My Name is Sabrina Siegel

April 2, 2019

Dear Commissioners,

I have come here today a resident and home owner in Eugene to bring to your attention the gravely dangerous situation that we are in, should 5G infrastructure continue deployment and be activated . Cellular units are being installed in front of homes and schools right now without any form of public notification or input.

Through the years we have been mislead by industry. The Telecoms and manufactures of wireless technology have normalized and promoted this technology without alerting us to the magnitude of its biological effects on humans and environment akin to the history of tobacco, asbestosis and DDT which was strayed liberally on bodies without care. Now there is a vast amount of peer reviewed science

April 2, 2019

revealing biological effect from low level non-ionizing radiation. There are thousands of studies. The Environmental Health Trust and Pub Med are reliable sources to look at. These studies show DNA breakage, oxidative cellular stress, cancer, diseases ranging from diabetes to Alzheimers. The newest data from the U.S National Toxicology Program shows "Clear Evidence of Cancer" by expert panel.

Representative Blumenthal, Eshoo, and others have demanded that the FCC prove the safety of 5G. In a congressional hearing the FCC and Telecom testified that they could not prove safety nor produce any study proving biological safety.

Why is 5G being installed in our city when not proven safe and there are thousands of peer reviewed studies showing harm? We want an emergency moratorium on 5G adopted immediately!

Here is

April 2, 2019

Dear Commissioners,

I have come here today a resident and home owner in Eugene to bring to your attention the gravely dangerous situation that we are in should 5G infrastructure continue deployment and be activated. Cellular units are being installed in front of homes and schools right now without any form of public notification or input.

Through the years we have been mislead by industry. The Telecoms and manufactures of wireless technology have normalized and promoted this technology without alerting us to the magnitude of its biological effects on humans and environment akin to the history of tobacco, asbestosis and DDT which was strayed liberally on bodies without care. Now there is a vast amount of peer reviewed science revealing biological effect from low level non-ionizing radiation. There are thousands of studies. The Environmental Health Trust and Pub Med are reliable sources to look at. These studies show DNA breakage, oxidative/cell stress, cancer, diseases ranging from diabetes to Alzheimers. The newest data from the U.S

April 2, 2019

National Toxicology Program shows "Clear Evidence of Cancer" by expert panel.

Representative Blumenthal, and Eshoo, and others have demanded that the FCC prove the safety of 5G. In a congressional hearing the FCC and Telecom's testified that they could not prove safety nor produce any study proving biological safety.

Why is 5G being installed in our city when not proven safe and there are thousands of peer reviewed studies showing harm?

We want an emergency moratorium on 5G adopted immediately!

Sabrina Siegel

Bekki Bruckner BEKKI BRUCKNER

UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine
9500 Gilman Drive, #0995
La Jolla, CA 92093-0995
Phone: 858 558-4950 x201

August 18, 2017

To whom it may concern,

I urge in the strongest terms that you vigorously oppose California SB 649.

If this bill passes, many people will suffer greatly, and needlessly, as a direct result.

This sounds like hyperbole. It is not.
My research group at UC San Diego alone has received hundreds of communications from people who have developed serious health problems from electromagnetic radiation, following introduction of new technologies. Others with whom I am in communication, have independently received hundreds of similar reports. Most likely these are a tip of an iceberg of tens or perhaps hundreds of thousands of affected person. As each new technology leading to further exposure to electromagnetic radiation is introduced – and particularly introduced in a fashion that prevents vulnerable individuals from avoiding it – a new group become sensitized to health effects. This is particularly true for pulsed signals in the radiowave and microwave portion of the spectrum, the type for which the proposed bill SB 640 will bypass local control.

Mechanisms by which health effects are exerted have been shown to include oxidative stress (the type of injury against which antioxidants protect ,see optional section below), damage to mitochondria (the energy producing parts of cells), damage to cell membranes[1, 21], and via these mechanisms, an impaired "blood brain barrier"[3-5] (the blood brain barrier defends the brain against introduction of foreign substances and toxins; additionally, disruption can lead to brain edema[6]), constriction of blood vessels and impaired blood flow to the brain[7], and triggering of autoimmune reactions[8, 9]. Following a large exposure, that depresses antioxidant defenses, magnifying vulnerability to future exposures, some persons no longer tolerate many other forms and intensities of electromagnetic radiation that previously caused them no problem, and that currently cause others no problem. But this group deserves – nay needs -- the right to be able to avoid these exposures.

Affected individuals not only experience "symptoms" that "merely" cause them distress and suffering, when they are exposed – symptoms like headaches[10, 11], ringing ears[10, 11] and chest pain[10] from impaired blood flow, heart rhythm abnormalities[10, 11], and inability to sleep[10, 11]. These symptoms arise from physiological injury. Moreover, **many experience significant health problems that can include seizures[11], heart failure, hearing loss[12-14] and severe cognitive impairment[11, 15].** The mechanisms involved are those also involved in development and progression of neurodegenerative conditions including Alzheimer's disease[16].

Fully half who were employed when their problems developed lost their job because of the problem, among participants of a survey we conducted. They reported that their condition had cost them up to 2 million dollars to date. Many had lost their homes. A number became homeless, and have swelled the ranks of so-called "EMF refugees"[17-19]. Among those affected, many were previously high functioning individuals – engineers, doctors, lawyers. The best and the brightest are among those whose lives – and ability to contribute to society –will be destroyed. High profile individuals with acknowledged electrohypersensitivity include, for instance, Gro Harlem Brundtland – the former 3-time Prime Minister of Norway and former Director General of the World Health Organization[20]; Matti Niemela, former Nokia Technology chief[21]; as well as the wife of Frank Clegg[22], who formerly headed Microsoft Canada and is current head of Canadians for Safe Technology[23].

Each new roll-out of electromagnetic technology for which exposure is obligatory, swells the ranks of those who develop problems with electromagnetic fields (EMF).- particularly following a significant exposure to pulsed radiowave-microwave radiation, and particularly when people have no ability to avoid it.

Many state that they didn't give credence to the problem (if they had heard of it at all) **until they themselves fell prey to it.**

This is not a psychologically driven condition. Multiple objective physiological changes reflecting mechanisms of injury have been shown in persons with this condition[24, 25].

The role for oxidative stress, that has been shown in innumerable studies (below)**, is affirmed by evidence of a link of this condition to genetic variants in antioxidant defenses**, that are less avid in defending against oxidative stress[307]. People cannot manipulate their genes, to produce such an outcome by suggestibility.

An analysis by a University of Washington researcher showed that most studies funded by industry reported failure to show physiological effects. However, most studies without such industry bias affirmed effects. This is redolent of findings shown in medicine[26], regarding which the former editor in chief of the BMJ (the British Medical Journal), Richard Smith, noted, based on findings of a study, "This {result} suggests that, far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies."[27]. So where articles deny injury from nonionizing radiowave-microwave radiation, there is commonly a stake aligned with financial benefit from such denial.

Those who are affected are in desperate need of *protection* by our elected officials. They need creation of safe spaces and housing, and roadways to allow travel, not removal of any prospect of one; protection of local rights to make decisions - **not removal of any recourse or ability to avoid what injures them**. They are far more strongly in need of protections than a great many protected classes – their problems arose due to actions of others, against which they were given no control – *and can be reversed,* in most cases, if the assault on them is rolled back. Through no fault of their own, and in some cases against their will (e.g. before opt out was permitted with smart meters), they were subjected to an

exposure that has altered their lives as they knew them, and forced them – needlessly - to the margins of society.

Let our focus be on safer, wired and well shielded technology – not more wireless.

This legislation, if passed, and the resulting unrestricted roll-out of this technology, will predictably and directly injure and disable a new group, and add depth of suffering to those already affected.

In other spheres we abridge freedoms to protect the vulnerable few. We require that every schoolchild be vaccinated, supposedly to protect the vulnerable few who may not respond effectively to a vaccine. The need to protect the vulnerable group is deemed to be so great that it justifies the decision to abridge individual rights.

In contrast, this bill seeks to abridge individual freedoms, and local rights, in the service of *harming* a vulnerable group, and creating a new one.
(The common factor appears to be that in both cases, the direction is aligned with a powerful industry that influences political decisions.)
Luckily, no abridgment of individual rights and freedoms is required to protect,t here.

If any group can opt out (such as, I understand, firefighters*)[28]; **then *every* group deserves that equal right.** Others should not be second class citizens, subject to fewer protections.

It would go far to helping this cause if anyone complicit in promoting or passing the legislation (and then after that, *their* families) were required to be the first subjected, for a substantial test period, to the *greatest* amount of exposure that anyone *else* (and their families) may be subjected to, when new policies of this type are rolled out. It will still not do them equal damage; because they may not represent the vulnerabilities that others will have; but such a policy might help them to think twice. *That* is a bill I would strongly endorse.

Most who are now affected – were not, until they were. This may become you – or your child or grandchild. Moreover, if you have a child, or a grandchild, his sperm, or her eggs (all of which she will already have by the time she is a fetus in utero), will be affected by the oxidative stress damage created by the electromagnetic radiation, in a fashion that may affect your future generations irreparably.

It was noted above that, among survey completers, fully half of those who were employed at the time they developed electrosensitivity, lost employment *due to* this problem. (This may understate the scope of the tragedy, since this most-affected group may be least likely to be able to respond to an online survey.) **Many who previously had no problem navigating in the world are now restricted from access to basic services** like hospital care, post offices and libraries because of these problems. With each new introduction of technology that exposes many to yet a new nondiscretionary source of electromagnetic radiation, particularly (but not exclusively) that which emits pulsed radiation in the radiowave-microwave part of the spectrum, a new group of people are affected; and the suffering of those who are already affected increases greatly.

Please, defend the public and our future. Protect the rights of the individual and the locality, against a form of incursion that will lead to serious harm to some – and set a terrible precedent. **Vote no on California SB 649**, and urge that everyone else do the same.

Sincerely,

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine

*Comment on the fire fighter exemption:"The legislature granted an exemption from SB 649 to the firefighters who requested it for health reasons. Throughout California firefighters have long complained of often disabling symptoms from cell towers on their stations. Cities frequently rent out space on fire stations to add to city revenue. …Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn't recall how to start the procedure over again…Prior to the installation of the tower on his station, this medic had not made a single mistake in 20 years. A pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse control in all 6 firefighters tested (https://ecfsapi.fcc.gov/file/7022117660.pdf). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada."[15 28]
Clearly, others who experience similar problems also deserve protections.

Optional – More on the Science

There is a robust literature showing that electromagnetic radiation, including in nonionizing frequencies, and at *levels*[29, 30] *below* those that are cause thermal effects (heating) – causes physiological effects, injury, and cell death –not only in humans but many animals and plants[3, 7, 31-49]. Unsurprisingly, industry has sought – against the tide of evidence to the contrary - to maintain that radiation must be ionizing or heating to cause injury.

Scores or hundreds of studies show that radiation, including specifically radiowave-microwave spectrum radiation, and including low-level exposure, can impair antioxidant defenses, increase "oxidative stress" (free radical injury) and damage mitochondria, the energy producing parts of cells[1, 2, 34, 50-6930, 70-104105-13646, 137-171]. These effects occur with ionizing and nonionizing radiation, at thermal and subthermal levels. (Indeed, much or most of the damage by ionizing radiation, and radiation above the thermal limit, occurs by mechanisms also documented to occur without ionization, and below the thermal limit.) These

mechanisms cohere with the mechanisms documented to play a role in symptoms and health conditions that are reported in those who are electrosensitive – extending to seizures[172-176], heart failure[177-184] and cognitive decline[5, 32, 57, 108, 185-195].

These mechanisms have known involvement in induction of **brain cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, and neurodegenerative conditions**, conditions that have exploded. In each case these have been linked, or presumptively linked, in some studies to electromagnetic radiation[8, 9, 16, 34, 196-219].

Such radiation also has effects on sperm[33, 100, 220-228]; and the DNA of sperm[229] (consistent with recent news reports of marked recent declines in sperm counts and function)..

Such radiation also has toxic effects in pregnancy[230], **to the fetus and subsequent offspring**[231-235] **including at low levels**[236], **and is tied to developmental problems in later life, including attention deficit and hyperactivity**[31, 235-241]. It is critical to defend pregnant women (and eggs of girls who may at a later time become pregnant) from exposures with such toxicity.

Electromagnetic radiation across much or most of the spectrum (not excluding visible light) has been shown to depress levels of melatonin[40, 72, 242-252], which is best known for its role in sleep (and indeed, impaired sleep is the most consistent symptom in affected individuals[10, 11]).

Melatonin is in fact a critical antioxidant that defends the body against harm from *many* toxic exposures[253-266] **including electromagnetic radiation itself** [61, 66, 67, 82, 101, 107, 118, 121, 138, 144, 151, 204, 249, 267-284]**- reducing the oxidative stress** that is implicated in cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, bipolar disorder and neurodegenerative conditions, and that also plays a role in heart attack and stroke[9, 285-329330-343].

Radiation, and specifically radiation in the radiowave-microwave portion of the spectrum can also depress levels of other critical antioxidant systems that also defend the body against chemical, radiation, and other sources of injury. These other antioxidant systems include the glutathione system, superoxide dismutase and catalase[81, 102, 115, 116, 233, 344-358] - which are also involved in defending against health problems.

This suggests that depression of antioxidant defenses due to electromagnetic radiation may magnify risk of chemically induced health effects (and depression of antioxidant systems due to some chemicals may amplify risk of harm from electromagnetic radiation). Indeed just such effects have been reported[359, 360].

References.

1. Benderitter M, Vincent-Genod L, Pouget JP, Voisin P. The cell membrane as a biosensor of oxidative stress induced by radiation exposure: a multiparameter investigation. Radiat Res 2003;159:471-83.
2. Baureus Koch CL, Sommarin M, Persson BR, Salford LG, Eberhardt JL. Interaction between weak low frequency magnetic fields and cell membranes. Bioelectromagnetics 2003;24:395-402.
3. Tang J, Zhang Y, Yang L, et al. Exposure to 900 MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. Brain Res 2015;1601:92-101.
4. Nittby H, Brun A, Eberhardt J, Malmgren L, Persson BR, Salford LG. Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone. Pathophysiology 2009;16:103-12.
5. Zhang. Exposure to 900 MHz electromagnetic fields activates the mpk-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats. Brain Res 2015;1609:92-101.
6. Adair JC, Baldwin N, Kornfeld M, Rosenberg GA. Radiation-induced blood-brain barrier damage in astrocytoma: relation to elevated gelatinase B and urokinase. J Neurooncol 1999;44:283-9.
7. Aalto S, Haarala C, Bruck A, Sipila H, Hamalainen H, Rinne JO. Mobile phone affects cerebral blood flow in humans. J Cereb Blood Flow Metab 2006;26:885-90.
8. Ivanov AA, Grigor'ev Iu G, Mal'tsev VN, et al. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 3. The effect of the long-term non-thermal RF EMF exposure on complement-fixation antibodies against homologenous tissue]. Radiats Biol Radioecol 2010;50:17-21.
9. Grigor'ev Iu G, Mikhailov VF, Ivanov AA, et al. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 4. Manifestation of oxidative intracellular stress-reaction after long-term non-thermal EMF exposure of rats]. Radiats Biol Radioecol 2010;50:22-7.
10. Lamech F. Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in victoria, australia: a case series. Altern Ther Health Med 2014;20:28-39.
11. Halteman E. Wireless utility meter safety impacts survey: Final Results Summary. Sept 13 2011;(http://emfsafetynetwork.org/wp-content/uploads/2011/09/Wireless-Utility-Meter-Safety-Impacts-Survey-Results-Final.pdf). 97.
12. Alsanosi AA, Al-Momani MO, Hagr AA, Almomani FM, Shami IM, Al-Habeeb SF. The acute auditory effects of exposure for 60 minutes to mobile`s electromagnetic field. Saudi Med J 2013;34:142-6.
13. Karaer I, Simsek G, Gul M, et al. Melatonin protects inner ear against radiation damage in rats. Laryngoscope 2015.
14. Celiker H, Ozgur A, Tumkaya L, et al. Effects of exposure to 2100MHz GSM-like radiofrequency electromagnetic field on auditory system of rats. Braz Otorhinolaryngol 2016;S1808-8694:302221.
15. Foster S. Health exemption for firefighters sends a message to the world. GALLERY;Posted on June 26, 2017.
16. Sobel E, Davanipour Z, Sulkava R, et al. Occupations with exposure to EMFs: a possible link for Alzheimer's disease. Amer J Epidemiol 1995;142:515-24.

17. Stein Y. Environmental refugees. UNESCO 10th World Conference on ZBioethics, Medical Ethics and Health Law 2015;Jerusalem, Israel:Jan 6-8.
18. Frompovich CJ. Environmental refugees: Electromagnetic hypersensitivity (EHS) sufferers. Naturalblazecom 2016;Jan 28.
19. http://www.emfanalysis.com/emf-refugee/.
20. ;http://articles.latimes.com/2010/feb/15/health/la-he-electromagnetic-syndrome1-2010feb15.
21. http://stopsmartmetersorguk/former-nokia-chief-mobile-phones-wrecked-my-health/.
22. ;http://www.huffingtonpost.ca/frank-clegg/post_5393_b_3745157.html.
23. Clegg F. Electrohypersensitivity Is Real. The Huffington Post, Canada 2013;June 12, 2013.
24. Belpomme D, Campagnac C, Irigaray P. Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. Rev Environ Health 2015;30:251-71.
25. Heuser G, Heuser SA. Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields. . Rev Environ Health 2017;Jul 5.
26. Golomb BA. Conflict of Interest in Medicine

http://thesciencenetwork.org/programs/beyond-belief-candles-in-the-dark/beatrice-golomb: Beyond Belief: Candles in the Dark, sponsored by The Science Network (tsntv.org), session entitled "This is Your Brain on Politics" Salk Institute. La Jolla, CA. Oct 5; 2008.

