Public Comment for January 6, 2026 Oregon Health Policy Board meeting:

1. Public comment from Bruce Thomson, MS, MD

Bolstering Adequate Medicaid Funding as a Response to Federal HR1

The Oregon Health Forum recently hosted a discussion regarding how to manage the upcoming shortfall of funding for Medicare and Medicaid as the impact of Federal HR 1 starts in the coming years. In its present form, HR 1 represents a $13B shortfall over the next 10 years to Medicaid/Medicare funding for the people of Oregon. The Forum panelists (John McConnell, Sean Kolmar, Jeremy Vandehey and Hayden Rook-Ley) focused on re-evaluating and adjusting the current Provider Tax and the Hospital Tax system that together are used to provide adequate funding for Oregon's Medicaid and Medicare programs. Approximately 13% of elderly Oregonians are covered by Medicare. While 66% of Oregonians are covered by private health insurance or employer sponsored health insurance; that leaves approximately one third of Oregonians covered by public insurance/ Medicaid. Medicaid coverage is highly variable around the state, for instance 90% of patients at an Oregon coastal hospital are covered by public funding.

In Corvallis in 2025, Samaritan Hospital system with five hospitals in 3 counties and Samaritan IHN/CCO and have applied for a merger/acquisition by an out of state non-profit corporation, Multicare. In Portland in 2023, CareOregon CCO was in the midst of a merger from a California corporation which withdrew from the deal following a state-wide effort to discourage CareOregon from moving forward with that merger/acquisition. The CareOregonCCO reserves in that proposed merger were significant. In 2022, a subsidiary of United HealthCare purchased Lane County's Oregon Medical Group (OMG) which had contracted with PacificSourceCCO. Within a year of that merger acquistion, one third of the medical staff had left OMG. In 2015-2016 Centene, a Kentucky corporation purchased TrilliumHealthCCO , of Lane County, it is not publicly known where the TrilliumHealthCCO Reserves went in that purchase. As of January 30, 2026, PacificSourceCCO will withdraw from serving 92,000 Medicaid patients in Lane County. Negotiations with TrilliumHealth are ongoing to meet the needs of these patients. Hopefully, those negotiations will be productive.

All mergers/acquisition have significant associated CCO reserve funds. When a hospital system manages a CCO, "reserve funds" can support the hospital system and/or can support a hospital foundation "for the benefit of the community". When a CCO is acquired, taxpayers in Oregon are not made aware of where their community "CCO reserves" go and who "owns" them. Oregonians would be relieved to know that CCO reserves have remained in Oregon rather than being transferred out of state by a

merger/acquisition. It would come as a relief to know that CCO reserve funds are available to the state for “unusual” situations such as the Covid pandemic or that have now developed as a result of HR1.

Before the start of the pandemic in early 2020, healthcare insurers in general typically averaged annual profits/ “margins” just under 1%. However, during the pandemic that leapt upward, to an average 4.6% by 2022. This was a result of federal dollars bestowed on insurers in Oregon, according to state data. At their highest, in 2022, operating margins at some of the insurers topped 7%. Some of the insurers, including for-profit Springfield-based Trillium Community Health Plan and Roseburg-based Umpqua Health Alliance, which has a mix of for-profit and nonprofit owners, paid about $60 million of those profits out as dividends to their owners. But most of the insurers simply piled up the money in their reserves and investment portfolios, greatly increasing their net assets or net worth (LUND REPORT 2023). By early 2023, the 16 insurers serving the Oregon Health Plan collectively garnered profits of nearly $440 million.

In order for Oregon to continue to be a national leader for providing health care to our state’s population, funding of Medicaid as portrayed in HR1, is a major roadblock. Unless creative sources of funding are found, the future of health care in Oregon is going to leave countless Oregon Medicaid patients with no place to turn to address their medical needs. Adjusting the “provider tax” and the “hospital tax” will help, that alone is not adequate. Without an adequate solution Oregon will likely experience an increase in premature deaths including an increase in newborn deaths as patients lose access to medical providers. In thinking about providing medical care to those patients, it would be helpful to know how the “CCO Reserves” might help fund Oregon’s Medicaid program. After all, the reserves are Oregon taxpayer’s money which was intended to provide medical care to disabled Oregonians without the ability to pay for private medical insurance.

Ethical considerations question how CCO RESERVES become “proprietary secrets”. Should taxpayers be given the opportunity to provide feedback into how CCO Reserves are spent in their community? Should a community have access to CCO reserves information, since taxpayers have paid into “CCO Reserve fund” through their tax dollars?

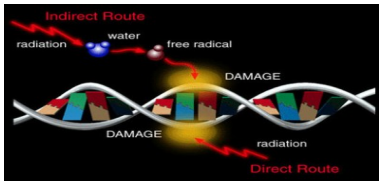
2. Public comment from David Morrison:

An edit to my previous email. OHA committed a felony when withholding the first draft of their review from a FOIA request. I neglected that detail. Also, would like their response to the 112pg scathing review of their methods and conclusions by numerous

international scientists and organizations: https://ehtrust.org/oregon-department-of-health-report-on-wi-fi-health-effects-documentation-of-scientific-errors/

OHA committed a felony in 2020 by withholding the first draft of their review stating that wi-fi in schools is safe. The first draft stated that "all studies showed worse health outcomes... all studies showed harm to reproductive organs." I want to know whether OHA is going to publish a new report based on their own results or whether they will continue to harm children in Oregon schools by suppressing the results.

(David Morrison provided four attachments – see following pages)



RADIATION FREE SCHOOLS

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OREGON HEALTH AUTHORITY ISSUES STATEMENT ON WIRELESS RADIATION IN SCHOOLS. ISSUES PRECAUTIONARY ADVICE.

Senate Bill 283 passed in 2019 required the OHA to review science to determine the safety of long term exposure to wi-fi and wireless microwave radiation in schools.

David Bangsberg, Chair of OHA's Citizen's Oversight Board, said The review mandated by SB 283 did not **"exclude the possibility of a causal effect"** and called for more studies as did Sen. Dembrow when he reviewed the poor methodology used by OHA.

The first draft of the Oregon Health Authority review reported the following health effects from wireless radiation and concluded: **"All studies showed negative outcome on health. All studies showed negative effects on reproductive organs."**

- Increased leukemia in children 5 Kilometers from Vatican cell towers.
- 13% increase in cancer from cell towers in Taiwan.
- Other studies-- high blood glucose in males, 21 studies showed negative effects on heart function, negative effects on memory, cognitive function, brain structure and function.
- Pre natal exposure studies showed spontaneous abortion, altered thyroid function, adverse effects fetal growth and child development, genotoxicity of oral mucosal cells, impact on salivary gland. Other studies showed Negative affects on mental health & depression, as well as 21 studies showing alterations in brain physiology and cerebral blood flow.

Internationally recognized scientist and Portland resident Dr. Martin Pall says: "Wi-Fi is an important threat to human health."

> Pall reports: "Repeated Wi-Fi studies show that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload."

OHA Tips to reduce RFR exposure from wireless devices

- Increase distance from wireless devices which decreases exposure exponentially.
- Reduce the amount of time spent using any wireless device.
- Increase the distance between personal wireless devices and the body.
- Check the wireless device for the recommended distance to keep away from the body.

WiFi may interact with signaling pathways in the brain, causing irreversible damage

By Dr. Surat P, Ph.D. Apr 18 2019

The effects of repeated WiFi exposure on human health have been widely debated. A recent study reviewed evidence from 23 controlled scientific studies which investigated the health effects of WiFi on animals, human cell lines, and humans to determine once and for all, whether WiFi has a detrimental effect on human health.

