may be important. As Panagopoulos states: "It is important to note that except for the RF/microwave carrier frequency, Extremely Low Frequencies - ELFs (0–3000 Hz) are always present in all telecommunication EMFs in the form of pulsing and modulation. There is significant evidence indicating that the effects of telecommunication EMFs on living organisms are mainly due to the included ELFs…. While ~50 % of the studies employing simulated exposures do not find any effects, studies employing real-life exposures from commercially available devices display an almost 100% consistency in showing adverse effects" (Panagopoulos, 2019). These effects may be exacerbated further with 5 G: "with every new generation of telecommunication devices…..the amount of information transmitted each moment…..is increased, resulting in higher variability and complexity of the signals with the living cells/ organisms even more unable to adapt" (Panagopoulos, 2019)."

This is an area that requires adequate research before deployment.

[106] Kostoff RN, Heroux P, Aschner M, Tsatsakis A. "Adverse health effects of 5G mobile networking technology under real-life conditions." *Toxicol Lett*. 2020;323:35-40. doi:10.1016/j.toxlet.2020.01.020