27. Smith R. Conflicts of interest: how money clouds objectivity. J R Soc Med 2006;99:292-7.
28. International Association of Fire Fighters Division of Occupational Health SaM. Position on the health effects from radio frequency/ microwave (RF/MW) radiation in fire department facilities from base stations for anttennas and towers for the conduction of cell phone transmissions. 2006.
29. Gurler HS, Bilgici B, Akar AK, Tomak L, Bedir A. Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic. Int J Radiat Biol 2014;90:892-6.
30. Jajte J, Zmyslony M. [The role of melatonin in the molecular mechanism of weak, static and extremely low frequency (50 Hz) magnetic fields (ELF)]. Med Pr 2000;51:51-7.
31. Hardell L, Sage C. Biological effects from electromagnetic field exposure and public exposure standards. Biomed Pharmacother 2008;62:104-9.
32. Deshmukh PS, Nasare N, Megha K, et al. Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. Int J Toxicol 2015;34:284-90.
33. Avendano C, Mata A, Sanchez Sarmiento CA, Doncel GF. Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation. Fertil Steril 2012;97:39-45 e2.
34. Barnes F, Greenenbaum B. Some Effects of Weak Magnetic Fields on Biological Systems: RF fields can change radical concentrations and cancer cell growth rates. IEEE Power Electronics Magazine 2016;3:60-8.
35. Blank M, Goodman R. Comment: a biological guide for electromagnetic safety: the stress response. Bioelectromagnetics 2004;25:642-6; discussion 7-8.

36. Burlaka A, Selyuk M, Gafurov M, Lukin S, Potaskalova V, Sidorik E. Changes in mitochondrial functioning with electromagnetic radiation of ultra high frequency as revealed by electron paramagnetic resonance methodsX. Int J Radiat Biol 2014;90:357-62.

37. Derias EM, Stefanis P, Drakeley A, Gazvani R, Lewis-Jones DI. Growing concern over the safety of using mobile phones and male fertility {THERMAL + NONTHERMAL}. Arch Androl 2006;52:9-14.

38. Diem E, Schwarz C, Adlkofer F, Jahn O, Rudiger H. Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro. Mutat Res 2005;583:178-83.

39. Ferreira AR, Knakievicz T, Pasquali MA, et al. Ultra high frequency-electromagnetic field irradiation during pregnancy leads to an increase in erythrocytes micronuclei incidence in rat offspring. Life Sci 2006;80:43-50.

40. Halgamuge MN. Pineal melatonin level disruption in humans due to electromagnetic fields and ICNIRP limits. Radiat Prot Dosimetry 2013;154:405-16.

41. Mancinelli F, Caraglia M, Abbruzzese A, d'Ambrosio G, Massa R, Bismuto E. Non-thermal effects of electromagnetic fields at mobile phone frequency on the refolding of an intracellular protein: myoglobin. J Cell Biochem 2004;93:188-96.

42. Lai H. Research on the neurological effects of nonionizing radiation at the University of Washington. Bioelectromagnetics 1992;13:513-26.

43. Lerchl A, Kruger H, Niehaus M, Streckert JR, Bitz AK, Hansen V. Effects of mobile phone electromagnetic fields at nonthermal SAR values on melatonin and body weight of Djungarian hamsters (Phodopus sungorus) - BODY WT CHG. J Pineal Res 2008;44:267-72.

44. Leszczynski D, Joenvaara S, Reivinen J, Kuokka R. Non-thermal activation of the hsp27/p38MAPK stress pathway by mobile phone radiation in human endothelial cells: molecular mechanism for cancer- and blood-brain barrier-related effects. Differentiation 2002;70:120-9.

45. Lixia S, Yao K, Kaijun W, et al. Effects of 1.8 GHz radiofrequency field on DNA damage and expression of heat shock protein 70 in human lens epithelial cells. Mutat Res 2006;602:135-42.

46. Sahin D, Ozgur E, Guler G, et al. The 2100MHz radiofrequency radiation of a 3G-mobile phone and the DNA oxidative damage in brain. J Chem Neuroanat 2016;75:94-8.

47. Song JM, Milligan JR, Sutherland BM. Bistranded oxidized purine damage clusters: induced in DNA by long-wavelength ultraviolet (290-400 nm) radiation? Biochemistry 2002;41:8683-8.

48. Yurekli AI, Ozkan M, Kalkan T, et al. GSM base station electromagnetic radiation and oxidative stress in rats. Electromagn Biol Med 2006;25:177-88.

49. Tafforeau M, Verdus MC, Norris V, et al. Plant sensitivity to low intensity 105 GHz electromagnetic radiation. Bioelectromagnetics 2004;25:403-7.

50. Ciejka E, Jakubowska E, Zelechowska P, Huk-Kolega H, Kowalczyk A, Goraca A. [Effect of extremely low frequency magnetic field on glutathione in rat muscles]. Med Pr 2014;65:343-9.

51. Consales C, Merla C, Marino C, Benassi B. Electromagnetic fields, oxidative stress, and neurodegeneration. Int J Cell Biol 2012;2012:683897.

52. Copeland ES. Production of free radicals in reduced glutathione and penicillamine by thermal hydrogen atoms and X-radiation. Int J Radiat Biol Relat Stud Phys Chem Med 1969;16:113-20.

53. Cravotto G, Binello A, Di Carlo S, Orio L, Wu ZL, Ondruschka B. Oxidative degradation of chlorophenol derivatives promoted by microwaves or power ultrasound: a mechanism investigation. Environ Sci Pollut Res Int 2010;17:674-87.

54. Crouzier D, Perrin A, Torres G, Dabouis V, Debouzy JC. Pulsed electromagnetic field at 9.71 GHz increase free radical production in yeast (Saccharomyces cerevisiae). Pathol Biol (Paris) 2009;57:245-51.

55. de Moraes Ramos FM, Schonlau F, Novaes PD, Manzi FR, Boscolo FN, de Almeida SM. Pycnogenol protects against Ionizing radiation as shown in the intestinal mucosa of rats exposed to X-rays. Phytother Res 2006;20:676-9.

56. Devi PU, Ganasoundari A. Modulation of glutathione and antioxidant enzymes by Ocimum sanctum and its role in protection against radiation injury. Indian J Exp Biol 1999;37:262-8.

57. Deshmukh PS, Banerjee BD, Abegaonkar MP, et al. Effect of low level microwave radiation exposure on cognitive function and oxidative stress in rats. Indian J Biochem Biophys 2013;50:114-9.

58. Dimri M, Joshi J, Chakrabarti R, Sehgal N, Sureshbabu A, Kumar IP. Todralazine protects zebrafish from lethal effects of ionizing radiation: role of hematopoietic cell expansion. Zebrafish 2015;12:33-47.

59. Dimri M, Joshi J, Shrivastava N, Ghosh S, Chakraborti R, Indracanti PK. Prilocaine hydrochloride protects zebrafish from lethal effects of ionizing radiation: role of hematopoietic cell expansion. Tokai J Exp Clin Med 2015;40:8-15.

60. Durovic B, Spasic-Jokic V. Influence of occupational exposure to low-dose ionizing radiation on the plasma activity of superoxide dismutase and glutathione level. Vojnosanit Pregl 2008;65:613-8.

61. El-Missiry MA, Fayed TA, El-Sawy MR, El-Sayed AA. Ameliorative effect of melatonin against gamma-irradiation-induced oxidative stress and tissue injury. Ecotoxicol Environ Saf 2007;66:278-86.

62. Falone S, Mirabilio A, Carbone MC, et al. Chronic exposure to 50Hz magnetic fields causes a significant weakening of antioxidant defence systems in aged rat brain. Int J Biochem Cell Biol 2008;40:2762-70.

63. Fitzgerald MP, Madsen JM, Coleman MC, et al. Transgenic biosynthesis of trypanothione protects Escherichia coli from radiation-induced toxicity. Radiat Res 2010;174:290-6.

64. Giannopoulou E, Katsoris P, Parthymou A, Kardamakis D, Papadimitriou E. Amifostine protects blood vessels from the effects of ionizing radiation. Anticancer Res 2002;22:2821-6.

65. Goraca A, Ciejka E, Piechota A. Effects of extremely low frequency magnetic field on the parameters of oxidative stress in heart. J Physiol Pharmacol 2010;61:333-8.

66. Goswami S, Haldar C. UVB irradiation severely induces systemic tissue injury by augmenting oxidative load in a tropical rodent: efficacy of melatonin as an antioxidant. J Photochem Photobiol B 2014;141:84-92.

67. Goswami S, Sharma S, Haldar C. The oxidative damages caused by ultraviolet radiation type C (UVC) to a tropical rodent Funambulus pennanti: role of melatonin. J Photochem Photobiol B 2013;125:19-25.

68. Groen HJ, Meijer C, De Vries EG, Mulder NH. Red blood cell glutathione levels in lung cancer patients treated by radiation and continuously infused carboplatin. Anticancer Res 1996;16:1033-7.

69. Guler G, Seyhan N, Aricioglu A. Effects of static and 50 Hz alternating electric fields on superoxide dismutase activity and TBARS levels in guinea pigs. Gen Physiol Biophys 2006;25:177-93.

70. Guler G, Turkozer Z, Tomruk A, Seyhan N. The protective effects of N-acetyl-L-cysteine and epigallocatechin-3-gallate on electric field-induced hepatic oxidative stress. Int J Radiat Biol 2008;84:669-80.

71. Gultekin FA, Bakkal BH, Guven B, et al. Effects of ozone oxidative preconditioning on radiation-induced organ damage in rats. J Radiat Res 2013;54:36-44.

72. Halgamuge MN. Critical time delay of the pineal melatonin rhythm in humans due to weak electromagnetic exposure. Indian J Biochem Biophys 2013;50:259-65.

73. Irmak MK, Fadillioglu E, Gulec M, Erdogan H, Yagmurca M, Akyol O. Effects of electromagnetic radiation from a cellular telephone on the oxidant and antioxidant levels in rabbits. Cell Biochem Funct 2002;20:279-83.

74. Jagetia G, Baliga M, Venkatesh P. Ginger (Zingiber officinale Rosc.), a dietary supplement, protects mice against radiation-induced lethality: mechanism of action. Cancer Biother Radiopharm 2004;19:422-35.

75. Jagetia GC, Malagi KJ, Baliga MS, Venkatesh P, Veruva RR. Triphala, an ayurvedic rasayana drug, protects mice against radiation-induced lethality by free-radical scavenging. J Altern Complement Med 2004;10:971-8.

76. Jagetia GC, Venkatesha VA, Reddy TK. Naringin, a citrus flavonone, protects against radiation-induced chromosome damage in mouse bone marrow. Mutagenesis 2003;18:337-43.

77. Jurkiewicz BA, Bissett DL, Buettner GR. Effect of topically applied tocopherol on ultraviolet radiation-mediated free radical damage in skin. J Invest Dermatol 1995;104:484-8.

78. Kalns J, Ryan KL, Mason PA, Bruno JG, Gooden R, Kiel JL. Oxidative stress precedes circulatory failure induced by 35-GHz microwave heating. Shock 2000;13:52-9.

79. Karslioglu I, Ertekin MV, Taysi S, et al. Radioprotective effects of melatonin on radiation-induced cataract. J Radiat Res (Tokyo) 2005;46:277-82.

80. Kim KC, Piao MJ, Cho SJ, Lee NH, Hyun JW. Phloroglucinol protects human keratinocytes from ultraviolet B radiation by attenuating oxidative stress. Photodermatol Photoimmunol Photomed 2012;28:322-31.

81. Klebanoff SJ. The effect of x-radiation on the glutathione metabolism of intact erythrocytes in vitro. J Gen Physiol 1958;41:725-36.

82. Koc M, Taysi S, Emin Buyukokuroglu M, Bakan N. The effect of melatonin against oxidative damage during total-body irradiation in rats. Radiat Res 2003;160:251-5.

83. Koiram PR, Veerapur VP, Kunwar A, et al. Effect of curcumin and curcumin copper complex (1:1) on radiation-induced changes of anti-oxidant enzymes levels in the livers of Swiss albino mice. J Radiat Res 2007;48:241-5.

84. Kowalski S. Changes of antioxidant activity and formation of 5-hydroxymethylfurfural in honey during thermal and microwave processing. Food Chem 2013;141:1378-82.

85. Koylu H, Mollaoglu H, Ozguner F, Naziroglu M, Delibas N. Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain. Toxicol Ind Health 2006;22:211-6.

86. Koyu A, Ozguner F, Yilmaz H, Uz E, Cesur G, Ozcelik N. The protective effect of caffeic acid phenethyl ester (CAPE) on oxidative stress in rat liver exposed to the 900 MHz electromagnetic field. Toxicol Ind Health 2009;25:429-34.

87. Lai H, Singh NP. Melatonin and a spin-trap compound block radiofrequency electromagnetic radiation-induced DNA strand breaks in rat brain cells. Bioelectromagnetics 1997;18:446-54.

88. Lai H, Singh NP. Melatonin and N-tert-butyl-alpha-phenylnitrone block 60-Hz magnetic field-induced DNA single and double strand breaks in rat brain cells. J Pineal Res 1997;22:152-62.

89. Lai H, Singh NP. Magnetic-field-induced DNA strand breaks in brain cells of the rat. Environ Health Perspect 2004;112:687-94.

90. Lantow M, Schuderer J, Hartwig C, Simko M. Free radical release and HSP70 expression in two human immune-relevant cell lines after exposure to 1800 MHz radiofrequency radiation. Radiat Res 2006;165:88-94.

91. Lee BC, Johng HM, Lim JK, et al. Effects of extremely low frequency magnetic field on the antioxidant defense system in mouse brain: a chemiluminescence study. J Photochem Photobiol B 2004;73:43-8.

92. Lee JH, Park JW. The effect of alpha-phenyl-N-t-butylnitrone on ionizing radiation-induced apoptosis in U937 cells. Free Radic Res 2005;39:1325-33.

93. Li HT, Schuler C, Leggett RE, Levin RM. Differential effects of coenzyme Q10 and alpha-lipoic acid on two models of in vitro oxidative damage to the rabbit urinary bladder. Int Urol Nephrol 2011;43:91-7.

94. Li P, Zhao QL, Wu LH, et al. Isofraxidin, a potent reactive oxygen species (ROS) scavenger, protects human leukemia cells from radiation-induced apoptosis via ROS/mitochondria pathway in p53-independent manner. Apoptosis 2014;19:1043-53.

95. Lin SY, Chang HP. Induction of superoxide dismutase and catalase activity in different rat tissues and protection from UVB irradiation after topical application of Ginkgo biloba extracts. Methods Find Exp Clin Pharmacol 1997;19:367-71.

96. Lourencini da Silva R, Albano F, Lopes dos Santos LR, Tavares AD, Jr., Felzenszwalb I. The effect of electromagnetic field exposure on the formation of DNA lesions. Redox Rep 2000;5:299-301.

97. Low WK, Sun L, Tan MG, Chua AW, Wang DY. L-N-Acetylcysteine protects against radiation-induced apoptosis in a cochlear cell line. Acta Otolaryngol 2008;128:440-5.

98. Lulli M, Witort E, Papucci L, et al. Coenzyme Q10 protects retinal cells from apoptosis induced by radiation in vitro and in vivo. J Radiat Res 2012;53:695-703.

99. Maaroufi K, Save E, Poucet B, Sakly M, Abdelmelek H, Had-Aissouni L. Oxidative stress and prevention of the adaptive response to chronic iron overload in the brain of young adult rats exposed to a 150 kilohertz electromagnetic field. Neuroscience 2011;186:39-47.

100. Mailankot M, Kunnath AP, Jayalekshmi H, Koduru B, Valsalan R. Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats. Clinics (Sao Paulo) 2009;64:561-5.

101. Manda K, Anzai K, Kumari S, Bhatia AL. Melatonin attenuates radiation-induced learning deficit and brain oxidative stress in mice. Acta Neurobiol Exp (Wars) 2007;67:63-70.

102. Manda K, Bhatia AL. Pre-administration of beta-carotene protects tissue glutathione and lipid peroxidation status following exposure to gamma radiation. J Environ Biol 2003;24:369-72.

103. Manda K, Reiter RJ. Melatonin maintains adult hippocampal neurogenesis and cognitive functions after irradiation. Prog Neurobiol 2010;90:60-8.

104. Martinez-Samano J, Torres-Duran PV, Juarez-Oropeza MA, Elias-Vinas D, Verdugo-Diaz L. Effects of acute electromagnetic field exposure and movement restraint on antioxidant system in liver, heart, kidney and plasma of Wistar rats: a preliminary report. Int J Radiat Biol 2010;86:1088-94.

105. Mathew ST, Bergstrom P, Hammarsten O. Repeated Nrf2 stimulation using sulforaphane protects fibroblasts from ionizing radiation. Toxicol Appl Pharmacol 2014;276:188-94.

106. McArdle AH. Protection from radiation injury by elemental diet: does added glutamine change the effect? Gut 1994;35:S60-4.

107. Meena R, Kumari K, Kumar J, Rajamani P, Verma HN, Kesari KK. Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress-mediated toxicity on male fertility pattern of Wistar rats. Electromagn Biol Med 2014;33:81-91.

108. Megha K, Deshmukh PS, Banerjee BD, Tripathi AK, Abegaonkar MP. Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats. Indian J Exp Biol 2012;50:889-96.

109. Mishra S, Reddy DS, Jamwal VS, et al. Semiquinone derivative isolated from Bacillus sp. INM-1 protects cellular antioxidant enzymes from gamma-radiation-induced renal toxicity. Mol Cell Biochem 2013;379:19-27.

110. Mitchell JB, Russo A. The role of glutathione in radiation and drug induced cytotoxicity. Br J Cancer Suppl 1987;8:96-104.

111. Molla M, Gironella M, Salas A, et al. Protective effect of superoxide dismutase in radiation-induced intestinal inflammation. Int J Radiat Oncol Biol Phys 2005;61:1159-66.

112. Morabito C, Rovetta F, Bizzarri M, Mazzoleni G, Fano G, Mariggio MA. Modulation of redox status and calcium handling by extremely low frequency electromagnetic fields in C2C12 muscle cells: A real-time, single-cell approach. Free Radic Biol Med 2010;48:579-89.

113. Moustafa YM, Moustafa RM, Belacy A, Abou-El-Ela SH, Ali FM. Effects of acute exposure to the radiofrequency fields of cellular phones on plasma lipid peroxide and antioxidase activities in human erythrocytes. J Pharm Biomed Anal 2001;26:605-8.