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WiFi or a wireless network consists of an antenna that is connected to the internet and several wireless devices, such as laptop, phone, etc. The electromagnetic frequency of WiFi is pulsed rather than continuous. This is a critical issue, as pulsed electromagnetic frequencies have a larger biological impact.

A 2015 study argued that more pulsed an electromagnetic frequency, more harmful they are for biological specimens. Researchers have also tried to determine the dose relationship between WiFi exposure and biological effects, and found that a specific intensity range of electromagnetic pulses may produce maximum effects, and this may drop off at lower and higher intensities.

When the impact of pulsed electromagnetic frequency was observed in the brains of mice, it was found that exposure for 1–2 months was relatively modest and that the changes were reversible after removing the trigger. However, months of exposure led to severe irreversible effects on neurons and the brain. These results suggest that the changes induced by pulsed electromagnetic frequencies accumulate over time, with harmful long-term effects.

Should we stop children and pregnant women from using WiFi connected devices?

The pulsed electromagnetic frequencies may be particularly damaging in young children due to the small size of their skulls and reduced skull thickness. This may increase brain exposure to pulsed electromagnetic frequencies.

Pulsed electromagnetic frequencies have also been shown to be particularly potent in embryonic stem cells. As these cells occur at a higher frequency in fetus and children, it further puts them at risk, leading to effects on brain development. This effect is particularly striking considering that WiFi placements are a common fixture around schools these days.

WiFi may interact with signaling channels in the human brain

One of the first studies to elucidate how the pulsed electromagnetic frequencies could affect human health showed that low-intensity pulsed electromagnetic frequencies could be blocked using drugs that block voltage-gated calcium channels. Subsequent studies showed activation of calcium channels in response to pulsed electromagnetic frequencies in plants, animals, and human cells.

Apart from calcium channels, voltage-gated sodium, potassium, and chloride channels were also shown to be activated by pulsed electromagnetic

frequencies. In humans, seven different voltage-gated ion channels are known to be activated by exposure to pulsed electromagnetic frequency.

This change was observed within five seconds in cells in culture, suggesting that this is a direct effect of pulsed electromagnetic frequency on the plasma membrane.

The different biological effects of pulsed electromagnetic frequency exposure include oxidative stress, lower female/male fertility, neurological effects, cell death, and damage, changes in steroid hormone levels, calcium overload.

Previous studies that have investigated this effect used computers with WiFi cards. Although WiFi cards have been designed to communicate with WiFi antennae, currently there is no information as to how these pulsed electromagnetic frequencies compare with the radiations of genuine WiFi.

Furthermore, many studies have claim there are no effects of pulsed electromagnetic frequencies as the observed effects were not scientifically significant. However, concluding that there is an absence of effects due to lack of statistical significance may not mean that there is no effect whatsoever.

The ubiquitous presence of WiFi in spaces occupied by humans, particularly in schools should be dealt with caution until the effects of pulsed electromagnetic frequencies on humans are established.

Source:

Martin L. Pall. 2018. Wi-Fi is an important threat to human health. *Environmental Research.* 164 pp.405-416. doi.org/10.1016/j.envres.2018.01.035

Written by

Dr. Surat P

Dr. Surat graduated with a Ph.D. in Cell Biology and Mechanobiology from the Tata Institute of Fundamental Research (Mumbai, India) in 2016. Prior to her Ph.D., Surat studied for a Bachelor of Science (B.Sc.) degree in Zoology, during which she was the recipient of an Indian Academy of Sciences Summer Fellowship to study the proteins involved in AIDs. She produces feature articles on a wide range of topics, such as medical ethics, data manipulation, pseudoscience and superstition, education, and human evolution. She is passionate about science communication and writes articles covering all areas of the life sciences.

Saved from URL: https://www.news-medical.net/news/20190418/WiFi-may-interact-with-signaling-pathways-in-the-brain-causing-irreversible-damage.aspx

Press Release May 31, 2016

ACS Responds to New Study Linking Cell Phone Radiation to Cancer

The U.S. National Toxicology Program (NTP) has released partial results from an animal study of the effect of radiofrequency radiation associated with cell phones. The group found radiofrequency radiation was linked to a higher risk of two cancers. Below is a response from **Otis W. Brawley, M.D., American Cancer Society Chief Medical Officer.**

"For years, the understanding of the potential risk of radiation from cell phones has been hampered by a lack of good science. This report from the National Toxicology Program (NTP) is good science.

"**The NTP report linking radiofrequency radiation (RFR) to two types of cancer marks a paradigm shift in our understanding of radiation and cancer risk. The findings are unexpected; we wouldn't reasonably expect non-ionizing radiation to cause these tumors**. This is a striking example of why serious study is so important in evaluating cancer risk. It's interesting to note that ***early studies on the link between lung cancer and smoking had similar resistance***, since theoretical arguments at the time suggested that there could not be a link.

On the Clear Evidence of the Risks to Children from Smartphone and WiFi Radio Frequency Radiation

Professor Tom Butler | University College Cork | tbutler@ucc.ie

Children's health and well-being is under significant threat from everyday digital technologies, as the past 15 years have seen the proliferation of microwave Radio Frequency Radiation (RFR) devices in the home, school and society. The safety standards for such devices—smartphones, tablets etc.—were based on the proven thermal or heating effects of microwave devices in adults, not children. Scientists in the life sciences have long been aware of equally harmful non-thermal effects. However, physicists and engineers have operated on the theory that non-ionizing RFR could not directly damage human DNA and lead to cancer, as it was far less powerful than ionizing radiation (x-rays, nuclear etc.). That theory has been solidly and roundly refuted, as this paper illustrates. Cancer risks aside, research studies have demonstrated that low-intensity RFR elicits a range of pathophysiological conditions in experimental animals and humans. This is why parents, educators and governments should be alarmed and take immediate and appropriate action. In an Irish, and indeed international context, there is clear ignorance on such matters. In response, this paper aims to inform by presenting clear evidence, in a balanced manner, of the risks to children based on proven scientific theories and empirical evidence. The paper concludes by offering practical advice on how the risks to children, and indeed adults, can be minimised.

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On the Clear Evidence of the Risks to Children from Smartphone and WiFi Radio Frequency Radiation

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"The level of proof required to justify action for health protection should be less than that required to constitute causality as a scientific principle"

Professor Rainer Frentzel-Beyme MD

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Abstract

Children's health and well-being is under significant threat from everyday digital technologies, as the past 15 years have seen the proliferation of microwave Radio Frequency Radiation (RFR) devices in the home, school and society. The safety standards for such devices—smartphones, tablets etc.—were based on the proven thermal effects of microwave devices in adults, not children. Scientists in the life sciences have long been aware of equally harmful non-thermal effects. However, physicists and engineers have operated on the theory that non-ionizing RFR could not directly damage human DNA and lead to cancer, as it was far less powerful than ionizing radiation (x-rays, nuclear etc.). That theory has been solidly and roundly refuted, as this paper illustrates. Cancer risks aside, research studies have demonstrated that low-intensity RFR elicits a range of pathophysiological conditions in experimental animals and humans. This is why parents, educators and governments should be alarmed and take immediate and appropriate action. In an Irish, and indeed international context, there is clear ignorance on such matters. In response, this paper aims to inform by presenting clear evidence, in a balanced manner, of the risks to children based on proven scientific theories and empirical evidence. The paper concludes by offering practical advice on how the risks to children, and indeed adults, can be minimised.