114. Musaev AV, Ismailova LF, Shabanova AB, Magerramov AA, Iusifov E, Gadzhiev AM. [Pro- and antioxidant effect of electromagnetic fields of extremely high frequency (460 MHz) on brain tissues in experiment]. Vopr Kurortol Fizioter Lech Fiz Kult 2004:19-23.

115. Mukundan H, Bahadur AK, Kumar A, et al. Glutathione level and its relation to radiation therapy in patients with cancer of uterine cervix. Indian J Exp Biol 1999;37:859-64.

116. Navarro J, Obrador E, Pellicer JA, Aseni M, Vina J, Estrela JM. Blood glutathione as an index of radiation-induced oxidative stress in mice and humans. Free Radic Biol Med 1997;22:1203-9.

117. Okano H. Effects of static magnetic fields in biology: role of free radicals. Front Biosci 2008;13:6106-25.

118. Oktem F, Ozguner F, Mollaoglu H, Koyu A, Uz E. Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin. Arch Med Res 2005;36:350-5.

119. Oral B, Guney M, Ozguner F, et al. Endometrial apoptosis induced by a 900-MHz mobile phone: preventive effects of vitamins E and C. Adv Ther 2006;23:957-73.

120. Ozguner F, Altinbas A, Ozaydin M, et al. Mobile phone-induced myocardial oxidative stress: protection by a novel antioxidant agent caffeic acid phenethyl ester. Toxicol Ind Health 2005;21:223-30.

121. Ozguner F, Bardak Y, Comlekci S. Protective effects of melatonin and caffeic acid phenethyl ester against retinal oxidative stress in long-term use of mobile phone: a comparative study. Mol Cell Biochem 2006;282:83-8.

122. Ozguner F, Oktem F, Armagan A, et al. Comparative analysis of the protective effects of melatonin and caffeic acid phenethyl ester (CAPE) on mobile phone-induced renal impairment in rat. Mol Cell Biochem 2005;276:31-7.

123. Ozguner F, Oktem F, Ayata A, Koyu A, Yilmaz HR. A novel antioxidant agent caffeic acid phenethyl ester prevents long-term mobile phone exposure-induced renal impairment in rat. Prognostic value of malondialdehyde, N-acetyl-beta-D-glucosaminidase and nitric oxide determination. Mol Cell Biochem 2005;277:73-80.

124. Ozyurt H, Cevik O, Ozgen Z, et al. Quercetin protects radiation-induced DNA damage and apoptosis in kidney and bladder tissues of rats. Free Radic Res 2014;48:1247-55.

125. Pall ML. Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. Rev Environ Health 2015;30:99-116.

126. Patruno A, Tabrez S, Pesce M, Shakil S, Kamal MA, Reale M. Effects of extremely low frequency electromagnetic field (ELF-EMF) on catalase, cytochrome P450 and nitric oxide synthase in erythro-leukemic cells. Life Sci 2015;121:117-23.

127. Patwardhan RS, Sharma D, Checker R, Thoh M, Sandur SK. Spatio-temporal changes in glutathione and thioredoxin redox couples during ionizing radiation-induced oxidative stress regulate tumor radio-resistance. Free Radic Res 2015;49:1218-32.

128. Paul P, Bansal P, Nayak PG, Pannakal ST, Priyadarsini KI, Unnikrishnan MK. Polyphenolic fraction of Pilea microphylla (L.) protects Chinese hamster lung fibroblasts against gamma-radiation-induced cytotoxicity and genotoxicity. Environ Toxicol Pharmacol 2012;33:107-19.

129. Pei H, Chen W, Hu W, et al. GANRA-5 protects both cultured cells and mice from various radiation types by functioning as a free radical scavenger. Free Radic Res 2014;48:670-8.

130. Piao MJ, Hyun YJ, Oh TH, et al. Chondracanthus tenellus (Harvey) hommersand extract protects the human keratinocyte cell line by blocking free radicals and UVB radiation-induced cell damage. In Vitro Cell Dev Biol Anim 2012;48:666-74.

131. Pillai S, Oresajo C, Hayward J. Ultraviolet radiation and skin aging: roles of reactive oxygen species, inflammation and protease activation, and strategies for prevention of inflammation-induced matrix degradation - a review. Int J Cosmet Sci 2005;27:17-34.

132. Rabbani ZN, Salahuddin FK, Yarmolenko P, et al. Low molecular weight catalytic metalloporphyrin antioxidant AEOL 10150 protects lungs from fractionated radiation. Free Radic Res 2007;41:1273-82.

133. Regoli F, Gorbi S, Machella N, et al. Pro-oxidant effects of extremely low frequency electromagnetic fields in the land snail Helix aspersa. Free Radic Biol Med 2005;39:1620-8.

134. Reliene R, Pollard JM, Sobol Z, Trouiller B, Gatti RA, Schiestl RH. N-acetyl cysteine protects against ionizing radiation-induced DNA damage but not against cell killing in yeast and mammals. Mutat Res 2009;665:37-43.

135. Roginskaya M, Bernhard WA, Razskazovskiy Y. Protection of DNA against direct radiation damage by complex formation with positively charged polypeptides. Radiat Res 2006;166:9-18.

136. Saenko Y, Cieslar-Pobuda A, Skonieczna M, Rzeszowska-Wolny J. Changes of reactive oxygen and nitrogen species and mitochondrial functioning in human K562 and HL60 cells exposed to ionizing radiation. Radiat Res 2013;180:360-6.

137. Sainz RM, Reiter RJ, Tan DX, et al. Critical role of glutathione in melatonin enhancement of tumor necrosis factor and ionizing radiation-induced apoptosis in prostate cancer cells in vitro. J Pineal Res 2008;45:258-70.

138. Sener G, Jahovic N, Tosun O, Atasoy BM, Yegen BC. Melatonin ameliorates ionizing radiation-induced oxidative organ damage in rats. Life Sci 2003;74:563-72.

139. Sener G, Kabasakal L, Atasoy BM, et al. Ginkgo biloba extract protects against ionizing radiation-induced oxidative organ damage in rats. Pharmacol Res 2006;53:241-52.

140. Seyhan N, Guler G. Review of in vivo static and ELF electric fields studies performed at Gazi Biophysics Department. Electromagn Biol Med 2006;25:307-23.

141. Shafiee H, Mohammadi H, Rezayat SM, et al. Prevention of malathion-induced depletion of cardiac cells mitochondrial energy and free radical damage by a magnetic magnesium-carrying nanoparticle. Toxicol Mech Methods 2010;20:538-43.

142. Sharma R, Tiku AB. Emodin, an anthraquinone derivative, protects against gamma radiation-induced toxicity by inhibiting DNA damage and oxidative stress. Int J Radiat Biol 2014;90:275-83.

143. Shi S, Wang G, Wang Y, Zhang L, Zhang L. Protective effect of nitric oxide against oxidative stress under ultraviolet-B radiation. Nitric Oxide 2005;13:1-9.

144. Shirazi A, Mihandoost E, Mohseni M, Ghazi-Khansari M, Rabie Mahdavi S. Radio-protective effects of melatonin against irradiation-induced oxidative damage in rat peripheral blood. Phys Med 2013;29:65-74.

145. Simko M. Cell type specific redox status is responsible for diverse electromagnetic field effects. Curr Med Chem 2007;14:1141-52.

146. Simko M, Droste S, Kriehuber R, Weiss DG. Stimulation of phagocytosis and free radical production in murine macrophages by 50 Hz electromagnetic fields. Eur J Cell Biol 2001;80:562-6.

147. Sirerol JA, Feddi F, Mena S, et al. Topical treatment with pterostilbene, a natural phytoalexin, effectively protects hairless mice against UVB radiation-induced skin damage and carcinogenesis. Free Radic Biol Med 2015;85:1-11.

148. Smith-Pearson PS, Kooshki M, Spitz DR, Poole LB, Zhao W, Robbins ME. Decreasing peroxiredoxin II expression decreases glutathione, alters cell cycle distribution, and sensitizes glioma cells to ionizing radiation and H(2)O(2). Free Radic Biol Med 2008;45:1178-89.

149. Song L, Wang D, Cui X, Hu W. The protective action of taurine and L-arginine in radiation pulmonary fibrosis. J Environ Pathol Toxicol Oncol 1998;17:151-7.

150. Stevens RG. Electromagnetic fields and free radicals. Environ Health Perspect 2004;112:A726; author reply A.

151. Taysi S, Koc M, Buyukokuroglu ME, Altinkaynak K, Sahin YN. Melatonin reduces lipid peroxidation and nitric oxide during irradiation-induced oxidative injury in the rat liver. J Pineal Res 2003;34:173-7.

152. Thotala D, Chetyrkin S, Hudson B, Hallahan D, Voziyan P, Yazlovitskaya E. Pyridoxamine protects intestinal epithelium from ionizing radiation-induced apoptosis. Free Radic Biol Med 2009;47:779-85.

153. Tofani S, Barone D, Berardelli M, et al. Static and ELF magnetic fields enhance the in vivo anti-tumor efficacy of cis-platin against lewis lung carcinoma, but not of cyclophosphamide against B16 melanotic melanoma. Pharmacol Res 2003;48:83-90.

154. Tulard A, Hoffschir F, de Boisferon FH, Luccioni C, Bravard A. Persistent oxidative stress after ionizing radiation is involved in inherited radiosensitivity. Free Radic Biol Med 2003;35:68-77.

155. Tunez I, Drucker-Colin R, Jimena I, et al. Transcranial magnetic stimulation attenuates cell loss and oxidative damage in the striatum induced in the 3-nitropropionic model of Huntington's disease. J Neurochem 2006;97:619-30.

156. von Deutsch AW, Mitchell CD, Williams CE, et al. Polyamines protect against radiation-induced oxidative stress. Gravit Space Biol Bull 2005;18:109-10.

157. Vujaskovic Z, Batinic-Haberle I, Rabbani ZN, et al. A small molecular weight catalytic metalloporphyrin antioxidant with superoxide dismutase (SOD) mimetic properties protects lungs from radiation-induced injury. Free Radic Biol Med 2002;33:857-63.

158. Wolf FI, Torsello A, Tedesco B, et al. 50-Hz extremely low frequency electromagnetic fields enhance cell proliferation and DNA damage: possible involvement of a redox mechanism. Biochim Biophys Acta 2005;1743:120-9.

159. Xu Y, Parmar K, Du F, Price BD, Sun Y. The radioprotective agent WR1065 protects cells from radiation damage by regulating the activity of the Tip60 acetyltransferase. Int J Biochem Mol Biol 2011;2:295-302.

160. Yakymenko I, Tsybulin O, Sidorik E, Henshel D, Kyrylenko O, Kyrylenko S. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. Electromagn Biol Med 2015;35:186-202.

161. Yang Y, Li B, Liu C, et al. Hydrogen-rich saline protects immunocytes from radiation-induced apoptosis. Med Sci Monit 2012;18:BR144-8.

162. Yokoyama H, Sato T, Ogata T, Ohya-Nishiguchi H, Kamada H. In vivo longitudinally detected ESR measurements at microwave regions of 300, 700, and 900 MHz in rats treated with a nitroxide radical. J Magn Reson 1997;129:201-6.

163. Yokus B, Cakir DU, Akdag MZ, Sert C, Mete N. Oxidative DNA damage in rats exposed to extremely low frequency electro magnetic fields. Free Radic Res 2005;39:317-23.

164. Yoshida T, Goto S, Kawakatsu M, Urata Y, Li TS. Mitochondrial dysfunction, a probable cause of persistent oxidative stress after exposure to ionizing radiation. Free Radic Res 2012;46:147-53.

165. Yoshikawa T, Tanigawa M, Tanigawa T, Imai A, Hongo H, Kondo M. Enhancement of nitric oxide generation by low frequency electromagnetic field. Pathophysiology 2000;7:131-5.

166. Zhang R, Kang KA, Piao MJ, et al. Eckol protects V79-4 lung fibroblast cells against gamma-ray radiation-induced apoptosis via the scavenging of reactive oxygen species and inhibiting of the c-Jun NH(2)-terminal kinase pathway. Eur J Pharmacol 2008;591:114-23.

167. Zhou BR, Yin HB, Xu Y, et al. Baicalin protects human skin fibroblasts from ultraviolet A radiation-induced oxidative damage and apoptosis. Free Radic Res 2012;46:1458-71.

168. Zhu W, Xu J, Ge Y, et al. Epigallocatechin-3-gallate (EGCG) protects skin cells from ionizing radiation via heme oxygenase-1 (HO-1) overexpression. J Radiat Res 2014;55:1056-65.

169. Zmyslony M, Palus J, Dziubaltowska E, et al. Effects of in vitro exposure to power frequency magnetic fields on UV-induced DNA damage of rat lymphocytes. Bioelectromagnetics 2004;25:560-2.

170. Zmyslony M, Politanski P, Rajkowska E, Szymczak W, Jajte J. Acute exposure to 930 MHz CW electromagnetic radiation in vitro affects reactive oxygen species level in rat lymphocytes treated by iron ions. Bioelectromagnetics 2004;25:324-8.

171. Zmyslony M, Rajkowska E, Mamrot P, Politanski P, Jajte J. The effect of weak 50 Hz magnetic fields on the number of free oxygen radicals in rat lymphocytes in vitro. Bioelectromagnetics 2004;25:607-12.

172. Petty RK, Harding AE, Morgan-Hughes JA. The clinical features of mitochondrial myopathy. Brain 1986;109 (Pt 5):915-38.

173. Frantseva MV, Velazquez JL, Hwang PA, Carlen PL. Free radical production correlates with cell death in an in vitro model of epilepsy. Eur J Neurosci 2000;12:1431-9.

174. DiMauro S, Andreu AL, De Vivo DC. Mitochondrial disorders. J Child Neurol 2002;17 Suppl 3:3S35-45; discussion 3S6-7.

175. Marin-Garcia J, Goldenthal MJ, Filiano JJ. Cardiomyopathy associated with neurologic disorders and mitochondrial phenotype. J Child Neurol 2002;17:759-65.

176. Kouchaki E, Motaghedifard M, Banafshe HR. Effect of mobile phne radiation on pentylenetetrazole-induced seizure threshold in mice. Iran J Basic Med Sci 2016;19:800-3.

177. Madmani ME, Yusuf Solaiman A, Tamr Agha K, et al. Coenzyme Q10 for heart failure. Cochrane Database Syst Rev 2014;6:CD008684.

178. Taub PR, Ramirez-Sanchez I, Ciaraldi TP, et al. Alterations in skeletal muscle indicators of mitochondrial structure and biogenesis in patients with type 2 diabetes and heart failure: effects of epicatechin rich cocoa. Clin Transl Sci 2012;5:43-7.

179. Indik JH, Goldman S, Gaballa MA. Oxidative stress contributes to vascular endothelial dysfunction in heart failure. Am J Physiol Heart Circ Physiol 2001;281:H1767-70.

180. Sharma R, Davidoff MN. Oxidative stress and endothelial dysfunction in heart failure. Congest Heart Fail 2002;8:165-72.

181. Wolfram R, Oguogho A, Palumbo B, Sinzinger H. Enhanced oxidative stress in coronary heart disease and chronic heart failure as indicated by an increased 8-epi-PGF(2alpha). Eur J Heart Fail 2005;7:167-72.

182. White M, Ducharme A, Ibrahim R, et al. Increased systemic inflammation and oxidative stress in patients with worsening congestive heart failure: improvement after short-term inotropic support. Clin Sci (Lond) 2006.

183. Kang D, Hamasaki N. Alterations of mitochondrial DNA in common diseases and disease states: aging, neurodegeneration, heart failure, diabetes, and cancer. Curr Med Chem 2005;12:429-41.

184. Kerimoglu G, Mercantepe T, Erol, H.S.

Turgut, A, Kaya H, Colakoglu S, Odaci E. Effects of long term exposure to 900 megahertz electromagnetic field on heart morphology and biochemistry of male adolescent rats. Biotech Histochem 2016;Aug 11: 1-10 {Epub ahead of print}.

185. Finsterer J. Cognitive decline as a manifestation of mitochondrial disorders (mitochondrial dementia). J Neurol Sci 2008;272:20-33.

186. Reiter RJ, Tan DX, Pappolla MA. Melatonin relieves the neural oxidative burden that contributes to dementias. Ann N Y Acad Sci 2004;1035:179-96.

187. Popescu BO, Toescu EC, Popescu LM, et al. Blood-brain barrier alterations in ageing and dementia. J Neurol Sci 2009;283:99-106.

188. Pappolla MA, Chyan YJ, Poeggeler B, et al. Alzheimer beta protein mediated oxidative damage of mitochondrial DNA: prevention by melatonin. J Pineal Res 1999;27:226-9.

189. Matsubara E, Bryant-Thomas T, Pacheco Quinto J, et al. Melatonin increases survival and inhibits oxidative and amyloid pathology in a transgenic model of Alzheimer's disease. J Neurochem 2003;85:1101-8.

190. Feng Z, Qin C, Chang Y, Zhang JT. Early melatonin supplementation alleviates oxidative stress in a transgenic mouse model of Alzheimer's disease. Free Radic Biol Med 2006;40:101-9.

191. Nittby H, Grafstrom G, Tian DP, et al. Cognitive impairment in rats after long-term exposure to GSM-900 mobile phone radiation. Bioelectromagnetics 2007.

192. Kim JY, Kim HJ, Kwon KN, Park MJ. Effects of radiofrequency field exposure on glutamate-induced oxidative stress in mouse hippocampal HT22 cells. Int J Radiat Biol 2016;Sept 20:1-22 {Epub ahead of print}.

193. Mugunthan N, Shanmugasamy K, Anbalagan J, Rajanarayanan S, Meenachi S. Effects of long term exposure of 9001800 MHz radiation emitted from 2G mobile phone on mice hippocampus - A histomorphometric study. J Clin Diagn Res 2016;10:AF01-6.

194. Killin LOJ, Starr JM, Shiue IJ, Russ TC. Environmental risk factors for demenita: a systematic review. BMC Geriatrics 2016;12 Oct:DOI: 10.1186/s12877-016-0342-y.

195. Sonmez OF, Odaci E, Bas O, Kaplan S. Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field. Brain Res 2010;1356:95-101.

196. Herbert MR, Sage C. Autism and EMF? Plausibility of a pathophysiological link – Part I. Pathophysiology 2013;20:191-209.

197. Zueva NA, Kovalenko AN, Gerasimenko TI, Man'kovskii BN, Korpachova TI, Efimov AS. [Analysis of irradiation dose, body mass index and insulin blood concentration in personnel cleaning up after the Chernobyl nuclear plant accident]. Lik Sprava 2001:26-8.

198. Grigor'ev Iu G, Grigor'ev OA, Ivanov AA, et al. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 1. Mobile communications and changes in electromagnetic conditions for the population. Needs for additional substantiation of the existing hygienic standards]. Radiats Biol Radioecol 2010;50:6-11.

199. Grigor'ev Iu G, Grigor'ev OA, Merkulov AV, Shafirkin AV, Vorob'ev AA. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 2. General scheme and conditions of the experiment. Development of RF exposure conditions complying with experimental tasks. Animal's status during the long-term exposure]. Radiats Biol Radioecol 2010;50:12-6.

200. Grigor'ev Iu G, Shafirkin AV, Nosocskii AM. [New data for proving the presence of significant effects of electromagnetic exposure (to autoimmune changes in rats)]. Radiats Biol Radioecol 2011;51:721-30.

201. Brainard GC, Kavet R, Kheifets LI. The relationship between electromagnetic field and light exposures to melatonin and breast cancer risk: a review of the relevant literature. J Pineal Res 1999;26:65-100.

202. Milham S. A cluster of male breast cancer in office workers. Am J Ind Med 2004;46:86-7.

203. Milham S, Ossiander E. Electric typewriter exposure and increased female breast cancer mortality in typists. Med Hypotheses 2007;68:450-1.

204. Naziroglu M, Tokat S, Demirci S. Role of melatonin on electromagnetic radiation-induced oxidative stress and Ca2+ signaling molecular pathways in breast cancer. J Recept Signal Transduct Res 2012;32:290-7.

205. Zhao G, Lin X, Zhou M, Zhao J. Relationship between exposure to extremely low-frequency electromagnetic fields and breast cancer risk: a meta-analysis. Eur J Gynaecol Oncol 2014;35:264-9.

206. Coureau G, Bouvier G, Lebailly P, et al. Mobile phone use and brain tumours in the CERENAT case-control study. Occup Environ Med;71:514-22.

207. Carlberg M, Hardell L. Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associated with long-term use of mobile and cordless phones. Int J Environ Res Public Health 2014;11:10790-805.

208. Carlberg M, Hardell L. Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation. Biomed Res Int 2017;2017:9218486.

209. Carlberg M, Koppel T, Ahonen M, Hardell L. Case-control study on occupational exposure to extremely low-frequency electromagnetic fields and glioma risk. Am J Ind Med 2017;April 10 (epub ahead of print).

210. Carlbert M, Hardell L. Evaluation of mobile phone and cordless phone use and glioma risk using the Bradford Hill viewpoints from 1965 on. Association or causation? Biomed Res Int 2017;Epub Mar 16:https://www.hindawi.com/journals/bmri/2017/9218486/

211. Hardell L, Carlberg M, Hansson Mild K. Use of mobile phones and cordless phones is associated with increased risk for glioma and acoustic neuroma. Pathophysiology 2013;20:85-110.

212. Hardell L, Carlberg M, Soderqvist F, Mild KH. Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. Int J Oncol 2013;43:1036-44.

213. Hardell L, Carlberg M. Use of mobile and cordless phones and survival of patients with glioma. Neuroepidemiology 2013;40:101-8.

214. Hardell L, Carlberg M. Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. Rev Environ Health 2013;28:97-106.

215. Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of case-control studies on malignant brain tumours and the use of mobile and cordless phones including living and deceased subjects. Int J Oncol 2011;38:1465-74.

216. Hardell L, Carlberg M, Soderqvist F, Mild KH. Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. Int J Oncol 2013;43:1833-45.

217. Hardell L, Carlberg M. Mobile phone and cordless phone use and the risk for glioma - Analysis of pooled case-control studies in Sweden, 1997-2003 and 2007-2009. Pathophysiology 2015;22:1-13.

218. Lerchl A, Kruger H, Niehaus M, Streckert JR, Bitz AK, Hansen V. Effects of mobile phone electromagnetic fields at nonthermal SAR values on melatonin and body weight of Djungarian hamsters (Phodopus sungorus). J Pineal Res 2008;44:267-72.

219. Lerchl A, Klose M, Grote K, et al. Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans. Biochem Biophys Res Commun 2015;459:585-90.

220. Adams JA, Galloway TS, Mondal D, Esteves SC, Mathews F. Effect of mobile telephones on sperm quality: a systematic review and meta-analysis. Environ Int 2014;70:106-12.

221. Houston BJ, Nixon B, King BV, De Iuliis GN, Aitken RJ. The effects of radiofrequency electromagnetic radiation on sperm function. Reproduction 2016;152:R263-R76.

222. Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G. Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. J Pediatr Urol;9:223-9.

223. Abeleva EA. [Changes of the Nature of Radiation-Induced Mutation in Spermatids of Drosophila under the Influence of Arginine]. Radiobiologiia 1964;4:426-31.

224. Hong R, Zhang Y, Liu Y, Weng EQ. [Effects of extremely low frequency electromagnetic fields on DNA of testicular cells and sperm chromatin structure in mice]. Zhonghua Lao Dong Wei Sheng Zhi Ye Bing Za Zhi 2005;23:414-7.

225. Ugras MY, Kurus M, Ates B, Soylemez H, Otlu A, Yilmaz I. Prunus armeniaca L (apricot) protects rat testes from detrimental effects of low-dose x-rays. Nutr Res 2010;30:200-8.

226. Den Boer PJ, van Loon AA, Mackenbach P, van der Schans GP, Grootegoed JA. Effect of glutathione depletion on the cytotoxicity of xenobiotics and induction of single-strand DNA breaks by ionizing radiation in isolated hamster round spermatids. Journal of reproduction and fertility 1990;88:259-69.

227. Liu C, Duan W, Xu S, et al. Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line. Toxicol Lett 2013;218:2-9.

228. Yan JG, Agresti M, Bruce T, Yan YH, Granlund A, Matloub HS. Effects of cellular phone emissions on sperm motility in rats. Fertil Steril 2007;88:957-64.

229. Aitken RJ, Bennetts LE, Sawyer D, Wiklendt AM, King BV. Impact of radio frequency electromagnetic radiation on DNA integrity in the male germline. Int J Androl 2005;28:171-9.

230. Guler G, Tomruk A, Ozgur E, Seyhan N. The effect of radiofrequency radiation on DNA and lipid damage in non-pregnant and pregnant rabbits and their newborns. Gen Physiol Biophys 2010;29:59-66.

231. Borhani N, Rajaei F, Salehi Z, Javadi A. Analysis of DNA fragmentation in mouse embryos exposed to an extremely low-frequency electromagnetic field. Electromagn Biol Med 2011;30:246-52.

232. Sedeghi T, Ahmadi A, Javadian M, et al. Preterm birth among women living within 600 meters of high voltage overhead power lines: a case-control study. Rom J Intern Med 2017;Apr 18:{Epub ahead of print}.

233. Bahreymi Toossi MH, Sadeghnia HR, Mohammad Mahdizadeh Feyzabadi M, et al. Exposure to mobile phone (900-1800 MHz) during pregnancy: tissue oxidative stress after childbirth. J Matern Fetal Neonatal Med 2017;Apr 23 {Epub ahead of print}:1-6.

234. Sudan M, Kheifets L, Arah O, Olsen J, Zeltzer L. Prenatal and Postnatal Cell Phone Exposures and Headaches in Children. Open Pediatr Med Journal 2012;6:46-52.

235. Aldad TS, Gan G, Gao XB, Taylor HS. Fetal radiofrequency radiation exposure from 800-1900 mhz-rated cellular telephones affects neurodevelopment and behavior in mice. Sci Rep;2:312.

236. Shahin S, Singh VP, Shukla RK, et al. 2.45 GHz microwave irradiation-induced oxidative stress affects implantation or pregnancy in mice, Mus musculus. Appl Biochem Biotechnol 2013;169:1727-51.

237. Othman H, Ammari M, Sakly M, Abdelmelek H. Effects of prenatal exposure to WiFi signal on postnatal development and behavior in rat: Influence of maternal restraint. Behavioral Brain Research 2017;36:291-302.

238. Zarei S, Mortazavi SMJ, Mehdizadeh AR, et al. A Challenging Issue in the Etiology of Speech Problems: The Effect of Maternal Exposure to Electromagnetic Fields on Speech Problems in the Offspring. Journal of Biomedical Physics & Engineering 2015;5:151-4.

239. Divan HA, Kheifets L, Obel C, Olsen J. Prenatal and postnatal exposure to cell phone use and behavioral problems in children. Epidemiology 2008;19:523-9.

240. Divan HA, Kheifets L, Obel C, Olsen J. Cell phone use and behavioural problems in young children. J Epidemiol Community Health 2012;66:524-9.

241. Birks L, Guxens M, Papadopoulou E, et al. Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts. Environment International 2017.

242. Reiter RJ. Alterations of the circadian melatonin rhythm by the electromagnetic spectrum: a study in environmental toxicology. Regul Toxicol Pharmacol 1992;15:226-44.

243. Reiter RJ. Static and extremely low frequency electromagnetic field exposure: reported effects on the circadian production of melatonin. J Cell Biochem 1993;51:394-403.

244. Reiter RJ. Electromagnetic fields and melatonin production. Biomed Pharmacother 1993;47:439-44.

245. Reiter RJ. Melatonin suppression by static and extremely low frequency electromagnetic fields: relationship to the reported increased incidence of cancer. Rev Environ Health 1994;10:171-86.

246. Fernie KJ, Bird DM, Petitclerc D. Effects of electromagnetic fields on photophasic circulating melatonin levels in American kestrels. Environ Health Perspect 1999;107:901-4.

247. Griefahn B, Kunemund C, Blaszkewicz M, Lerchl A, Degen GH. Effects of electromagnetic radiation (bright light, extremely low-frequency magnetic fields, infrared radiation) on the circadian rhythm of melatonin synthesis, rectal temperature, and heart rate. Ind Health 2002;40:320-7.

248. Jarupat S, Kawabata A, Tokura H, Borkiewicz A. Effects of the 1900 MHz electromagnetic field emitted from cellular phone on nocturnal melatonin secretion. J Physiol Anthropol Appl Human Sci 2003;22:61-3.

249. [Melatonin in the environmental medicine diagnosis in connection with electromagnetic fields: statement of the commission "Methods and Quality Assurance in Environmental Medicine"]. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 2005;48:1406-8.

250. Rapoport SI, Breus TK. [Melatonin as a most important factor of natural electromagnetic fields impacting patients with hypertensive disease and coronary heart disease. Part 1]. Klin Med (Mosk) 2011;89:9-14.

251. Dyche J, Anch AM, Fogler KA, Barnett DW, Thomas C. Effects of power frequency electromagnetic fields on melatonin and sleep in the rat. Emerg Health Threats J 2012;5.

252. Qin F, Zhang J, Cao H, et al. Effects of 1800-MHz radiofrequency fields on circadian rhythm of plasma melatonin and testosterone in male rats. J Toxicol Environ Health A 2012;75:1120-8.

253. Bagchi M, Balmoori J, Ye X, Bagchi D, Ray SD, Stohs SJ. Protective effect of melatonin on naphthalene-induced oxidative stress and DNA damage in cultured macrophage J774A.1 cells. Mol Cell Biochem 2001;221:49-55.

254. Abdel Moneim AE, Ortiz F, Leonardo-Mendonca RC, et al. Protective effects of melatonin against oxidative damage induced by Egyptian cobra (Naja haje) crude venom in rats. Acta Trop 2015;143:58-65.

255. Abd-Elghaffar S, El-Sokkary GH, Sharkawy AA. Aluminum-induced neurotoxicity and oxidative damage in rabbits: protective effect of melatonin. Neuro Endocrinol Lett 2005;26:609-16.

256. Abdel-Wahab MH, Arafa HM, El-Mahdy MA, Abdel-Naim AB. Potential protective effect of melatonin against dibromoacetonitrile-induced oxidative stress in mouse stomach. Pharmacol Res 2002;46:287-93.

257. Abdel-Wahhab MA, Abdel-Galil MM, El-Lithey M. Melatonin counteracts oxidative stress in rats fed an ochratoxin A contaminated diet. J Pineal Res 2005;38:130-5.

258. Abraham P, Kolli VK, Rabi S. Melatonin attenuates methotrexate-induced oxidative stress and renal damage in rats. Cell Biochem Funct 2010;28:426-33.

259. Agil A, Reiter RJ, Jimenez-Aranda A, et al. Melatonin ameliorates low-grade inflammation and oxidative stress in young Zucker diabetic fatty rats. J Pineal Res 2013;54:381-8.

260. Aksoy N, Vural H, Sabuncu T, Aksoy S. Effects of melatonin on oxidative-antioxidative status of tissues in streptozotocin-induced diabetic rats. Cell Biochem Funct 2003;21:121-5.

261. Aktas C, Kanter M, Erboga M, Mete R, Oran M. Melatonin attenuates oxidative stress, liver damage and hepatocyte apoptosis after bile-duct ligation in rats. Toxicol Ind Health 2014;30:835-44.

262. Albendea CD, Gomez-Trullen EM, Fuentes-Broto L, et al. Melatonin reduces lipid and protein oxidative damage in synaptosomes due to aluminium. J Trace Elem Med Biol 2007;21:261-8.

263. Al-Malki AL. Synergestic effect of lycopene and melatonin against the genesis of oxidative stress induced by cyclophosphamide in rats. Toxicol Ind Health 2014;30:570-5.

264. Aranda M, Albendea CD, Lostale F, et al. In vivo hepatic oxidative stress because of carbon tetrachloride toxicity: protection by melatonin and pinoline. J Pineal Res 2010;49:78-85.

265. Arushanian EB. [Limitation of oxidative stress as the main factor of the universal protective properties of melatonin]. Eksp Klin Farmakol 2012;75:44-9.

266. Bagheri F, Goudarzi I, Lashkarbolouki T, Elahdadi Salmani M. Melatonin prevents oxidative damage induced by maternal ethanol administration and reduces homocysteine in the cerebellum of rat pups. Behav Brain Res 2015;287:215-25.

267. Aynali G, Naziroglu M, Celik O, Dogan M, Yariktas M, Yasan H. Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin. Eur Arch Otorhinolaryngol 2013;270:1695-700.

268. Bardak Y, Ozerturk Y, Ozguner F, Durmus M, Delibas N. Effect of melatonin against oxidative stress in ultraviolet-B exposed rat lens. Curr Eye Res 2000;20:225-30.

269. Argun M, Tok L, Uguz AC, Celik O, Tok OY, Naziroglu M. Melatonin and amfenac modulate calcium entry, apoptosis, and oxidative stress in ARPE-19 cell culture exposed to blue light irradiation (405 nm). Eye (Lond) 2014;28:752-60.

270. Ayata A, Mollaoglu H, Yilmaz HR, Akturk O, Ozguner F, Altuntas I. Oxidative stress-mediated skin damage in an experimental mobile phone model can be prevented by melatonin. J Dermatol 2004;31:878-83.

271. Bhatia AL, Manda K. Study on pre-treatment of melatonin against radiation-induced oxidative stress in mice. Environ Toxicol Pharmacol 2004;18:13-20.

272. Guney Y, Hicsonmez A, Uluoglu C, et al. Melatonin prevents inflammation and oxidative stress caused by abdominopelvic and total body irradiation of rat small intestine. Braz J Med Biol Res 2007;40:1305-14.

273. Jang SS, Kim HG, Lee JS, et al. Melatonin reduces X-ray radiation-induced lung injury in mice by modulating oxidative stress and cytokine expression. Int J Radiat Biol 2013;89:97-105.

274. Kim BC, Shon BS, Ryoo YW, Kim SP, Lee KS. Melatonin reduces X-ray irradiation-induced oxidative damages in cultured human skin fibroblasts. J Dermatol Sci 2001;26:194-200.

275. Koc M, Taysi S, Buyukokuroglu ME, Bakan N. Melatonin protects rat liver against irradiation-induced oxidative injury. J Radiat Res 2003;44:211-5.

276. Manda K, Ueno M, Anzai K. Melatonin mitigates oxidative damage and apoptosis in mouse cerebellum induced by high-LET 56Fe particle irradiation. J Pineal Res 2008;44:189-96.

277. Naziroglu M, Celik O, Ozgul C, et al. Melatonin modulates wireless (2.45 GHz)-induced oxidative injury through TRPM2 and voltage gated Ca(2+) channels in brain and dorsal root ganglion in rat. Physiol Behav 2012;105:683-92.

278. Oksay T, Naziroglu M, Dogan S, Guzel A, Gumral N, Kosar PA. Protective effects of melatonin against oxidative injury in rat testis induced by wireless (2.45 GHz) devices. Andrologia 2012.

279. Sener G, Atasoy BM, Ersoy Y, Arbak S, Sengoz M, Yegen BC. Melatonin protects against ionizing radiation-induced oxidative damage in corpus cavernosum and urinary bladder in rats. J Pineal Res 2004;37:241-6.

280. Sharma S, Haldar C. Melatonin prevents X-ray irradiation induced oxidative damagein peripheral blood and spleen of the seasonally breeding rodent, Funambulus pennanti during reproductively active phase. Int J Radiat Biol 2006;82:411-9.

281. Sokolovic D, Djindjic B, Nikolic J, et al. Melatonin reduces oxidative stress induced by chronic exposure of microwave radiation from mobile phones in rat brain. J Radiat Res 2008;49:579-86.

282. Taysi S, Memisogullari R, Koc M, et al. Melatonin reduces oxidative stress in the rat lens due to radiation-induced oxidative injury. Int J Radiat Biol 2008;84:803-8.

283. Tok L, Naziroglu M, Dogan S, Kahya MC, Tok O. Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats. Indian J Ophthalmol 2014;62:12-5.