Introduction

Exposure of humans to non-ionizing radio frequency radiation (RFR) has increased dramatically over the past 20 years, particularly where children are concerned. Epidemiological and experimental research reports increased risk of pathophysiological conditions with current exposures to Smartphone and WiFi RFR that include: cellular DNA damage, leading to a range of cancers; sperm and testicular damage leading to male infertility; neuropsychiatric conditions, including post-natal neural development, and learning and cognitive problems; and melatonin reduction leading to sleep disruption; among others. There is a considerable body of evidence on the harmful effects of electromagnetic pollution that should have the World Health Organization (WHO) and governing bodies establishing guidelines to protect public health, as they have with environmental pollution. In light of recent scientific evidence, in May 2015 over 200 eminent scientists have launched an international appeal to the United Nations and the WHO based on the conviction that there is a real and present danger to children, in particular, by what they consider outdated industry standards in relation to microwave radiation.

On November 1st 2018, the final report of a 10-year $30m comprehensive study by US National Institute of Environmental Health Sciences' National Toxicology Program (NTP) confirmed that radio frequency radiation (RFR) from Smartphones caused cancer in animals.[1] That study clearly refutes the long-held theory that non-ionizing radiation, such as RFR, cannot cause cancers or lead to other effects on the health and well-being of humans. The findings of this study opens an ethical Pandora's Box for mobile phone companies and BigTechs such as Apple, Facebook, Google and others, as the use of microwave RFR technologies underpin their business models. Such technologies are now ubiquitous in society, whether it is in the home, classroom, workplace, or in transport systems. The fact that they might pose a real risk to the health and well-being of users and particularly children was never considered. This creates a dilemma for parents and educators, as the evidence on the risks to human health and well-being associated with widespread and indiscriminate exposure to RFR is clear and unambiguous, with children being particularly at risk.

This paper begins by reporting on a ground-breaking study by the National Toxicology Program's (NTP) at the U.S. Department of Health and Human Services. The final report was issued on November 1st 2018 and in the press release Dr. John Bucher, Senior Scientist, at the National Toxicology Program *stated, "We have concluded that there was clear evidence that male rats developed cancerous heart tumors called malignant schwannomas. The occurrence of malignant schwannomas in the hearts of male rats is the strongest cancer finding in our study."* [2] Categorising the major findings as *"clear evidence"* is significant as this is the highest burden of proof in a scientific study by the NTP. It employs 4 levels of evidence. Other findings were categorised as *Some Evidence* (brain tumours such as glioma and adrenal gland tumours) and *Equivocal* (cancers of the prostate and pituitary glands). None of the findings were at level 4, No Evidence. The paper discusses these findings in the context of previous research. It then presents the biological and cellular mechanisms found to be responsible for these effects. The paper then presents evidence that RFR promotes the development of existing cancers and examines why the existing safety standards are not fit for purpose. Next explored are the perspectives of insurance companies and telecommunications operators on the risks.

Proof of the Potential Toxicity and Carcinogenicity of RFR

In 1999, the US Food and Drug Administration's (FDA) Center for Devices and Radiological Health commissioned the National Toxicology Program study on the potential toxicity and carcinogenicity of RFR.[3] The FDA's concerns followed the emergence and widespread use of first generation cell phone devices in the early 1980s and second generation (2G) systems in the 1990s. The health focus and associated safety standards were, and still are, centred on the thermal effects (i.e. heating of tissues from microwaves) and not on the non-thermal effects. To be sure, the findings of extant research at the time were mixed, with no clear evidence either way of potential negative health implications of low-intensity RFR, especially where cancer was concerned.[4] In 2011 the IARC classified WiFi and microwave radiation from cordless and mobile phones as a ***possible*** Class 2B carcinogen. While the findings of epidemiological studies have been debated, and chiefly focus on the long-term development of brain tumours, a recent review of such studies is unequivocal and states that *"[m]obile phone radiation causes brain tumors and should be classified as a* ***probable*** *human carcinogen (2A)"* by the WHO's International Agency for Research on Cancer (IARC).[5]

The NTP study is not the first of its kind—it confirms the findings of previous research on the links between RFR exposure and various cancers—it is the most comprehensive, however. Since 1999 when the FDA flagged the issue of potential non-thermal effects of microwave radiation, a wealth of new experimental and epidemiological research demonstrated the very real biological effects of RFR on the brain, nervous systems, hearts and testes of mammals, including humans. Cancers aside, many of these studies consistently report a range of side-effects in humans, from sleep deprivation and headaches, to neurological damage, and learning disorders. Consequently, in 2014, the California Medical Association (CMA) [6] stated that *"peer reviewed research has demonstrated adverse biological effects of wireless EMF [i.e. RFR] including single and double stranded DNA breaks, creation of reactive oxygen species, immune dysfunction, cognitive processing effects, stress protein synthesis in the brain, altered brain development, sleep and memory disturbances, ADHD, abnormal behavior,*

sperm dysfunction, and brain tumors." The CMA were following the lead of the American Academy of Paediatrics, which in 2013 petitioned the US Federal Communications Commission (FCC) and to the Food and Drug Administration (FDA) to reassess safety standards to RFR in order to *"protect children's health and well-being throughout their lifetimes and reflect current use patterns."*[7]

The final peer-reviewed findings of the NTP study were released on November 1st 2018. Given the significance of the findings there was a muted response from the press. Coverage from the New York Times argued that the focus on 2G and 3G technologies somehow weakened the study's findings.[8] This is a spurious argument, as 4G Smartphones are backward compatible with 2G and 3G. More worryingly the International Commission on Non-Ionizing Radiation Protection (ICNIRP) decided that the findings did not provide a reason to revise current (i.e. 20-year-old) RFR exposure standards. However, Dr. Ronald Melnick rebutted the ICNIRP analysis stating it contained several false and misleading statements.[9] Dr Fiorella Belpoggi, Director of the Cesare Maltoni Cancer Research Center of the Ramazzini Institute, which had recently conducted separate research that reproduced the findings of the NTP Study, also took issue with the ICNIRP—*"We are scientists, our role is to produce solid evidence for hazard and risk assessment. Underestimating the evidence from carcinogen bioassays and delays in regulation have already proven many times to have severe consequences, as in the case of asbestos, smoking and vinyl chloride."*[10] In their study, Dr Belpoggi and her colleagues found an *"increase in the incidence of tumors of the brain and heart in RFR-exposed Sprague-Dawley rats. These tumors are of the same histotype of those observed in some epidemiological studies on cell phone users."*[11] The NTP study also reported that DNA damage (strand breaks) was significantly increased in the brains of rats and mice exposed to RFR. The findings also reported reduced birth weights of rat pups whose mothers were exposed to RFR, in addition to cardiomyopathy of the right ventricle in the rats studied.[12]