284. Yilmaz S, Yilmaz E. Effects of melatonin and vitamin E on oxidative-antioxidative status in rats exposed to irradiation. Toxicology 2006;222:1-7.

285. Albers DS, Beal MF. Mitochondrial dysfunction and oxidative stress in aging and neurodegenerative disease. J Neural Transm Suppl 2000;59:133-54.

286. Ansari MA, Joshi G, Huang Q, et al. In vivo administration of D609 leads to protection of subsequently isolated gerbil brain mitochondria subjected to in vitro oxidative stress induced by amyloid beta-peptide and other oxidative stressors: relevance to Alzheimer's disease and other oxidative stress-related neurodegenerative disorders. Free Radic Biol Med 2006;41:1694-703.

287. Arumugam S, Thandavarayan RA, Arozal W, et al. Quercetin offers cardioprotection against progression of experimental autoimmune myocarditis by suppression of oxidative and endoplasmic reticulum stress via endothelin-1/MAPK signalling. Free Radic Res 2012;46:154-63.

288. Barnham KJ, Masters CL, Bush AI. Neurodegenerative diseases and oxidative stress. Nat Rev Drug Discov 2004;3:205-14.

289. Bashir S, Harris G, Denman MA, Blake DR, Winyard PG. Oxidative DNA damage and cellular sensitivity to oxidative stress in human autoimmune diseases. Ann Rheum Dis 1993;52:659-66.

290. Belch JJ, Mackay IR, Hill A, Jennings P, McCollum P. Oxidative stress is present in atherosclerotic peripheral arterial disease and further increased by diabetes mellitus. Int Angiol 1995;14:385-8.

291. Benz CC, Yau C. Ageing, oxidative stress and cancer: paradigms in parallax. Nat Rev Cancer 2008;8:875-9.

292. Bernstein AI, Miller GW. Oxidative signaling in experimental autoimmune encephalomyelitis. Toxicol Sci 2010;114:159-61.

293. Bonnefont-Rousselot D. Obesity and oxidative stress: potential roles of melatonin as antioxidant and metabolic regulator. Endocr Metab Immune Disord Drug Targets 2014;14:159-68.

294. Butterfield DA, Castegna A, Drake J, Scapagnini G, Calabrese V. Vitamin E and neurodegenerative disorders associated with oxidative stress. Nutr Neurosci 2002;5:229-39.

295. Butterfield DA, Howard BJ, LaFontaine MA. Brain oxidative stress in animal models of accelerated aging and the age-related neurodegenerative disorders, Alzheimer's disease and Huntington's disease. Curr Med Chem 2001;8:815-28.

296. Ceriello A, Motz E. Is oxidative stress the pathogenic mechanism underlying insulin resistance, diabetes, and cardiovascular disease? The common soil hypothesis revisited. Arterioscler Thromb Vasc Biol 2004;24:816-23.

297. Chang YC, Chuang LM. The role of oxidative stress in the pathogenesis of type 2 diabetes: from molecular mechanism to clinical implication. Am J Transl Res 2010;2:316-31.

298. Chauhan A, Chauhan V. Oxidative stress in autism. Pathophysiology 2006;13:171-81.

299. Chauhan A, Chauhan V, Brown WT, Cohen I. Oxidative stress in autism: increased lipid peroxidation and reduced serum levels of ceruloplasmin and transferrin--the antioxidant proteins. Life Sci 2004;75:2539-49.

300. Dhaun N, Kluth DC. Oxidative stress promotes hypertension and albuminuria during the autoimmune disease systemic lupus erythematosus. Hypertension 2012;59:e47; author reply e8.

301. Dobrian AD, Davies MJ, Schriver SD, Lauterio TJ, Prewitt RL. Oxidative stress in a rat model of obesity-induced hypertension. Hypertension 2001;37:554-60.

302. Donkena KV, Young CY, Tindall DJ. Oxidative stress and DNA methylation in prostate cancer. Obstet Gynecol Int 2010;2010:302051.

303. Facheris M, Beretta S, Ferrarese C. Peripheral markers of oxidative stress and excitotoxicity in neurodegenerative disorders: tools for diagnosis and therapy? J Alzheimers Dis 2004;6:177-84.

304. Gilgun-Sherki Y, Melamed E, Offen D. Oxidative stress induced-neurodegenerative diseases: the need for antioxidants that penetrate the blood brain barrier. Neuropharmacology 2001;40:959-75.

305. Henriksen EJ, Diamond-Stanic MK, Marchionne EM. Oxidative stress and the etiology of insulin resistance and type 2 diabetes. Free Radic Biol Med 2011;51:993-9.

306. Hoeldtke RD, Bryner KD, VanDyke K. Oxidative stress and autonomic nerve function in early type 1 diabetes. Clin Auton Res 2011;21:19-28.

307. Islam MT. Oxidative stress and mitochondrial dysfunction-linked neurodegenerative disorders. Neurol Res 2017;39:73-82.

308. James SJ, Cutler P, Melnyk S, et al. Metabolic biomarkers of increased oxidative stress and impaired methylation capacity in children with autism. Am J Clin Nutr 2004;80:1611-7.

309. Kaffe ET, Rigopoulou EI, Koukoulis GK, Dalekos GN, Moulas AN. Oxidative stress and antioxidant status in patients with autoimmune liver diseases. Redox Rep 2015;20:33-41.

310. Karbownik M, Reiter RJ. Melatonin protects against oxidative stress caused by delta-aminolevulinic acid: implications for cancer reduction. Cancer Invest 2002;20:276-86.

311. Karbownik M, Reiter RJ, Burkhardt S, Gitto E, Tan DX, Lewinski A. Melatonin attenuates estradiol-induced oxidative damage to DNA: relevance for cancer prevention. Exp Biol Med (Maywood) 2001;226:707-12.

312. Kern JK, Jones AM. Evidence of toxicity, oxidative stress, and neuronal insult in autism. J Toxicol Environ Health B Crit Rev 2006;9:485-99.

313. Khandrika L, Kumar B, Koul S, Maroni P, Koul HK. Oxidative stress in prostate cancer. Cancer Lett 2009.

314. Kovacic P, Jacintho JD. Systemic lupus erythematosus and other autoimmune diseases from endogenous and exogenous agents: unifying theme of oxidative stress. Mini Rev Med Chem 2003;3:568-75.

315. Kumagai S, Jikimoto T, Saegusa J. [Pathological roles of oxidative stress in autoimmune diseases]. Rinsho Byori 2003;51:126-32.

316. Kumagai S, Nobuhara Y, Saegusa J. [Oxidative stress and autoimmune diseases]. Nihon Naika Gakkai Zasshi 2003;92:1096-103.

317. Kupczyk D, Rybka J, Kedziora-Kornatowska K, Kedziora J. [Melatonin and oxidative stress in elderly patients with type 2 diabetes]. Pol Merkur Lekarski 2010;28:407-9.

318. Lin MT, Beal MF. Mitochondrial dysfunction and oxidative stress in neurodegenerative diseases. Nature 2006;443:787-95.

319. Mariani E, Polidori MC, Cherubini A, Mecocci P. Oxidative stress in brain aging, neurodegenerative and vascular diseases: an overview. J Chromatogr B Analyt Technol Biomed Life Sci 2005;827:65-75.

320. McGinnis WR. Oxidative stress in autism. Altern Ther Health Med 2005;11:19.

321. Moreno-Otero R. May oxidative stress contribute to autoimmune hepatitis pathogenesis, and can antioxidants be of value as adjuvant therapy for refractory patients? Dig Dis Sci 2013;58:1440-1.

322. Nguyen AM, Rao NA. Oxidative photoreceptor cell damage in autoimmune uveitis. J Ophthalmic Inflamm Infect 2011;1:7-13.

323. Pandi-Perumal SR, BaHammam AS, Brown GM, et al. Melatonin antioxidative defense: therapeutical implications for aging and neurodegenerative processes. Neurotox Res 2013;23:267-300.

324. Pereira EC, Ferderbar S, Bertolami MC, et al. Biomarkers of oxidative stress and endothelial dysfunction in glucose intolerance and diabetes mellitus. Clin Biochem 2008;41:1454-60.

325. Pillarisetti S, Saxena U. Role of oxidative stress and inflammation in the origin of Type 2 diabetes--a paradigm shift. Expert Opin Ther Targets 2004;8:401-8.

326. Rao AV, Balachandran B. Role of oxidative stress and antioxidants in neurodegenerative diseases. Nutr Neurosci 2002;5:291-309.

327. Rodrigues P, de Marco G, Furriol J, et al. Oxidative stress in susceptibility to breast cancer: study in Spanish population. BMC Cancer 2014;14:861.

328. Rose S, Melnyk S, Pavliv O, et al. Evidence of oxidative damage and inflammation associated with low glutathione redox status in the autism brain. Transl Psychiatry 2012;2:e134.

329. Rossignol DA, Frye RE. A review of research trends in physiological abnormalities in autism spectrum disorders: immune dysregulation, inflammation, oxidative stress, mitochondrial dysfunction and environmental toxicant exposures. Mol Psychiatry 2012;17:389-401.

330. Shah AA, Sinha AA. Oxidative stress and autoimmune skin disease. Eur J Dermatol 2013;23:5-13.

331. Sheridan J, Wang LM, Tosetto M, et al. Nuclear oxidative damage correlates with poor survival in colorectal cancer. Br J Cancer 2009;100:381-8.

332. Sondergaard ES, Gogenur I. [Oxidative stress may cause metastatic disease in patients with colorectal cancer.]. Ugeskr Laeger 2014;176.

333. Srinivasan V. Melatonin oxidative stress and neurodegenerative diseases. Indian J Exp Biol 2002;40:668-79.

334. Sun GY, Wood WG. Recent developments in understanding oxidative mechanisms and contributions of glial cell activation, mitochondrial dysfunction, and lipids and signaling pathways to neurodegenerative diseases. Preface. Mol Neurobiol 2010;41:53-4.

335. Udensi UK, Tchounwou PB. Dual effect of oxidative stress on leukemia cancer induction and treatment. J Exp Clin Cancer Res 2014;33:106.

336. Valko M, Rhodes CJ, Moncol J, Izakovic M, Mazur M. Free radicals, metals and antioxidants in oxidative stress-induced cancer. Chem Biol Interact 2006;160:1-40.

337. Vessby J, Basu S, Mohsen R, Berne C, Vessby B. Oxidative stress and antioxidant status in type 1 diabetes mellitus. J Intern Med 2002;251:69-76.

338. Wells PG, McCallum GP, Chen CS, et al. Oxidative stress in developmental origins of disease: teratogenesis, neurodevelopmental deficits, and cancer. Toxicol Sci 2009;108:4-18.

339. Yamamoto T. Autoimmune mechanisms of scleroderma and a role of oxidative stress. Self Nonself 2011;2:4-10.

340. Yao Y, Walsh WJ, McGinnis WR, Pratico D. Altered vascular phenotype in autism: correlation with oxidative stress. Arch Neurol 2006;63:1161-4.

341. Yu JH, Kim H. Oxidative stress and cytokines in the pathogenesis of pancreatic cancer. J Cancer Prev 2014;19:97-102.

342. Zephy D, Ahmad J. Type 2 diabetes mellitus: Role of melatonin and oxidative stress. Diabetes Metab Syndr 2015;9:127-31.

343. Zoroglu SS, Armutcu F, Ozen S, et al. Increased oxidative stress and altered activities of erythrocyte free radical scavenging enzymes in autism. Eur Arch Psychiatry Clin Neurosci 2004;254:143-7.

344. Torbenko VP, Bogdanova IA, Gerasimov AM. [Effect of a combined radiation lesion on the enzyme activity of the glutathione redox system of the rat liver]. Biull Eksp Biol Med 1983;95:48-50.

345. Erden M, Bor NM. Changes of reduced glutathion, glutathion reductase, and glutathione peroxidase after radiation in guinea pigs. Biochem Med 1984;31:217-27.

346. Evans JW, Taylor YC, Brown JM. The role of glutathione and DNA strand break repair in determining the shoulder of the radiation survival curve. Br J Cancer Suppl 1984;6:49-53.

347. Boyer TD, Vessey DA, Kempner E. Radiation inactivation of microsomal glutathione S-transferase. J Biol Chem 1986;261:16963-8.

348. Connor MJ, Wheeler LA. Depletion of cutaneous glutathione by ultraviolet radiation. Photochem Photobiol 1987;46:239-45.

349. Singh LR, Uniyal BP, Mukherjee SK, Sarkar SR, Sharma SK. Effect of whole body gamma-radiation on glutathione reductase of rat tissues. Strahlenther Onkol 1987;163:337-9.

350. Leus NF, Kolomiichuk SG, Lishchenko VB. [Activity of glutathione-S-transferase in the blood plasma, liver and crystalline lens tissues as affected by low doses of ionizing radiation and polychromatic light]. Ukr Biokhim Zh 1997;69:54-9.

351. Grande S, Luciani AM, Rosi A, et al. Radiation effects on soluble metabolites in cultured HeLa cells examined by 1H MRS: changes in concentration of glutathione and of lipid catabolites induced by gamma rays and proton beams. Int J Cancer 2001;96 Suppl:27-42.

352. Rathgen GH. [Radiation-induced changes of the glutathione content of some rat organs modified by cysteine]. Strahlentherapie 1970;139:243-50.

353. Rathgen GH, Lieser H. [Significance of glutathione in radiation effect studies and chemical radiation protection]. Strahlentherapie 1972;143:670-6.

354. Sarkar SR, Singh LR, Uniyal BP, Chaudhuri BN. Effect of whole body gamma radiation on reduced glutathione contents of rat tissues. Strahlentherapie 1983;159:32-3.

355. Rosi A, Grande S, Luciani AM, et al. Role of glutathione in apoptosis induced by radiation as determined by 1H MR spectra of cultured tumor cells. Radiat Res 2007;167:268-82.

356. Tanita J, Tsuchida S, Hozawa J, Sato K. Expression of glutathione S-transferase-pi in human squamous cell carcinomas of the pharynx and larynx. Loss after radiation therapy. Cancer 1993;72:569-76.

357. Vartanyan LS, Gurevich SM, Kozachenko AI, Nagler LG, Lozovskaya EL, Burlakova EB. Changes in superoxide production rate and in superoxide dismutase and glutathione peroxidase activities in subcellular organelles in mouse liver under exposure to low doses of low-intensity radiation. Biochemistry (Mosc) 2000;65:442-6.

358. Woodward GE. The effect of ultra-violet, radium and X-ray radiation on glutathione in pure solution. Biochem J 1933;27:1411-4.

359. Byun YH, Ha M, Kwon HJ, et al. Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study. PLoS One 2013;8:e59742.

360. Sanie-Jahromi F, Saadat Z, Saadat M. Effects of extremely low frequency electromagnetic fields and cisplatin on mRNA levels of some DNA repair genes. Life Sciences 2016;3205:30588-4.

"Clear Evidence Of Cancer" Concludes U.S. National Toxicology Program Expert Panel On Cell Phone Radiation

(/#facebook) (/#twitter) (/#google_plus)
(https://www.addtoany.com/share#url=https%3A%2F%2Fehtrust.org%2Fclear-evidence-of-cancer-concludes-the-expert-panel-to-the-us-national-toxicology-prog findings%2F&title=%E2%80%9CClear%20Evidence%20of%20Cancer%E2%80%9D%20Concludes%20U.S.%20National%20Toxicology%20Program%20Expert%20Par

Scientific panel advises there is evidence for an association between both heart and brain cancers and cell phone radiation in large-scale animal study.

Expanded Press Release (with radio/TV/print news at bottom of page)

(Triangle Park, NC) March 28, 2018

Scientific panel advises there is evidence for an association between both heart and brain cancers and cell phone radiation in large-scale animal study.

(Triangle Park, NC) Scientists concluded (https://ehtrust.org/actions-from-peer-review-of-the-draft-national-toxicology-program-technical-reports-on-cell-phone-radiofrequency-radiation-march-26-28-2018/) there is "clear evidence" linking cell phone radiation to the development of cancers in rats. The U.S. government invited an expert panel to make a majority-rules declaration in response to the $25 million U.S. government National Toxicology Program (NTP) study of cell phone radiation in animals. After a three-day review of the study data, they voted to strengthen the conclusions that cell phone radiation caused health effects in the cell phone radiation exposed rats and mice.

Scientific American (https://www.scientificamerican.com/article/new-studies-link-cell-phone-radiation-with-cancer/) and *The Nation* (https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/) both ran stories on the issue along with *The News and Observer* entitling their piece, "Can your cellphone cause cancer? Scientists find definitive link in study of rats. (http://www.newsobserver.com/news/business/health-care/article207112454.html)" Ira Flatow of Science Friday also featured the scientific conference findings in a radio interview "Is There A Cell Phone Link To Cancer? A Definite Maybe" (https://www.sciencefriday.com/segments/is-there-a-cell-phone-link-to-cancer-a-definite-maybe/) on March 30, 2018.

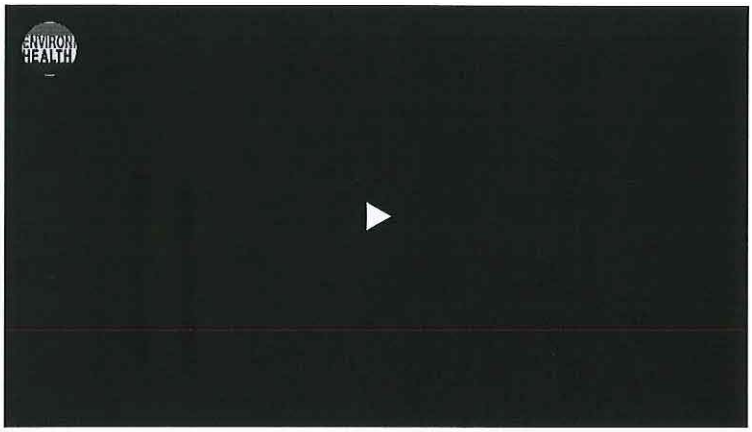
CELL PHONE FINE PRINT WARNINGS
(https://ehtrust.org/key-issues/fine-print-warnings/)

CELL PHONE RADIATION FAQ'S
(https://ehtrust.org/take-action/educate-yourself/cell-phones-and-wireless-radiation-faqs/)

WIFI IN SCHOOLS
(https://ehtrust.org/key-issues/wifi-in-schools/)

CELL PHONES AND BREAST CANCER
(https://ehtrust.org/key-issues/cell-phones-and-breast-cancer/)

The National Institute of Environmental Health Sciences (NIEHS), National Toxicology Program released a statement about the conclusions of the panel for each endpoint, found here (https://ehtrust.org/actions-from-peer-review-of-the-draft-national-toxicology-program-technical-reports-on-cell-phone-radiofrequency-radiation-march-26-28-2018/). NIEHS also wrote an article on the March conclusions of "clear evidence" in an article entitled, "NTP cell phone studies — experts recommend elevated conclusions (https://factor.niehs.nih.gov/2018/4/feature/feature-2-cell-phone/index.htm)." See the presentation by NIEHS on DNA damage found in rats and mice. (https://ehtrust.org/wp-content/uploads/Evaluation-of-Genotoxicity-of-Cell-Phone-Radiofrequency-Radiation-in-Male-and-f-the-Genot-d-Female-notoxicity-e-Rats-and-y-Ce-d-Mice-ell-Ra-e-Following-g-Subchronic-ncy-c-Exposure-Poster-.pdf)



The peer review panel voted that the malignant schwannoma tumors found in the heart of male rats be scientifically categorized as "clear evidence of carcinogenicity" and that the malignant gliomas found in the brain of male rats be categorized as "some evidence of carcinogenicity." In addition, they voted that the increased tumors of the adrenal medulla in male rats exposed to the GSM type of cell phone radiation be categorized as "some evidence of carcinogenicity," adding a new type of tumor thought to be caused by the exposure. The expert panel advised strengthening the conclusions regarding seven different health effects. The panel called attention to statistically significant increases in an unusual pattern of cardiomyopathy, or damage to heart tissue, in exposed male and female rats. The panel highlighted that in Italy a recent animal study (https://www.sciencedirect.com/science/article/pii/S0013935118300367?via%3Dihub) on radiofrequency radiation at much lower radiation levels than the NTP study found the same types of rare malignancies.

In addition to the heart and brain cancers, statistically significant increased numbers of tumors were found in other organs at one or more of the exposure levels studied, including the prostate gland, pituitary gland, adrenal gland, liver, and pancreas. See the bottom of this release for a full list of cancer endpoints.

"What should happen now is the FDA should be immediately working on developing a quantitative risk assessment from this data and in the meantime the FDA, FCC, and other agencies should promote precautionary measures for the population—especially for children," said Ronald Melnick PhD, who led the design of the NTP study in his 28-year career as a scientist at the National Toxicology Program. Melnick is currently senior advisor to Environmental Health Trust (https://ehtrust.org) (EHT).

"Enough is enough, how many more deaths would be needed before serious action is taken? Evidence just continues to accumulate. On March 28, 2018, the external peer reviewers of the National Toxicology Program voted to increase the level of evidence for the causal role of radiofrequency radiation for several tumors and other negative health effects. It's time for action,"

commented Annie Sasco MD, DrPH, former Chief of Research Unit of Epidemiology for Cancer Prevention at the International Agency for Research on Cancer of the World Health Organization and medical advisor to EHT.

"The NTP study found far more than evidence of cancer. Animals exposed in their lifetimes to the same amount of radiation that a human can receive in theirs gave birth to smaller babies with more defects in their hearts. What also makes these results especially compelling is the fact that all well-designed studies of people with 10 or more years of exposures to cell phones find higher risks for comparable tumors—gliomas and acoustic neuromas. Yet exposures continue to increase every day in schools and homes throughout this nation as children are handed two-way microwave radiating devices to use next to their young developing bodies," stated Devra Davis PhD, MPH, Visiting Professor of Medicine at Hebrew University and President of Environmental Health Trust, who added, "the Ramazzini Study published this week in *Environmental Research* (https://www.ncbi.nlm.nih.gov/labs/journals/environ-res/new/2018-03-14/) found statistically significant increases of the same rare cancers as found in the National Toxicology Program study, but at radiation levels significantly lower than those of the NTP. Combined, these two studies strengthen the case that this radiation is a carcinogen. Cautionary action is urgently needed to reduce exposures for children and the rest of us. The chairman of our Business Advisory Group Frank Clegg, former President of Microsoft Canada, has advised: 'I come from a smart industry. Tell us what we need to do and we will get it done.'"

This animal evidence, together with the extensive human evidence showing increased risk of gliomas of the brain and vestibular schwannomas in humans exposed to prolonged radiofrequency radiation, largely from cell phones, especially if the exposure begins at a young age, coupled with a rising incidence of brain cancers in young people in the U.S., conclusively confirms that radiofrequency radiation is a Category 1 human carcinogen," explains Anthony Miller MD, Professor Emeritus, Dalla Lana School of Public Health, University of Toronto, medical advisor to EHT, who has served as an advisor to the World Health Organization.

"The peer reviewers reviewed the tumor data in a transparent scientific process. This landmark U.S. government study, in addition to the recently released Italian Ramazzini study, provides the scientific evidence governments need to take swift action to protect the public," said Theodora Scarato, Executive Director of EHT who added, "The rollout of 5G small cells must be halted. Schools need to install wired internet networks. Communities should have maintained landlines. Solutions exist such as Ethernet and fiber optic networks. Public Health Departments need to initiate public awareness campaigns to educate the public on how to reduce exposure. People need to understand just how easy it is to use wired connections, instead of wireless radiation, especially at home. Employers need to prioritize this issue and make changes in the workplace to limit and minimize workplace exposures. We have a responsibility to take action on this issue now."

Dr. Marc Arazi stated that he traveled from France 4000 miles to tell the National Toxicology Program scientists that the way cell phones are radiation tested do not reflect real human exposure and that the exposure levels they used are comparable and in fact lower than radiation exposures people can be experiencing from cell phone use. "In terms of actual use, almost all of our mobile phones expose us to levels 2 to 10 times higher than the limits allowed by the regulations to protect our health. I say this based on government radiation tests conducted between 2012 and 2016 by the French National Frequencies Agency on nearly 400 of the best-selling mobile phones in Europe. This issue is at the origin of the international health and industrial scandal called Phonegat (https://ehtrust.org/cell-phone-radiation-scandal-french-government-data-indicates-cell-phones-exposeconsumers-radiation-levels-higher-manufacturers-claim/)e. The radiation measurements found in the French tests (https://ehtrust.org/france-cell-phone-radiation-tests-make-model-sar-radiation-measurements-379-phones/) far exceed the exposure levels used in the NTP study. I presented these revelations publicly during the Peer Review session in front of the authors of the study and the scientists of the pane. I was pleased to hear Dr. John Bucher of the NTP explain to reporters how to reduce radiation exposure by keeping the phone at a distance from the body.

"This is an important step forward in our understanding. But the NTP study, in my judgement substantially underestimates the risk. That is because they used a reverberation exposure chamber which lowers the polarization of the electromagnetic field and can also produce substantial amounts of destructive interference. Both of these changes decrease biological effects," stated Martin Pall, PhD, Professor Emeritus of Biochemistry and Basic Medical Sciences, Washington State University.

"RFR from wireless devices appears to act as a common toxic exposure similar to other chemical toxins and metals. In this increasingly wireless environment, more people will be developing chronic diseases. It will take decades (if it is even possible) to sort out the additive contribution of harm from wireless technology. Your research indicates that guidelines need to be based on biological cellular effects and not thermal effects. Precaution is warranted. Reduction of exposure to RFR is a preventative public health measure," stated Cindy Russell, MD of Physicians For Safe Technology (https://mdsafetech.org) and author of "Wi-Fi in Schools" (https://issuu.com/18621/docs/bulletin_0415_web/17?e=8664035/12346964) and "A 5G Wireless Future: Will It Give Us a Smart Nation or Contribute to An Unhealthy One?" (https://ehtrust.org/13302-2/).

The National Institute of Environmental Health Sciences webcast of the three-day review will be online within days. The NIEHS meeting webpage with powerpoint slide presentations is here. (https://ntp.niehs.nih.gov/about/org/sep/trpanel/meetings/docs/2018/march/presentations.html)

RECOMMENDATIONS OF CLASSIFICATION OF CANCERS AND PRE CANCERS in NTP STUDY

On March 26-28, 2018 the NTP expert peer review panel recommended the following actions related to the strength of confidence in the association between the finding and the exposure-NTP's scale (https://ntp.niehs.nih.gov/results/pubs/longterm/defs/index.html) of clear evidence, some evidence, equivocal evidence, and no evidence. For seven cancer endpoints, the peer review recommendations were to increase the level of evidence (noted with a *) They recommended the following strength of evidence classifications after a review of the study findings.

Clear Evidence of Carcinogenic Activity

- *Increases in malignant schwannoma in the heart in male rats (GSM and CDMA) – **clear evidence of carcinogenic activity**

Some Evidence of Carcinogenic Activity: The strength of the response is less than that required for clear evidence but is enough to consider it an association.

- * malignant glioma in the brain in male rats (GSM and CDMA) – **some evidence of carcinogenic activity**
- *Increases in pheochromocytoma (benign, malignant, or complex combined) in the adrenal medulla male rats (GSM) – **some evidence of carcinogenic activity**

Equivocal Evidence of Carcinogenic Activity: A marginal increase of neoplasms that *may* be related to the exposure.

- Increases in adenoma or carcinoma (combined) in the prostate gland in male rats (GSM and CDMA) – **equivocal evidence of carcinogenic activity**
- Increases in benign or malignant granular cell tumors in the brain in male rats (GSM) **equivocal evidence of carcinogenic activity**
- Increases in adenoma in the pars distalis of the pituitary gland in male rats exposed to both GSM and CDMA – **equivocal evidence of carcinogenic activity**
- Increases in adenoma in the pars distalis of the pituitary gland in male rats CDMA – **equivocal evidence of carcinogenic activity**
- Increases in pancreatic islet cell adenoma or carcinoma in male rats (GSM) **-equivocal evidence of carcinogenic activity**
- * Increases in malignant schwannomas in the heart in female rats GSM and CDMA –**equivocal**

evidence of carcinogenic activity

- Increases in malignant glioma in the brain in female CDMA- **equivocal evidence of carcinogenic activity**

- Increases in pheochromocytoma (benign, malignant, or complex combined) in the adrenal medulla in female rats (CDMA) **– equivocal evidence of carcinogenic activity**

Additional Findings:

- DNA damage was significantly increased in the frontal cortex of male mice (both modulations GSM and CDMA), peripheral leukocytes of female mice (CDMA only), and hippocampus of male rats (CDMA only). "These results suggest that exposure to RFR has the potential to induce measurable DNA damage under certain exposure conditions," stated the NTP scientists in this PDF of the Genotoxicity findings (https://ehtrust.org/wp-content/uploads/Evaluation-of-Genotoxicity-of-Cell-Phone-Radiofrequency-Radiation-in-Male-and-f-the-Genot-d-Female-notoxicity-e-Rats-and-y-Ce-d-Mice-ell-Ra-e-Following-g-Subchronic-ncy-c-Exposure-Poster-.pdf).
- Cardiomyopathy of the right ventricle in both male and female exposed animals in both CDMA and GSM.
- Increases in nonneoplastic lesions in the heart, brain, and prostate gland in male rats (GSM and CDMA).
- Increases in nonneoplastic lesions in the heart, thyroid gland, and adrenal gland in female rats occurred with exposures to GSM.
- Increases in nonneoplastic lesions of the brain in females exposed to CDMA.

* Peer reviewers increased the level of strength of evidence (https://ntp.niehs.nih.gov/results/pubs/longterm/defs/index.html)from the draft report.

Click here to download (https://ehtrust.org/wp-content/uploads/EHT-Cell-Phone-Radiation-Infographic_FINAL-2.pdf) and share an infographic about cell phone radiation and cancer.

Environmental Health Trust has compiled key documents and resources so you get the information you need about the National Toxicology Program Study findings.

National Toxicology Program Cell Phone Radiation Study Documents

"NTP cell phone studies — experts recommend elevated conclusions " (https://factor.niehs.nih.gov/2018/4/feature/feature-2-cell-phone/index.htm) NIEHS published article on the "clear evidence" of cancer conclusions of the peer review.

"Statement of the Conclusions of the NIEHS Peer Review" (https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/actions20180328_508.pdf) The NIEHS NTP issued this two page document that lists the final conclusions of the peer review panel for each cancer endpoint.

NIEHS NTP Webpage with powerpoints of presentations from the peer review meetings, (https://ntp.niehs.nih.gov/about/org/sep/trpanel/meetings/docs/2018/march/presentations.html)Website with Submitted Expert Comments (https://ntp.niehs.nih.gov/about/org/sep/trpanel/meetings/docs/2018/march/index.html)

Video by NIEHS of the three day March 26-28 2018 peer review meeting that includes all presentations and comments. (https://ntp.niehs.nih.gov/about/org/sep/trpanel/meetings/docs/2018/march/videos/index.html)

Youtube Playlist of excerpts from the three day March 26-28 peer review. (https://www.youtube.com/watch?v=KQfE3V4p9-c&list=PLT6DbkXhTGoDCMzMWKamWFXfl139ILy4e)

Full report/presentation by NIEHS on DNA damage found in rats and mice. (https://ehtrust.org/wp-content/uploads/Evaluation-of-Genotoxicity-of-Cell-Phone-Radiofrequency-Radiation-in-Male-and-f-the-Genot-d-Female-notoxicity-e-Rats-and-y-Ce-d-Mice-ell-Ra-e-Following-g-Subchronic-ncy-c-Exposure-Poster-.pdf)Note: This information was presented in 2017 at a conference and found via a public information request.

The Peer Review panel of experts for the NTP technical Report See it here (https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/roster_20180328_508.pdf)

Draft Technical Reports NTP Rat Report: Studies of Cell Phone Radiofrequency Radiation (Rats), (https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr595peerdraft.pdf)NTP Mice Report: Studies of Cell Phone Radiofrequency Radiation (Mice) (https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/tr596peerdraft.pdf)

National Institute of Health Press Materials

2/1/2018 NIEHS Press Release "High Exposure to Radiofrequency Radiation Linked to Tumor Activity in Male Rats" (https://www.niehs.nih.gov/news/newsroom/releases/2018/february2/index.cfm)

***Statement on conclusions of the peer review meeting by NIEHS, released after external peer review meeting. (https://ntp.niehs.nih.gov/ntp/about_ntp/trpanel/2018/march/actions20180328_508.pdf)

NEWS STORIES

New Studies Link Cell Phone Radiation with Cancer, (https://www.scientificamerican.com/article/new-studies-link-cell-phone-radiation-with-cancer/)Scientific American March 29, 2018

Can cellphones really cause cancer?, Pittsburgh (KDKA) (http://pittsburgh.cbslocal.com/2018/03/29/can-cellphones-cause-cancer/)

Findings of cancer in rodents exposed to cell-phone-like radiation draws crowd to RTP (http://www.cbs17.com/news/findings-of-cancer-in-rodents-exposed-to-cell-phone-like-radiation-draws-crowd-to-rtp/1086391625), CBS News

"Can your cellphone cause cancer? Scientists find definitive link in study of rats" (http://www.newsobserver.com/news/business/health-care/article207112454.html) The News and Observer March 28, 2018

"Researchers find the cellphone-cancer risk is higher than originally thought" (https://www.theblaze.com/news/2018/03/30/researchers-find-the-cellphone-cancer-risk-is-higher-than-originally-thought) The Blaze March 30, 2018

The Nation: How Big Wireless Made Us Think That Cell Phones Are Safe: A Special Investigation: The disinformation campaign—and massive radiation increase—behind the 5G rollout (https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/). By Mark Hertsgaard and Mark Dowie, The Nation, March 29, 2018

On Point WBUR NPR Interview "Big Tobacco lied about cigarettes. Is Big Wireless lying about cell phones? We'll look at the cancer-cell phone connection." (http://www.wbur.org/onpoint/2018/04/05/cell-phones-cancer-connection)

New Study Links Cancer to Cell Phone Use, (https://www.nbcdfw.com/news/health/New-Study-Links-Cancer-to-Cell-Phone-Use-478243173.html) NBC DFW March 28, 2018

Advocates for Tougher RFR Standards Welcome Expert Views, (https://ehtrust.org/tr-daily-advocates-for-tougher-rfr-standards-welcome-expert-views/) Paul Kirby, Senior Editor, TRDaily

"We now have the first clear evidence **cell phone radiation** can cause cancer in rats" (https://qz.com/1241867/cell-phone-radiation-can-cause-cancer-in-rats-according-to-the-final-results-of-a-us-government-study/) Quartz, March 30, 2018

"Is There A Cell Phone Link To Cancer? A Definite Maybe" (https://www.sciencefriday.com/segments/is-there-a-cell-phone-link-to-cancer-a-definite-maybe/) Science Friday Radio 7:56 Minute Radio, March 30, 2018

Cell Phone Radiation Linked to **Cancer** in New Studies (https://interestingengineering.com/cell-phone-radiation-linked-to-cancer-in-new-studies), Interesting Engineering, April 1, 2018

Article tags: cell phone radiation (https://ehtrust.org/tag/cell-phone-radiation/), cell phones and brain cancer (https://ehtrust.org/tag/cell-phones-and-brain-cancer/), national toxicology program (https://ehtrust.org/tag/national-toxicology-program/)

ENVIRONMENTAL HEALTH TRUST

Email us at
info@ehtrust.org
(mailto:info@ehtrust.org)