After more than 20 years of widespread cell phone use, one would expect to see a rise in cancers, particularly brain tumours. A research review of the incidence of glioblastoma multiforme tumours in England during 1995–2015 reported a *"a sustained and highly statistically significant ASR [(incidence rate)] rise in glioblastoma multiforme (GBM) across all ages. The ASR for GBM more than doubled from 2.4 to 5.0, with annual case numbers rising from 983 to 2531. Overall, this rise is mostly hidden in the overall data by a reduced incidence of lower-grade tumours."*[13] The study did not focus on RFR as the cause, so the findings must be considered 'open to interpretation' in this regard, as other environmental mechanisms cannot be ruled out. Another recent review study on epidemiological studies on brain and salivary gland tumours and mobile phone use found the cumulative evidence to be inconclusive, but indicated that cancers may have longer latency (i.e. greater than 15 years) and childhood use to be of concern.[14] In contrast, the French CERENAT study stated that, "Consistent with previous studies, we found an increased risk in the heaviest users, especially for gliomas."[15] While these studies emanate from natural scientists, two social scientists found that *"that mobile phone subscription rates are positively and statistically significantly associated with death rates from brain cancer 15-20 years later. As a falsification test, we find few positive associations between mobile phone subscription rates and deaths from rectal, pancreatic, stomach, breast or lung cancer or ischemic heart disease."*[16]

Commenting on the general issue of a rise in brain tumours, cancer epidemiologist Geoffrey Kabat, argues that the risk of brain cancer in the US is

low, 6 in every 100,000, compared to 150 in every 100,000 for breast cancer.[17] He therefore implies that the cancer risk from RFR is overhyped, as epidemiological data can be open to various interpretations. Whichever way one looks at it, the incidence of such tumours is indeed low. But if recent studies are accurate, then this rate may more than double over a 20 year period[11] or increase in line with mobile phone use,[14] as RFR is now accepted as either a causal or a contributory mechanism in the occurrence of brain tumours and other cancers. However, what none of these studies take into account is that the number of RFR sources has increased dramatically throughout the home, school and work environments over the past 10 years, with WiFi routers, 2-4G enabled tablets, the proliferation of WiFi enabled devices and wearables, and the number of mobile phones per person.

There is also evidence that RFR from cell phones may be triggering breast cancer in young women who carry their devices on or near their breasts.[18] To compound matters even further, one of the significant findings of the NTP study was the presence of RFR promoted the growth of tumours caused by other carcinogens.[1,8,10,11] The findings of the cumulative body of research are objective, and particularly disturbing where children are concerned. Rigorous experimental studies on laboratory rats have found that daily exposures to low-levels of microwave radiation, such as that emitted by WiFi devices, causes significant biological changes in a range of major organs such as the brains, hearts, reproductive systems, and eyes of the rats being studied.[19]

All this has profound implications for the increasing numbers of children and adolescents exposed to RFR on a daily basis. And the risks to children are considerable: *"Because cells are rapidly dividing and organ systems are developing during childhood and adolescence, exposure to carcinogens during these early life stages is a major risk factor for cancer later in life. Because young people have many expected years of life, the clinical manifestations of cancers caused by carcinogens have more time in which to develop during characteristically long latency periods."* [20] A recent study demonstrated that in **a child's brain the hippocampus and hypothalamus absorb 1.6–3.1 times the microwave energy of an adult brain**. The absorption rate is 2.5 times higher than an adult's where a child's cerebellum is concerned. The same study found that the bone marrow in a child's skull absorbs microwave radiation at a level 10 times greater than that of an adult.[21] In addition, a child's eyes absorb higher levels of microwave radiation than adults. [22] If, as the latest scientific evidence indicates, low-level microwave radiation poses a health risk, and if safety standards are outdated, then it is logical to assume that children are at significant risk from any device radiating microwave radiation.[23]

Dr Christopher J. Portier, Associate Director, National Institute of Environmental Health Sciences and Director, Office of Risk Assessment Research, co-authored an article with Dr Wendy Leonard in *Scientific American*, following the initial release of the NTP study findings in 2016. They conclude that, *"Cellphones probably cause cancer if the exposure is close enough, long enough, and in sufficient magnitude. We don't yet know the risk for a given level of exposure in humans. We need more data in this area, not only for cellphones, but for bluetooth devices, wifi and all the other RF-EMF devices out there. Until then, reduce your exposure whenever possible."* [24]

Clearly, this is a complex matter, made even more so by the fact that there was no hope of a paradigm change, until the 'smoking gun' provided by the NTP study removed any doubt that RFR can act directly, via identified mechanisms, to induce tumours in biological organisms

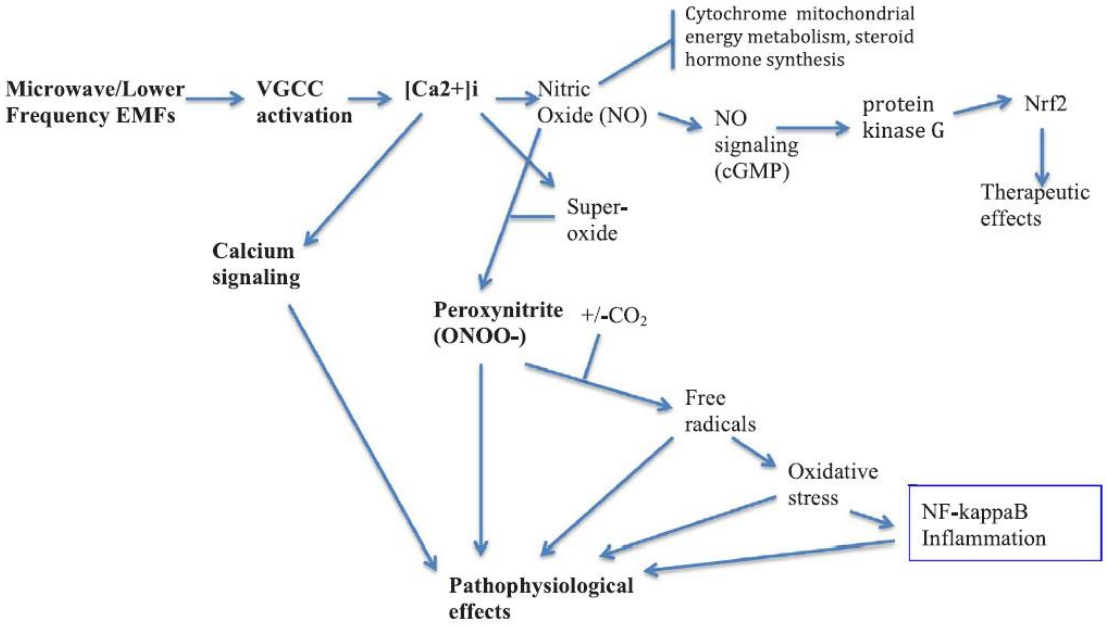


Figure 1 Mechanisms and Pathways to Pathophysiological Effects (Reproduced from Pall 2018)

exposed to radiation levels within those permitted by existing standards and to which users are typically exposed. This should stimulate a reassessment of the risks in relation to all RFR use, particularly children. *"The level of proof required to justify action for health protection should be less than that required to constitute causality as a scientific principle"*.[25] We are far beyond that level of proof where RFR is concerned.

What are the Biological Mechanisms that Produce Ill-health in Children and Adults?

While the direct effects of certain carcinogens are widely acknowledged, research illustrates that *"carcinogens may also partly exert their effect by generating reactive oxygen species (ROS) during their metabolism. Oxidative damage to cellular DNA can lead to mutations and may, therefore, play an important role in the initiation and progression of multistage carcinogenesis…Elevated levels of ROS and down regulation of ROS scavengers and antioxidant enzymes are associated with various human diseases including various cancers. ROS are also implicated in diabetes and neurodegenerative diseases"*[26]. Research on mobile phone RFR and WiFi pulsed microwave signals has also demonstrated that they produce elevated levels of reactive oxygen species (ROS) which in turn cause oxidative stress in cell.[27,28, 29] Oxidative stress is caused by an imbalance between ROS and the counter effects of antioxidants that help detoxify and repair biological systems. Thus, the body normally employs antioxidant defence mechanisms to counter ROS and help avoid diseases such as cancer, which are trigged by oxidative stress and its tendency to cause strand breaks in a cell's DNA.