Mailing address

P.O. Box 58, Teton Village
WY 83025

Express mail should be sent to

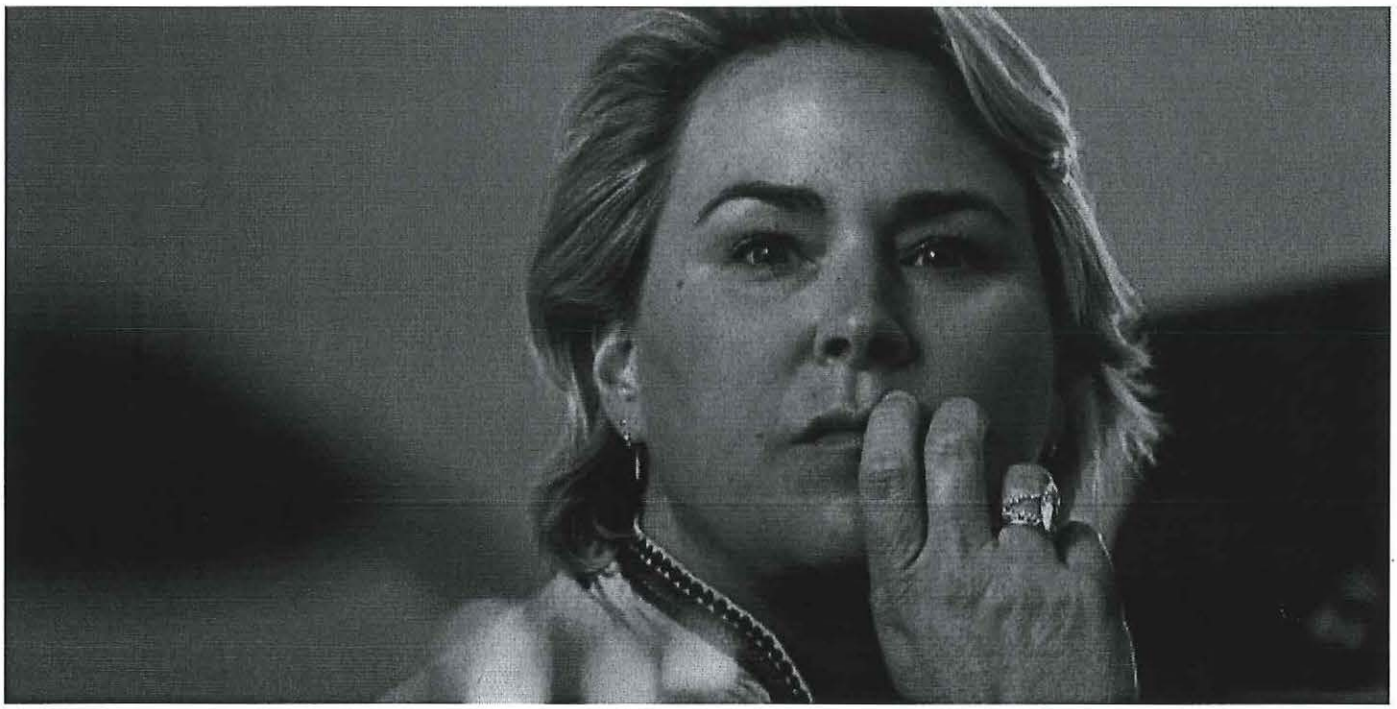
7100 N Rachel Way Unit 6
Eagles Rest
Teton Village WY 83025

About Environmental Health Trust (EHT) (https://ehtrust.org/about/)
Key Issues (https://ehtrust.org/key-issues/)
Policy (https://ehtrust.org/policy/)
Science (https://ehtrust.org/science/)
Educate Yourself (https://ehtrust.org/take-action/educate-yourself/)
Take Action (https://ehtrust.org/take-action/)
Resources to Share (https://ehtrust.org/resources-to-share/)
Media & Publications (https://ehtrust.org/publicatio

FACEBOOK (HTTPS://FACEBOOK.COM/EHTRUST)
TWITTER (HTTPS://TWITTER.COM/SAFERPHONES)
YOUTUBE (HTTPS://WWW.YOUTUBE.COM/USER/WATCHEHTRUST

Radiation concerns halt Brussels 5G development, for now

Monday, 01 April 2019 10:54



© *Belga*

Plans for a pilot project to provide high-speed 5G wireless internet in Brussels have been halted due to fears for the health of citizens, according to reports.

In July, the government concluded an agreement with three telecom operators to relax the strict radiation standards in Brussels. But according to the Region, it is now impossible to estimate the radiation from the antennas required for the service.

"I cannot welcome such technology if the radiation standards, which must protect the citizen, are not respected, 5G or not," Environment minister Céline Fremault (CDH) told Bruzz. "The people of Brussels are not guinea

pigs whose health I can sell at a profit. We cannot leave anything to doubt," she added.

A pilot project is not feasible with the current radiation standards, and Fremault told Bruzz that she does not intend to make an exception.

The Brussels region has particularly strict radiation standards for telecom applications. The standard of 6 volts per metre has already led to problems in the past with providing fast mobile internet via 4G in the capital.

Last week, the various governments in Belgium once again failed to reach agreement on the auctioning of the 5G licences. The file remains stuck on the distribution of the proceeds. It will be up to the next government to handle the proposal, said Telecom Minister Philippe De Backer (Open VLD) last week.

The Brussels Times

More Stories

How Big Wireless Made Us Think That Cell Phones Are Safe: A Special Investigation

The disinformation campaign—and massive radiation increase—behind the 5G rollout.

By Mark Hertsgaard and Mark Dowie March 29, 2018

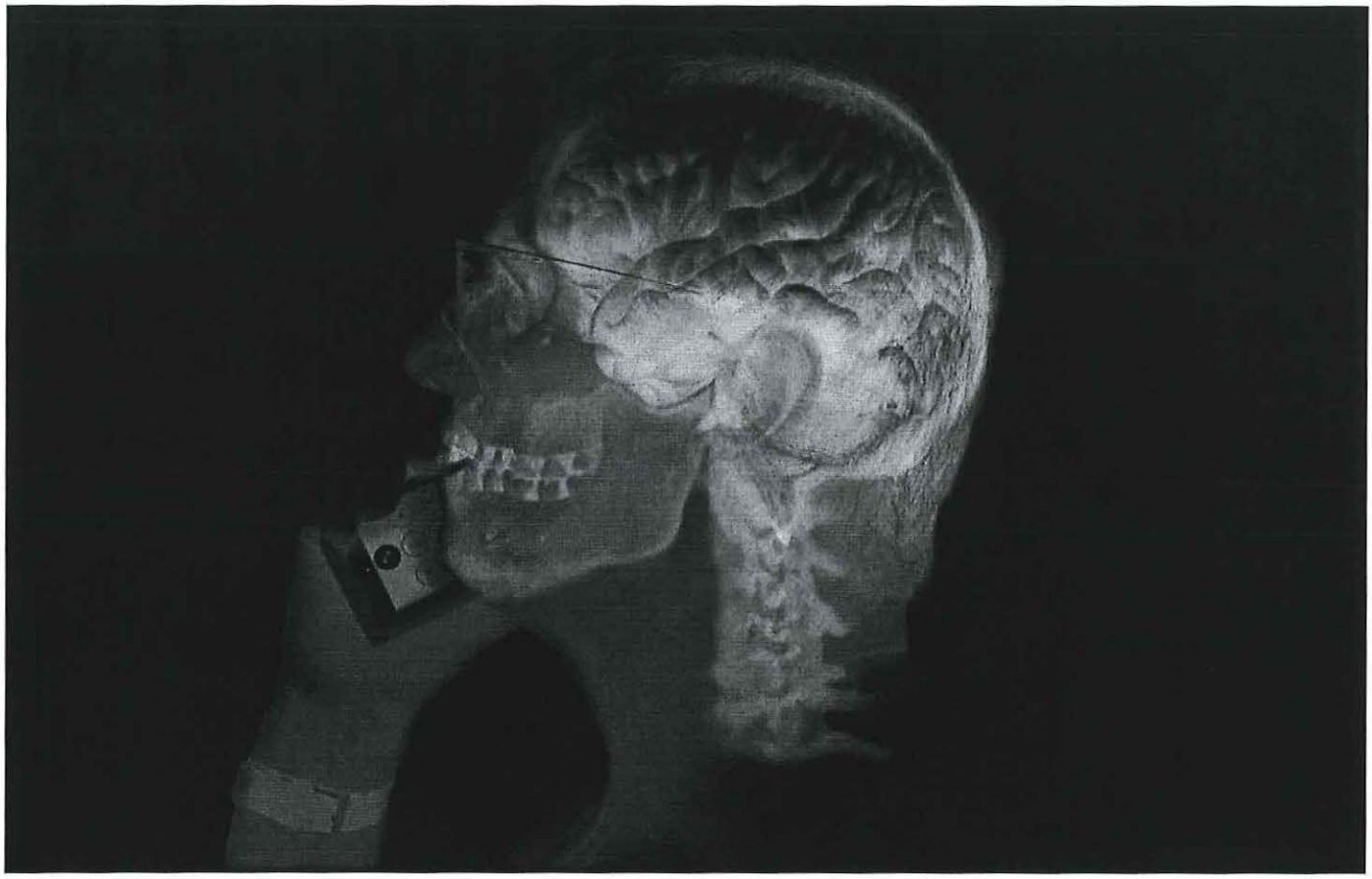


Illustration by Don Carroll.

Things didn't end well between George Carlo and Tom Wheeler; the last time the two met face-to-face, Wheeler had security guards escort Carlo off the premises. As president of the Cellular Telecommunications and Internet Association (CTIA), Wheeler was the wireless industry's point man in

Washington. Carlo was the scientist handpicked by Wheeler to defuse a public-relations crisis that threatened to strangle his infant industry in its crib. This was back in 1993, when there were only six cell-phone subscriptions for every 100 adults in the United States. But industry executives were looking forward to a booming future.

Listen to Mark Hertsgaard on the Start Making Sense podcast.

Remarkably, cell phones had been allowed onto the US consumer market a decade earlier without any government safety testing. Now, some customers and industry workers were being diagnosed with cancer. In January 1993, David Reynard sued the NEC America Company, claiming that his wife's NEC phone caused her lethal brain tumor. After Reynard appeared on national TV, the story went viral. A congressional subcommittee announced an investigation; investors began dumping their cell-phone stocks; and Wheeler and the CTIA swung into action.

A week later, Wheeler announced that his industry would pay for a comprehensive research program. Cell phones were already safe, Wheeler told reporters; the new research would simply "re-validate the findings of the existing studies."

George Carlo seemed like a good bet to fulfill Wheeler's mission. He was an epidemiologist who also had a law degree, and he'd conducted studies for other controversial industries. After a study funded by Dow Corning, Carlo had declared that breast implants posed only minimal health risks. With chemical-industry funding, he had concluded that low levels of dioxin, the chemical behind the Agent Orange scandal, were not dangerous. In 1995, Carlo began directing the industry-financed Wireless Technology Research project (WTR), whose eventual budget of $28.5 million made it the best-funded investigation of cell-phone safety to date.

Outside critics soon came to suspect that Carlo would be the front man for an industry whitewash. They cited his dispute with Henry Lai, a professor of biochemistry at the University of Washington, over a study that Lai had conducted examining whether cell-phone radiation could damage DNA. In 1999, Carlo and the WTR's general counsel sent a letter to the university's president urging that Lai be fired for his alleged violation of research protocols. Lai accused the WTR of tampering with his experiment's results. Both Carlo and Lai deny the other's accusations.

Critics also attacked what they regarded as the slow pace of WTR research. The WTR was merely "a confidence game" designed to placate the public but stall real research, according to Louis Slesin, editor of the trade publication *Microwave News*. "By dangling a huge amount of money in front of the cash-starved [scientific] community," Slesin argued, "Carlo guaranteed silent obedience. Anyone who dared complain risked being cut off from his millions." Carlo denies the allegation.

Whatever Carlo's motives might have been, the documented fact is that he and Wheeler would eventually clash bitterly over the WTR's findings, which Carlo presented to wireless-industry leaders on February 9, 1999. By that date, the WTR had commissioned more than 50 original studies and reviewed many more. Those studies raised "serious questions" about cell-phone safety, Carlo told a closed-door meeting of the CTIA's board of directors, whose members included the CEOs or top officials of the industry's 32 leading companies, including Apple, AT&T, and Motorola.

Carlo sent letters to each of the industry's chieftains on October 7, 1999, reiterating that the WTR's research had found the following: "The risk of rare neuro-epithelial tumors on the outside of the brain was more than doubled... in cell phone users"; there was an apparent "correlation between brain tumors occurring on the right side of the head and the use of the phone on the right side of the head"; and "the ability of radiation from a phone's antenna to cause functional genetic damage [was] definitely positive...."

Carlo urged the CEOs to do the right thing: give consumers "the information they need to make an informed judgment about how much of this unknown risk they wish to assume," especially since some in the industry had "repeatedly and falsely claimed that wireless phones are safe for all consumers including children."

The World Health Organization classifies cell-phone radiation as a "possible" carcinogen.

The very next day, a livid Tom Wheeler began publicly trashing Carlo to the media. In a letter he shared with the CEOs, Wheeler told Carlo that the CTIA was "certain that you have never provided CTIA with the studies you mention"—an apparent effort to shield the industry from liability in the lawsuits that had led to Carlo's hiring in the first place. Wheeler charged further that the studies had not been published in peer-reviewed journals, casting doubt on their validity.

Wheeler's tactics succeeded in dousing the controversy. Although Carlo had in fact repeatedly briefed Wheeler and other senior industry officials on the studies, which had indeed undergone peer review and would soon be published, reporters on the technology beat accepted Wheeler's discrediting of Carlo and the WTR's findings. (Wheeler would go on to chair the Federal Communications Commission, which regulates the wireless industry. He

agreed to an interview for this article but then put all of his remarks off the record, with one exception: his statement that he has always taken scientific guidance from the US Food and Drug Administration, which, he said, "has concluded, 'the weight of scientific evidence had not linked cell phones with any health problems.'")

Why, after such acrimony, Carlo was allowed to make one last appearance before the CTIA board is a mystery. Whatever the reason, Carlo flew to New Orleans in February 2000 for the wireless industry's annual conference, where he submitted the WTR's final report to the CTIA board. According to Carlo, Wheeler made sure that none of the hundreds of journalists covering the event could get anywhere near him.

When Carlo arrived, he was met by two seriously muscled men in plain clothes; the larger of the two let drop that he had recently left the Secret Service. The security men steered Carlo into a holding room, where they insisted he remain until his presentation. When summoned, Carlo found roughly 70 of the industry's top executives waiting for him in silence. Carlo had spoken a mere 10 minutes when Wheeler abruptly stood, extended a hand, and said, "Thank you, George." The two muscle men then ushered the scientist to a curbside taxi and waited until it pulled away.

In the years to come, the WTR's cautionary findings would be replicated by numerous other scientists in the United States and around the world, leading the World Health Organization in 2011 to classify cell-phone radiation as a "possible" human carcinogen and the governments of Great Britain, France, and Israel to issue strong warnings on cell-phone use by children. But as the taxi carried Carlo to Louis Armstrong International Airport, the scientist wondered whether his relationship with the industry might have turned out differently if cell phones had been safety-tested before being allowed onto the consumer market, before profit took precedence over science. But it was too

late: Wheeler and his fellow executives had made it clear, Carlo told *The Nation*, that "they would do what they had to do to protect their industry, but they were not of a mind to protect consumers or public health."

This article does not argue that cell phones and other wireless technologies are necessarily dangerous; that is a matter for scientists to decide. Rather, the focus here is on the global industry behind cell phones—and the industry's long campaign to make people believe that cell phones are safe.

As happened earlier with Big Tobacco and Big Oil, the wireless industry's own scientists privately warned about the risks.

That campaign has plainly been a success: 95 out of every 100 adult Americans now own a cell phone; globally, three out of four adults have cell-phone access, with sales increasing every year. The wireless industry is now one of the fastest-growing on Earth and one of the biggest, boasting annual sales of $440 billion in 2016.

Carlo's story underscores the need for caution, however, particularly since it evokes eerie parallels with two of the most notorious cases of corporate deception on record: the campaigns by the tobacco and fossil-fuel industries to obscure the dangers of smoking and climate change, respectively. Just as tobacco executives were privately told by their own scientists (in the 1960s) that smoking was deadly, and fossil-fuel executives were privately told by their own scientists (in the 1980s) that burning oil, gas, and coal would cause a "catastrophic" temperature rise, so Carlo's testimony reveals that wireless executives were privately told by their own scientists (in the 1990s) that cell phones could cause cancer and genetic damage.

Carlo's October 7, 1999, letters to wireless-industry CEOs are the smoking-gun equivalent of the November 12, 1982, memo that M.B. Glaser, Exxon's manager of environmental-affairs programs, sent to company executives

explaining that burning oil, gas, and coal could raise global temperatures by a destabilizing 3 degrees Celsius by 2100. For the tobacco industry, Carlo's letters are akin to the 1969 proposal that a Brown & Williamson executive wrote for countering anti-tobacco advocates. "Doubt is our product," the memo declared. "It is also the means of establishing a controversy...at the public level."

Like their tobacco and fossil-fuel brethren, wireless executives have chosen not to publicize what their own scientists have said about the risks of their products. On the contrary, the industry—in America, Europe, and Asia—has spent untold millions of dollars in the past 25 years proclaiming that science is on its side, that the critics are quacks, and that consumers have nothing to fear. This, even as the industry has worked behind the scenes—again like its Big Tobacco counterpart—to deliberately addict its customers. Just as cigarette companies added nicotine to hook smokers, so have wireless companies designed cell phones to deliver a jolt of dopamine with each swipe of the screen.

This *Nation* investigation reveals that the wireless industry not only made the same moral choices that the tobacco and fossil-fuel industries did; it also borrowed from the same public-relations playbook those industries pioneered. The playbook's key insight is that an industry doesn't have to win the scientific argument about safety; it only has to keep the argument going. That amounts to a win for the industry, because the apparent lack of certainty helps to reassure customers, even as it fends off government regulations and lawsuits that might pinch profits.

Central to keeping the scientific argument going is making it appear that not all scientists agree. 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 offense as well as

defense: funding studies friendly to the industry while attacking studies that raise questions; placing industry-friendly experts on advisory bodies like the World Health Organization; and seeking to discredit scientists whose views depart from the industry's.

Funding friendly research has perhaps been the most important component of this strategy, because it conveys the impression that the scientific community truly is divided. Thus, when studies have linked wireless radiation to cancer or genetic damage—as Carlo's WTR did in 1999; as the WHO's Interphone study did in 2010; and as the US National Toxicology Program did in 2016—industry spokespeople can point out, accurately, that other studies disagree. "[T]he overall balance of the evidence" gives no cause for alarm, asserted Jack Rowley, research and sustainability director for the Groupe Special Mobile Association (GSMA), Europe's wireless trade association, speaking to reporters about the WHO's findings.