A raft of studies indicate that a chain of biological mechanisms produces the observed negative health outcomes in laboratory animals and humans. Martin Pall, Professor Emeritus of Biochemistry and Basic Medical Sciences, Washington State University points to the role of voltage-gated calcium channel (VGCC)

activation, which is triggered by RFR sources such as 2-4G and Wifi, as being one of primary causal mechanisms.[30] In his review published in 2018, he cites over 120 empirical research papers in support of his thesis. There is, therefore, a cumulative body of evidence which refutes the proposition that RFR has no biological effects, other than local thermal effects on tissue. Professor Pall's earlier 2013 review paper cites 22 research studies that specifically point to the role played by VGCC activation.[31] The number of studies replicating experiments that corroborate this theory has grown significantly, while none appear to refute it. The figure 1 illustrates the posited mechanisms, pathways and outcomes. A detailed discussion is beyond the scope of this paper, however, several important mediating mechanisms and pathophysiological outcomes are now discussed.

A recent review of scientific studies concluded that relatively brief, regular, and also long-term use of microwave devices resulted in negative impacts on biological systems, especially the brain.[32] This review by Kesari et al. squarely highlights the role played by reactive oxygen species (ROS) as a key mechanism (generated by exposure to microwaves) in producing serious negative effects in living organisms. Exposure to ionizing radiation has been long known to disturb the balance between ROS and the antioxidants that neutralise them. Usually this imbalance results in a high probability that the subject will develop cancers and other chronic conditions. A wealth of studies now illustrate, however, that non-ionizing radiation emitted from smart phones, cordless phones, WiFi, Bluetooth and other wireless technologies, such as those powering the Internet of Things (IoT) can severely disturb this balance also, by amplifying ROS, suppressing antioxidants, and increasing oxidative stress. There is substantial evidence that oxidative damage to cellular proteins, lipids and DNA is at the root cause of many of the ill-effects of microwave RFR. Most worrying in all of this is that scientists have found that the mutagenic effects on the DNA of living cells occurs under low-levels of exposure to the pulsed microwave radiation found in most of these devices. The consequences for children are obvious, given their greater exposure levels and susceptibility to health ill-effects and also that their bodies are constantly growing and developing.[33, 34]

A recent study illustrates relatively low level of exposure required to produce adverse biological effects. Chauhan et al.[8] published the results of their experiment on Wistar rats in 2016. The rats in this experiment were exposed to RFR at 25% of the normal level at the human ear and 15% of the level when carried for 2 hours per day for 35 days. Autopsies of the rats exposed to RFR revealed significantly high levels of ROS in the livers, brains and spleens of the exposed animals. In addition, histological changes were also found in brains, livers, testes, kidneys and spleens. In line with a wealth of other similar studies, the researchers concluded that the *"results indicate possible implications of such exposure on human health."* Earlier studies found that rat brains exposed to RFR exhibited an increase in single strand DNA breaks and chromosomal damage in brain cells. Thus it is beyond doubt that the substantial increase in ROS in living cells under RFR at low signal strength could be causing a broad spectrum of health disorders and diseases, including cancer, in humans and particularly in children. Certainly, recent studies have provided empirical evidence to support this theory.

Another recently discovered mechanism found to affect the growth of glioblastoma multiforme tumours in humans is the p53 protein.[35] Glioblastoma are the most common and most malignant of the glial tumours found in the brain and central nervous

system. These researchers studied 63 patients with this type of tumour and found that patients that used *"mobile phones for ≥3 hours a day show a consistent pattern of increased risk for the mutant type of p53 gene expression in the peripheral zone of the glioblastoma, and that this increase was significantly correlated with shorter overall survival time."* This is a significant finding. More worrying is a recent study conducted on the Swedish National Inpatient Register: *"The main finding in this study was increasing rate of brain tumor of unknown type in the central nervous system."* [36] The research being conducted by the 'Hardell Group' in Sweden, which is responsible for this study, has consistently demonstrated a link between mobile phone use and cancer. Two recent studies from the group confirm the link between RFR and cancers in humans. In the first, both mobile and cordless phones were associated with an increased the risk of glioma, a type of brain tumour. [37] It found that the *"First use of mobile or cordless phone before the age of 20 gave higher OR [odds ratio] for glioma than in later age groups."* Which indicates that children or teenagers are at significant risk. In the second, researchers found that the rise in thyroid cancers in Sweden was linked with increase in exposure to RF-EMF.[38] To be sure, epidemiological studies such as the latter are akin to looking for a needle in a haystack, and are criticised by some as being flawed, however their findings need to be viewed in a new light given the scientific evidence emerging from laboratory experiments such as the NTP study.

Evidence that Microwave RFR Promotes the Development of Existing Cancers

One important recent finding is that RFR has cocarcinogenic effects. In research published in 2010, carcinogen-treated mice exposed to RFR demonstrated significant tumour-promoting effects.[39] A study by Lerchl et al. in 2015[40] replicated the earlier study using higher numbers of animals in both the control and experimental groups. Lerchl et al. confirmed and extended the previous findings. They report that numbers of tumours of the lungs and livers in exposed animals in were significantly higher than in the control groups. They also reported significantly elevated lymphomas through RFR exposure. The scientists hypothesized that cocarcinogenic effects may have been *"caused by metabolic changes due to exposure."* It is significant, and extremely worrying, that tumour-promoting effects were produced *"at low to moderate exposure levels (0.04 and 0.4 W/kg SAR), thus well below exposure limits for the users of mobile phones."* The authors conclude that their *"findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones."* The mechanisms presented in the previous section help explain why and how RFR exposures induce the observed findings in these and other studies.

Why are Existing Standards Unsafe?

The existing standards for mobile (2,3, & 4G) and WiFi are considered unsafe. The US Federal Communications Commission (FCC) mandates that *"The safe limit for a mobile phone user is an SAR of 1.6 watts per kg (1.6 W/kg), averaged over one gram of tissue, and compliance with this limit must be demonstrated before FCC approval is granted for marketing of a phone in the United States."* SAR is the Specific Absorption Rate. Expressed in Watts (a unit of electrical power) per kilogram of human tissue, SAR measures of the rate at which RFR energy is absorbed by the human body. In the testing procedures the FCC uses to certify that cell phones don't exceed the 1.6 *W/kg* SAR limit, the devices are tested 0.59 inches and 0.98 inches (1.5cm to 2.5cm) from the body. Hence,

smartphone manufacturers provide these guidelines buried in their safety information. If users operate their devices within these limits, which most do, they are in breach of the safe operating limits and are more at risk from both thermal and non-thermal effects. To make matters worse, 75% of smartphones regularly exceed FCC safety limits as a recent correspondence between Washington DC law firm, Swankin & Turner, who sent a letter to the FCC indicates. The letter questioned whether the agency adequately enforced its cell phone radiation exposure limits.[41]

If a smartphone is on, but not being used for calls, text, or to browse online, it still communicates with cell phone base towers to maintain internet access. This allows app notifications, instant message texts, updates, and so on. So your phone is never off. Hence, when you carry it in your pockets or on a belt wallet, it's not being operated within the safe distance and the phone manufacturer is not liable. Note that the safety limits for cell phones and Wifi focus on thermal effects only. Remember also that non-thermal effects have been observed at much lower SAR levels from individual devices and also cellular base stations and WiFi router. [42] Russian scientist Dr. Yuri Grigoriev, Chairman of the Russian National Committee on Non-ionizing Radiation Protection (RNCNIRP) points out that *"National and international regulatory limits for radiofrequency radiation (RFR) exposure from cell phones and cell towers are outdated."* [43] He argues that Western standards are inadequate to protect human health, in contrast with those in Russia, especially where the health of children is concerned. In Belpomme et al. study[42], whose authors include cancer researchers, it is argued that *"In spite of a large body of evidence for human health hazards from non-ionizing EMFs at intensities that do not cause measureable tissue heating, summarized in an encyclopaedic fashion in the Bioinitiative Report (www.bioinitiative.org), the World Health Organization (WHO) and governmental agencies in many countries have not taken steps to warn of the health hazards resulting from exposures to EMFs at low, non-thermal intensities, nor have they set exposure standards that are adequately health protective."*

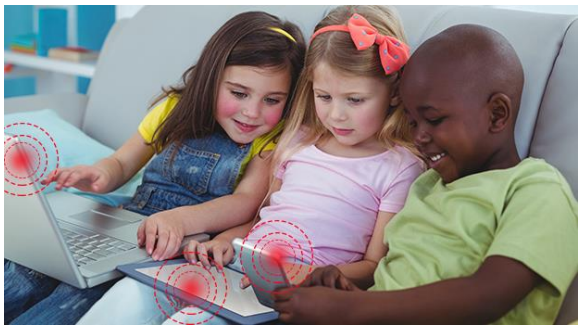
The industry safety standard for WiFi was established in 1996 by the FCC. It adopted the IEEE standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz, of 1991, which was based on that issued by the National Council on Radiation Protection (NRCP) in 1986. This standard covers only the thermal hazards from Radio Frequency Radiation (RFR). RFR is also known as non-ionizing microwave radiation. There is a long-standing belief among physicists and electronics engineers that, unlike ionizing radiation such as X-rays, non-ionizing radiation such as RFR is not powerful enough to cause damage to human DNA. Non-ionizing microwave radiation could not, therefore, according to that theory be a cause of cancer or other non-thermal biological effects in humans. This theory has, however, been falsified, as indicated above.

The hazards covered by the FCC standard are based on the specific absorption dose-rate (SAR) that produces thermal effects in body tissue. As indicated SAR is typically measured in Watts/Kilogram. So, put simply, SAR estimates the amount of energy absorbed by a human body or part thereof when exposed to an RFR signal. While accurate, it chiefly focuses on thermal effects of RF-EMF. The FCC guidelines are based on a 4 W/Kg adverse level effect observed in laboratory animals. This excerpt from the Code of Federal Regulations (CFR 47/2.1093) is instructive:

"The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of

1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits."

Based on existing theories and research data, the FCC recognised the safety problems with WiFi and recommended that such devices are not operated less than 20 cm from the human body for 30 minutes. However, as far back as 2002, the Environmental Protection Agency (EPA) stated that the *"FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalisation by many that the guidelines protect human beings from harm by any or all mechanisms is not justified"*[44]. The EPA's reservations were justified, given research findings published over the past 15 years that refute the theory that hazards were confined to thermal effects.



When is laptop not a laptop? When it's WiFi-enabled. Such devices must be 20 cm or 8" from the body— an adult body, that is.

We might add that at the time, the FCC never envisaged adults carrying WiFi enabled devices on their person, and certainly never envisaged children using these devices on a regular basis. Note too that adults and children carry WiFi-enabled smartphones on their person, less than 1 cm from their bodies and well within the 20 (8") cm limit of safe operation. This is also true of WiFi-enabled WhatsApp and Skype calls. However, today such devices are in widespread daily use by children across developed countries. Furthermore, given the observable patterns of use, the 30-minute maximum exposure is being breached on a regular basis by both adults and children. Given the scientific evidence, it is troubling to think that children are carrying or operating WiFi devices on or near their person, breaching the safety guidelines set by the FCC, and for periods much, much longer than 30 minutes.

Opposing views come from the BigTech and telecommunications companies, who like the tobacco lobby before them, are arguing that there is no danger in using WiFi technology or mobile phones. This view is based on the aforementioned belief that non-ionizing radiation such as microwaves are not powerful enough to cause damage to human DNA. However, as Professor Martin Pall concludes *"Repeated Wi-Fi studies show that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload."*[30]

What do Insurance Companies and Regulators and Telecoms Operators have to say about the Risks?

In 2010 Lloyds of London[45] published a paper on the emerging risks of RFR. At the time it likened links between non-ionizing radiation and cancer to that which exists between asbestos and cancer, indicating that time and more research would establish a causal link. In 2015, rumours spread across the web that Lloyds of London had stopped covering health risks associated with RFR

devices. However, it appears that the exclusion of RFR from insurance policies was issued by an individual underwriter, CFC Underwriting Ltd to the effect that: *"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."* It was reported that this exclusion applied to insurance cover for architects and engineers in Canada, following health concerns centering on a programme to install Wi-Fi in all British Columbian schools without parents' consent. Lloyd's 2010 report predated the IARC's decision in 2011 to classify RFR as a Class 2B carcinogen. As research on the health risks of RFR produces more empirical evidence, insurance companies will act accordingly. Indeed, occupational insurance for medical practitioners now specifically excludes any medical conditions that arise from exposure to non-ionizing radiation such as RF-EMF, including that from phones and mobile devices. Indeed, expect a strong response from the insurance industry as its actuaries evaluate the risks posed by long-term exposure to RFR in the weight of recent scientific evidence.

Regulators, such as the Securities and Exchange Commission, also recognise the economic impact of risks, as do mobile phone and internet services providers. Take, for example, that Vodafone and Verizon, among others, now include, and make provision for in their financial reports, the risks of litigation in relation to the health effects of products and services involving RFR, whether from smartphones or WiFi routers. Clearly neither believes that the small print in the safety information issued with RFR devices is sufficient. Take, for example, the following excerpt from Vodafone Group PLC, Annual Report.

*"**7. Our business may be impacted by actual or perceived health risks associated with the transmission of radio waves from mobile telephones, transmitters and associated equipment.** Risk: Concerns have been expressed that the electromagnetic signals emitted by mobile telephone handsets and base stations may pose health risks. We are not aware that such health risks have been substantiated, however, in the event of a major scientific finding supporting this view this might result in prohibitive legislation being introduced by governments (or the European Union), a major reduction in mobile phone usage (especially by children), a requirement to move base station sites, significant difficulty renewing or acquiring site leases, and/or major litigation. An inadequate response to electromagnetic fields ('EMF') issues may result in loss of confidence in the industry and Vodafone."*[1]

Discussion

In a submission to the United Nations in 2015, over 200 scientists requested it to address *"the emerging public health crisis"* related to the use of RFR emitting devices.[46] They urged the United Nations Environmental Programme (UNEP) to review current exposure standards and to identify measures to substantially lower human exposures to microwave radiation. The scientists argued that existing *"guidelines do not cover long-term exposure and low-intensity effects"* and are *"insufficient to protect public health."* They note the urgency in this, as children are more vulnerable to the effects of RFR.

Microwave radiation is considered by majority of informed scientists as an invisible source of potentially toxic

[1] Vodafone Group PLC, Annual Report 2012. https://www.vodafone.com/content/annualreport/annual_report12/downloads/performance_vodafone_ar2012_sections/principal_risk_factors_and_uncertainties_vodafone_ar2012.pdf.

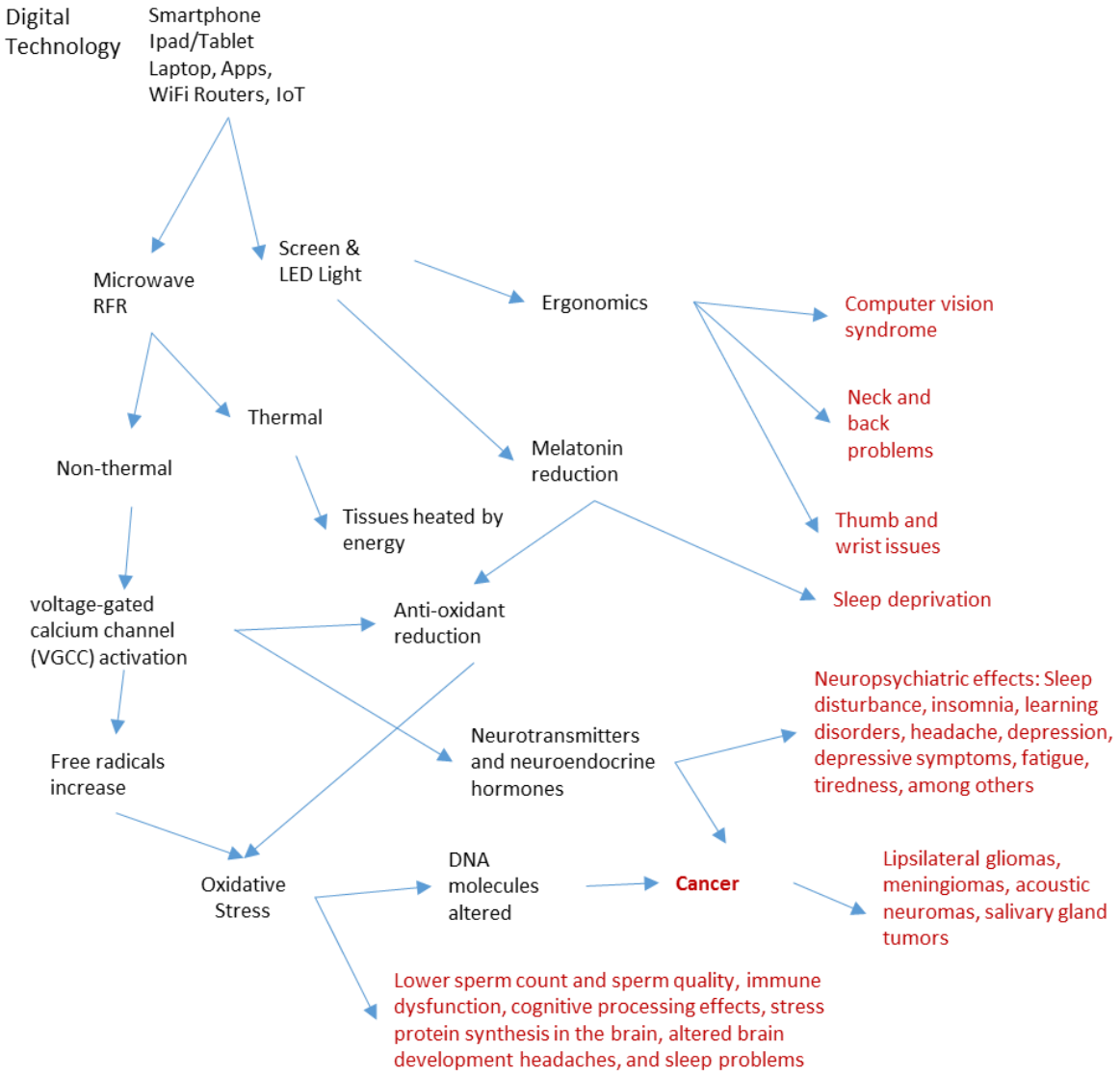
pollution that scientific research in the sciences has identified as being harmful to biological systems and, ultimately, human health and well-being. Think of a smoke-filled bar of yore, where smokers and non-smokers alike are subjected to toxic carcinogens. Now, think of that same bar in countries where smoking is banned from such premises. However, have we replaced one hazard with another, if one considers the RFR being emitted by the WiFi routers, and radio units all of the smart devices in pubs, cafes, restaurants, homes, schools, and the workplace in the age of the Internet of Things (IoT), the scale of the dilemma that we have unthinkingly drifted into becomes clear. That, is of course, if one accepts the scientific evidence.

All this is of concern to informed computer scientists and technologists, who find the exposure to a multiplicity of, and close proximity to, WiFi signals problematic. Take, for example, Ajay Malik, SVP of Engineering and Products, Network World, who has also called for the WiFi standard to be reviewed by the FCC. He argues that the *"amount of radiation exposure today is over 100 times higher as we live in proximity to a very large number of actively transmitting Wi-Fi Devices and Wi-Fi Access Points/Routers."* [47] He therefore raises questions on the cumulative impact on adults and children of these unplanned for levels of exposure that often can go beyond SAR safety limits. Of course, he is unaware of the non-thermal health effects which are, perhaps, of greater concern, as the relevant mechanisms operate at lower exposure levels and durations.

The child in the image below is not operating his tablet device safely—that is, he is not in compliance with existing safety standards, inappropriate as they may be. As a consequence, his vital organs, eyes and brain are being exposed to unacceptable and potentially unsafe levels of microwave radiation. Over time the cells in his body will develop oxidative stress, due to elevated levels of ROS and attenuated levels of anti-oxidants associated with exposure to microwave radiation. However, the bright light shining on his face is also affecting his developing eyes, which are more sensitive to those of an adult.

Vision issues aside, this light acts to significantly attenuate melatonin production in the brain. The first order effect here is interference with the circadian rhythm and sleep disturbance. The research literature on the effect that LED screens have in suppressing melatonin levels is unequivocal. Cajochen et al. provide convincing evidence of the effect that *"A 5-h evening exposure to a white LED backlit screen… elicited a significant suppression of the evening rise in endogenous melatonin and subjective as well as objective sleepiness, as indexed by a reduced incidence of slow eye movements and EEG low-frequency activity (1–7 Hz) in frontal brain regions."* [48] Sleep disruption is also problematic as *"sleep mediates learning and memory processing"* and is vital for memory *"encoding, consolidation, and reconsolidation, into the constellation of additional processes that are critical for efficient memory development."* [49] However, as melatonin is also one of the body's most effective antioxidants and ROS scavengers, it is putting him at particular risk of second-order effects. It specifically increases the probability, low

What's wrong with this picture?



The mechanisms involve altered activity of antioxidant enzymes, altered immune system response, increased free radical accumulation in cells, oxidative damage to DNA, and apoptosis.

Figure 2 RFR Mechanisms and Outcomes

that this may be, that at some point in the future he may develop cancer as an adult. One must also consider the remote probability that he may develop cancers or other ill-effects conditions in childhood. However, scientific experiments have also demonstrated that exposure to WiFi radiation also affects brain development in young rats and their ability to learn and engage in routine problem solving [50, 51, 42]. The implications for brain development in children is clear, as are the consequences for their immediate well-being.

Conclusions

As far back as 1973, a review and study by Russian scientists on the effects of low-intensity RFR on experimental

animals indicated clear evidence of effects on the brain and nervous system, and also the heart and testes, of subjects.[52] Historically, Russia has more stringent safety standards than the West, whether it is the EU or US, when it comes to RFR.[43] The evidence provided by Russian scientists and their contemporaries in the US and Europe should have given pause to the telecommunications industry and regulators in relation to the commericalisation and widespread use of mobile telephony in the 1980s. However, in 2019 the cumulative body of scientific evidence should have governments and regulators take immediate action to change policy and implement appropriate safety standards for digital technologies, as it is children that are most at risk.

Given the clear risks that RFR-based technologies present, it is also vital for parents and educators to take immediate action on the use of microwave emitting devices where children are concerned. As there is overwhelming evidence that safety standards are woefully outdated, the action to be taken is clear. The *precautionary principle* should be applied and the use of all microwave RFR-enabled devices, from WiFi-enabled tablets (and smartphones) to WiFi routers, should be heavily curtailed or eliminated. The figure above summarizes this paper's findings and provides compelling reasons for why such action is necessary.

As indicated, Figure 2 summarises the evidence of risk and indicates the role of specific mechanisms in producing the various threats to human health and well-being. Each of the outcomes identified are independent of each other; hence, the risk of some form of ill-health to children due to RFR exposure is highly probable.

At the risk of repetition, there is only one realistic course of action. Children and adolescents should not be using smartphones, or WiFi-enabled tablet devices, and their expose to RFR sources should be minimized. This might seem impractical in the digital world, but in our real analogue world, children and teenagers are no longer permitted legal access to cigarettes, nor is it socially acceptable for adults to smoke in their presence. Given the current scientific evidence, the pathophysiological properties of RFR appear to be no different than cigarette smoke or similar carcinogens.

Thus, in light of the evidence, the *precautionary principle* should be applied and governments should implement policies that result in the removal of WiFi routers and all WiFi devices from the classrooms of elementary/primary and secondary/high schools. Just to remind the reader what the *precautionary principle* means: *"When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."*[2] We are well beyond that point, as this paper illustrates. The application of the *precautionary principle* is a statutory requirement in some areas of law in the European Union, as expressed in the *Charter of Fundamental Rights*. Thus EU governments at least have a political and an ethical responsibility to act.

In the absence of appropriate government policy, educators need to reconsider the untrammeled use of WiFi in schools and not employ iPads or tablets for use by children in class. Devices that use e-Ink, or similar types of electronic paper display, as opposed to LED screens, should be used in the classroom and at home to access e-books/texts, but these should be operated in airplane mode when reading.

Parents and guardians also need to act and should consider the following

[2] https://en.wikipedia.org/wiki/Precautionary_principle

recommendations in order to exercise their personal duty of care:

- Educate children and adolescents about the health risks of all smart devices.
- Restrict device time to 30 minutes for all RFR-enabled devices, not just screen time.
- In respect of screen time, all LED screen devices should have a Blue Light Filter. Apps like F-Lux are ideal here. This minimises melatonin reduction in users.
- Smart phones have 2/3/4G, WiFi and Bluetooth radio units all of which are normally switched on. These should be used only when required. In addition, the small print on Health and Safety information that comes with a smartphone typically indicates that they should NOT be carried nor operated less than 2.5 cm from the body.
- Remember that the WiFi Safety standards for ALL devices is that they must be operated 20 cm or 8" from the body and for no more than 30 minutes.
    - Given the risk handing a young child an active RFR device, such as a smartphone or an iPad, to hold in their car seat/pram, is for all intents and purposes the same as giving them a cigarette to smoke.
- If children or adolescents have access to smartphones and WiFi devices, the devices should not be carried or operated on or near their person.
    - Ear & microphones should be used for all calls.
- If children are using screen device for games, they should be operated in airplane mode.
- Ensure WiFi routers are not in or near or directly beneath children's bedrooms and they should be switched off at night. No RFR device, including some types of baby monitors, should in in a child's bedroom.
- Minimise the use in the home of all Internet of Things (IoT) devices such as Smart Meters, Virtual Assistants, Hive, Chromecast, WiFi dongles, and so on.

There is also a clear onus on scientists and practitioners in the computing and IT industry to act and ensure that the safety standards for all RFR and WiFi devices are reviewed in light of the recent scientific findings. To do otherwise would be irresponsible. There will be enormous resistance to change from vested interests and the political establishment. This has already happened, with orchestrated campaigns against natural scientists conducting independent research on the health implications of RFR, particularly in the US. An excerpt from a recent article in *The Guardian* newspaper summarises the type of response to be expected from industry with respect to microwave RFR and in particular the release of the findings of the NTP study. *"Central to keeping the scientific argument going is making it appear that not all scientists agree. Towards that end, and again like the tobacco and fossil-fuel industries, the wireless industry has "war-gamed" science, as a Motorola internal memo in 1994 phrased it. War-gaming science involves playing offence as well as defence – funding studies friendly to the industry while attacking studies that raise questions; placing industry-friendly experts on advisory bodies such as the World Health Organisation and seeking*

to discredit scientists whose views differ from the industry's."[53]

Returning to the quote at the beginning of this paper by Professor Frentzel-Beyme MD, we have, as the evidence adduced herein indicates, far exceeded the *"level of proof required to justify action for health protection."* The theory that non-ionizing RFR exposure could ***not*** cause cancer has been refuted using the scientific method. It is ironic, in the era of neoconservatism, neoliberalism, and the anti-environmental policies of necon *cheerleader-in-chief* Donald Trump, that the smoking gun should be provided by the National Toxicology Program of the US Department of Health and Human Services. This study, as indicated above, is just the latest of many to provide the "*clear evidence"* required for policy and social change.

The need for social change is this area is as important, and no less controversial, than that required to respond to the challenge of global warming. However, the forces resisting change to the *status quo* are considerable. Take for example that *"Not one major news organisation in the US or Europe reported [the] scientific news [published by the NTP]. But then, news coverage of mobile phone safety has long reflected the outlook of the wireless industry."*[53] In order to combat vested interests and protect children, parents and grandparents, aunts and uncles, need to act to change extant social perspectives on seemingly harmless digital technologies that entertain and beguile, and which offer affordances without apparent consequences. That will be the challenge for readers of this paper. To understand that technology is not neutral—that it has negative as well as positive consequences for users and society, and that there is a dark side to the bright screen on which you may be reading this article.

About the Author

Professor Tom Butler is a social scientist at University College Cork. A former satellite and microwave communications engineer and IT professional, he is more than familiar with the traditional safety issues relating to microwave RFR. His *Pauline conversion* from the engineering perspective on RFR thermal safety occurred through research engagements with the Chief Risk Officer of a global corporation who pointed out the significant risks to children from the non-thermal effects of RFR. These discussions and related events in his personal life stimulated Professor Butler's interest in this important topic.

In a research context, Professor Butler is a former Government of Ireland Research Fellow, Principal Investigator (PI) of the Governance Risk and Compliance Technology Centre (2013-2018), PI of the SmaRT and SamRT4Reg Commercialisation Fund Projects (2017-2019), and Co-PI of two Marie Skłodowska-Curie Career-FIT Fellowships in Artificial Intelligence (2019-2022). With over €8.5 million in research funding on the application of digital technologies to date, he has 220 publications and 11 inventions. Tom is a member of the European Commission's Expert Group on Regulatory Obstacles to Financial Innovation (ROFIEG) in the area of FinTech, a member of the Global RegTech Council, and a member of the Financial Industry Enterprise Data Management Council (EDMC).

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