A closer look reveals the industry's sleight of hand. When Henry Lai, the professor whom Carlo tried to get fired, analyzed 326 safety-related studies completed between 1990 and 2005, he learned that 56 percent found a biological effect from cell-phone radiation and 44 percent did not; the scientific community apparently was split. But when Lai recategorized the studies according to their funding sources, a different picture emerged: 67 percent of the independently funded studies found a biological effect, while a mere 28 percent of the industry-funded studies did. Lai's findings were replicated by a 2007 analysis in *Environmental Health Perspectives* that concluded industry-funded studies were two and a half times less likely than independent studies to find a health effect.

One key player has not been swayed by all this wireless-friendly research: the insurance industry. *The Nation* has not been able to find a single insurance company willing to sell a product-liability policy that covered cell-phone

radiation. "Why would we want to do that?" one executive chuckled before pointing to more than two dozen lawsuits outstanding against wireless companies, demanding a total of $1.9 billion in damages. Some judges have affirmed such lawsuits, including a judge in Italy who refused to allow industry-funded research as evidence.

Even so, the industry's neutralizing of the safety issue has opened the door to the biggest, most hazardous prize of all: the proposed revolutionary transformation of society dubbed the "Internet of Things." Lauded as a gigantic engine of economic growth, the Internet of Things will not only connect people through their smartphones and computers but will connect those devices to a customer's vehicles and home appliances, even their baby's diapers—all at speeds faster than can currently be achieved.

Billions of cell-phone users have been subjected to a public-health experiment without informed consent.

There is a catch, though: The Internet of Things will require augmenting today's 4G technology with 5G, thus "massively increasing" the general population's exposure to radiation, according to a petition signed by 236 scientists worldwide who have published more than 2,000 peer-reviewed studies and represent "a significant portion of the credentialed scientists in the radiation research field," according to Joel Moskowitz, the director of the Center for Family and Community Health at the University of California, Berkeley, who helped circulate the petition. Nevertheless, like cell phones, 5G technology is on the verge of being introduced without pre-market safety testing.

Lack of definitive proof that a technology is harmful does not mean the technology is safe, yet the wireless industry has succeeded in selling this logical fallacy to the world. In truth, the safety of wireless technology has

been an unsettled question since the industry's earliest days. The upshot is that, over the past 30 years, billions of people around the world have been subjected to a massive public-health experiment: Use a cell phone today, find out later if it causes cancer or genetic damage. Meanwhile, the wireless industry has obstructed a full and fair understanding of the current science, aided by government agencies that have prioritized commercial interests over human health and news organizations that have failed to inform the public about what the scientific community really thinks. In other words, this public-health experiment has been conducted without the informed consent of its subjects, even as the industry keeps its thumb on the scale.

"The absence of absolute proof does not mean the absence of risk," Annie Sasco, the former director of epidemiology for cancer prevention at France's National Institute of Health and Medical Research, told the attendees of the 2012 Childhood Cancer conference. "The younger one starts using cell phones, the higher the risk," Sasco continued, urging a public-education effort to inform parents, politicians, and the press about children's exceptional susceptibility.

For adults and children alike, the process by which wireless radiation may cause cancer remains uncertain, but it is thought to be indirect. Wireless radiation has been shown to damage the blood-brain barrier, a vital defense mechanism that shields the brain from carcinogenic chemicals elsewhere in the body (resulting, for example, from secondhand cigarette smoke). Wireless radiation has also been shown to interfere with DNA replication, a proven progenitor of cancer. In each of these cases, the risks are higher for children: Their skulls, being smaller, absorb more radiation than adults' skulls do, while children's longer life span increases their cumulative exposure.

The wireless industry has sought to downplay concerns about cell phones' safety, and the Federal Communications Commission has followed its

example. In 1996, the FCC established cell-phone safety levels based on "specific absorption rate," or SAR. Phones were required to have a SAR of 1.6 watts or less per kilogram of body weight. In 2013, the American Academy of Pediatrics advised the FCC that its guidelines "do not account for the unique vulnerability and use patterns specific to pregnant women and children." Nevertheless, the FCC has declined to update its standards.

The FCC has granted the industry's wishes so often that it qualifies as a "captured agency," argued journalist Norm Alster in a report that Harvard University's Edmond J. Safra Center for Ethics published in 2015. The FCC allows cell-phone manufacturers to self-report SAR levels, and does not independently test industry claims or require manufacturers to display the SAR level on a phone's packaging. "Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's congressional oversight committees to its persistent agency lobbying," Alster wrote. He also quoted the CTIA website praising the FCC for "its light regulatory touch."

The revolving-door syndrome that characterizes so many industries and federal agencies reinforces the close relationship between the wireless industry and the FCC. Just as Tom Wheeler went from running the CTIA (1992– 2004) to chairing the FCC (2013–2017), Meredith Atwell Baker went from FCC commissioner (2009–2011) to the presidency of the CTIA (2014 through today). To ensure its access on Capitol Hill, the wireless industry made $26 million in campaign contributions in 2016, according to the Center for Responsive Politics, and spent $87 million on lobbying in 2017.

Neutralizing the safety issue has been an ongoing imperative because the research keeps coming, much of it from outside the United States. But the industry's European and Asian branches have, like their US counterpart, zealously war-gamed the science, spun the news coverage, and thereby

warped the public perception of their products' safety.

The WHO began to study the health effects of electric- and magnetic-field radiation (EMF) in 1996 under the direction of Michael Repacholi, an Australian biophysicist. Although Repacholi claimed on disclosure forms that he was "independent" of corporate influence, in fact Motorola had funded his research: While Repacholi was director of the WHO's EMF program, Motorola paid $50,000 a year to his former employer, the Royal Adelaide Hospital, which then transferred the money to the WHO program. When journalists exposed the payments, Repacholi denied that there was anything untoward about them because Motorola had not paid him personally. Eventually, Motorola's payments were bundled with other industry contributions and funneled through the Mobile and Wireless Forum, a trade association that gave the WHO's program $150,000 annually. In 1999, Repacholi helped engineer a WHO statement that "EMF exposures below the limits recommended in international guidelines do not appear to have any known consequence on health."

Two wireless trade associations contributed $4.7 million to the Interphone study launched by the WHO's International Agency for Cancer Research in 2000. That $4.7 million represented 20 percent of the $24 million budget for the Interphone study, which convened 21 scientists from 13 countries to explore possible links between cell phones and two common types of brain tumor: glioma and meningioma. The money was channeled through a "firewall" mechanism intended to prevent corporate influence on the IACR's findings, but whether such firewalls work is debatable. "Industry sponsors know [which scientists] receive funding; sponsored scientists know who provides funding," Dariusz Leszczynski, an adjunct professor of biochemistry at the University of Helsinki, has explained.

The FCC grants the wireless industry's wishes so often that it

qualifies as a "captured agency."

To be sure, the industry could not have been pleased with some of the Interphone study's conclusions. The study found that the heaviest cell-phone users were 80 percent more likely to develop glioma. (The initial finding of 40 percent was increased to 80 to correct for selection bias.) The Interphone study also concluded that individuals who had owned a cell phone for 10 years or longer saw their risk of glioma increase by nearly 120 percent. However, the study did not find any increased risk for individuals who used their cell phones less frequently; nor was there evidence of any connection with meningioma.

When the Interphone conclusions were released in 2010, industry spokespeople blunted their impact by deploying what experts on lying call "creative truth-telling." "Interphone's conclusion of no overall increased risk of brain cancer is consistent with conclusions reached in an already large body of scientific research on this subject," John Walls, the vice president for public affairs at the CTIA, told reporters. The wiggle word here is "overall": Since some of the Interphone studies did not find increased brain-cancer rates, stipulating "overall" allowed Walls to ignore those that did. The misleading spin confused enough news organizations that their coverage of the Interphone study was essentially reassuring to the industry's customers. *The Wall Street Journal* announced "Cell Phone Study Sends Fuzzy Signal on Cancer Risk," while the BBC's headline declared: "No Proof of Mobile Cancer Risk."

The industry's $4.7 million contribution to the WHO appears to have had its most telling effect in May 2011, when the WHO convened scientists in Lyon, France, to discuss how to classify the cancer risk posed by cell phones. The industry not only secured "observer" status at Lyon for three of its trade associations; it placed two industry-funded experts on the working group that

would debate the classification, as well as additional experts among the "invited specialists" who advised the group.

Niels Kuster, a Swiss engineer, initially filed a conflict-of-interest statement affirming only that his research group had taken money from "various governments, scientific institutions and corporations." But after Kuster co-authored a summary of the WHO's findings in *The Lancet Oncology*, the medical journal issued a correction expanding on Kuster's conflict-of-interest statement, noting payments from the Mobile Manufacturers Forum, Motorola, Ericsson, Nokia, Samsung, Sony, GSMA, and Deutsche Telekom. Nevertheless, Kuster participated in the entire 10 days of deliberations.

The industry also mounted a campaign to discredit Lennart Hardell, a Swedish professor of oncology serving on the working group. Hardell's studies, which found an increase in gliomas and acoustic neuromas in long-term cell-phone users, were some of the strongest evidence that the group was considering.

Hardell had already attracted the industry's displeasure back in 2002, when he began arguing that children shouldn't use cell phones. Two scientists with industry ties quickly published a report with the Swedish Radiation Authority dismissing Hardell's research. His detractors were John D. Boice and Joseph K. McLaughlin of the International Epidemiology Institute, a company that provided "Litigation Support" and "Corporate Counseling" to various industries, according to its website. Indeed, at the very time Boice and McLaughlin were denigrating Hardell's work, the institute was providing expert-witness services to Motorola in a brain-tumor lawsuit against the company.

The wireless industry didn't get the outcome that it wanted at Lyon, but it did limit the damage. A number of the working group's scientists had favored

increasing the classification of cell phones to Category 2A, a "probable" carcinogen; but in the end, the group could only agree on an increase to 2B, a "possible" carcinogen.

That result enabled the industry to continue proclaiming that there was no scientifically established proof that cell phones are dangerous. Jack Rowley of the GSMA trade association said that "interpretation should be based on the overall balance of the evidence." Once again, the slippery word "overall" downplayed the significance of scientific research that the industry didn't like.

Industry-funded scientists had been pressuring their colleagues for a decade by then, according to Leszczynski, another member of the Lyon working group. Leszczynski was an assistant professor at Harvard Medical School when he first experienced such pressure, in 1999. He had wanted to investigate the effects of radiation levels higher than the SAR levels permitted by government, hypothesizing that this might better conform to real-world practices. But when he proposed the idea at scientific meetings, Leszczynski said, it was shouted down by Mays Swicord, Joe Elder, and C.K. Chou—scientists who worked for Motorola. As Leszczynski recalled, "It was a normal occurrence at scientific meetings—and I attended really a lot of them—that whenever [a] scientist reported biological effects at SAR over [government-approved levels], the above-mentioned industry scientists, singularly or as a group, jumped up to the microphone to condemn and to discredit the results."

Years later, a study that Leszczynski described as a "game changer" discovered that even phones meeting government standards, which in Europe were a SAR of 2.0 watts per kilogram, could deliver exponentially higher peak radiation levels to certain skin and blood cells. (SAR levels reached a staggering 40 watts per kilogram—20 times higher than officially permitted.)

In other words, the official safety levels masked dramatically higher exposures in hot spots, but industry-funded scientists obstructed research on the health impacts.

"Everyone knows that if your research results show that radiation has effects, the funding flow dries up." —Dariusz Leszczynski, adjunct professor of biochemistry at the University of Helsinki

"Everyone knows that if your research results show that radiation has effects, the funding flow dries up," Leszczynski said in an interview in 2011. Sure enough, the Radiation and Nuclear Safety Authority of Finland, where Leszczynski had a long career, discontinued research on the biological effects of cell phones and discharged him a year later.

According to scientists involved in the process, the WHO may decide later this year to reconsider its categorization of the cancer risk posed by cell phones; the WHO itself told *The Nation* that before making any such decision, it will review the final report of the National Toxicology Program, a US government initiative. The results reported by the NTP in 2016 seem to strengthen the case for increasing the assessment of cell-phone radiation to a "probable" or even a "known" carcinogen. Whereas the WHO's Interphone study compared the cell-phone usage of people who had contracted cancer with that of people who hadn't, the NTP study exposed rats and mice to cell-phone radiation and observed whether the animals got sick.

"There is a carcinogenic effect," announced Ron Melnick, the designer of the study. Male rats exposed to cell-phone radiation developed cancer at a substantially higher rate, though the same effect was not seen in female rats. Rats exposed to radiation also had lower birth rates, higher infant mortality, and more heart problems than those in the control group. The cancer effect occurred in only a small percentage of the rats, but that small percentage

could translate into a massive amount of human cancers. "Given the extremely large number of people who use wireless communications devices, even a very small increase in the incidence of disease...could have broad implications for public health," the NTP's draft report explained.

But this was not the message that media coverage of the NTP study conveyed, as the industry blanketed reporters with its usual "more research is needed" spin. "Seriously, stop with the irresponsible reporting on cell phones and cancer," demanded a *Vox* headline. "Don't Believe the Hype," urged *The Washington Post*. *Newsweek*, for its part, stated the NTP's findings in a single paragraph, then devoted the rest of the article to an argument for why they should be ignored.

The NTP study was to be peer-reviewed at a meeting on March 26–28, amid signs that the program's leadership is pivoting to downplay its findings. The NTP had issued a public-health warning when the study's early results were released in 2016. But when the NTP released essentially the same data in February 2018, John Bucher, the senior scientist who directed the study, announced in a telephone press conference that "I don't think this is a high-risk situation at all," partly because the study had exposed the rats and mice to higher levels of radiation than a typical cell-phone user experienced.

Microwave News's Slesin speculated on potential explanations for the NTP's apparent backtracking: new leadership within the program, where a former drug-company executive, Brian Berridge, now runs the day-to-day operations; pressure from business-friendly Republicans on Capitol Hill and from the US military, whose weapons systems rely on wireless radiation; and the anti-science ideology of the Trump White House. The question now: Will the scientists doing the peer review endorse the NTP's newly ambivalent perspective, or challenge it?

The scientific evidence that cell phones and wireless technologies in general can cause cancer and genetic damage is not definitive, but it is abundant and has been increasing over time. Contrary to the impression that most news coverage has given the public, 90 percent of the 200 existing studies included in the National Institutes of Health's PubMed database on the oxidative effects of wireless radiation—its tendency to cause cells to shed electrons, which can lead to cancer and other diseases—have found a significant impact, according to a survey of the scientific literature conducted by Henry Lai. Seventy-two percent of neurological studies and 64 percent of DNA studies have also found effects.

The wireless industry's determination to bring about the Internet of Things, despite the massive increase in radiation exposure this would unleash, raises the stakes exponentially. Because 5G radiation can only travel short distances, antennas roughly the size of a pizza box will have to be installed approximately every 250 feet to ensure connectivity. "Industry is going to need hundreds of thousands, maybe millions, of new antenna sites in the United States alone," said Moskowitz, the UC Berkeley researcher. "So people will be bathed in a smog of radiation 24/7."

There is an alternative approach, rooted in what some scientists and ethicists call the "precautionary principle," which holds that society doesn't need absolute proof of hazard to place limits on a given technology. If the evidence is sufficiently solid and the risks sufficiently great, the precautionary principle calls for delaying the deployment of that technology until further research clarifies its impacts. The scientists' petition discussed earlier urges government regulators to apply the precautionary principle to 5G technology. Current safety guidelines "protect industry—not health," contends the petition, which "recommend[s] a moratorium on the roll-out of [5G]...until potential hazards for human health and the environment have been fully investigated by scientists independent from industry."

No scientist can say with certainty how many wireless-technology users are likely to contract cancer, but that is precisely the point: We simply don't know. Nevertheless, we are proceeding as if we do know the risk, and that the risk is vanishingly small. Meanwhile, more and more people around the world, including countless children and adolescents, are getting addicted to cell phones every day, and the shift to radiation-heavy 5G technology is regarded as a fait accompli. Which is just how Big Wireless likes it.

Law Offices of Harry V. Lehmann PC

Harry Vere Lehmann
Principal Attorney

4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

April 2, 2019

TO: Lane County Board of Comissioners

FR: Harry Lehmann

RE: 5G Science, Government Liability
and The Long Con

Dear Commissioners Bozievich, Farr, Berney, Sorenson and Buch

I am in a break between appearances in Court in California. This letter is a ten minute piece, best I can do, but will include elements from other documents, admittedly pasted in quickly, but you will find the data well authenticated. Most important, please see the letter from Dr. Golomb, a full Professor at the University of California School of Medicine, San Diego, which references more than 360 sources to the same effect, non-ionizing microwave radiation is dangerous to health. I personally lost four people from my circle of friends and colleagues, one of which was my most trusted friend, which propelled me into this area of study several years ago. I am an unimportant trial lawyer from California, but a science and engineering lawyer by background and would not write were the science not strong. The enclosed February 21, 2019 letter to our Board of Supervisors of the County of Marin is the most thorough compact summary of the EMF issues, including 5G and governmental liability currently known to me. I am familiar with Eugene as our daughter is a Duck.

Knowing that the enclosed is thick, mostly with scientific citation, my purpose with this cover letter is to outline some key points in a condensed way.

The 9th Circuit Cases

The law on this subject is the subject of intense litigation in the 9th Circuit, transferred from the 10th, which will decide whether FCC has the legal capacity to seize your County's property. No applications should be granted, due to uncertainty alone, until that matter is decided. I cannot take the time for full citation but will provide later if asked.

The Long Con

All of us, including myself, have been the recipients of a Long Con by the Cellular

Telephone Industry Association. For clear and convincing data on this point, well-researched history, see the March 29, 2018 edition of The Nation magazine, here is the link to the article which describes this advertizing history:

https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/

For further data showing the industry intentionally, using this very term, tried to 'war game' the scientific work of Dr. Henry Lai, who first proved DNA damage from cellular radiation, conduct an Internet search for: "Dr. Henry Lai Seattle Magazine" . I regret that the ten minutes I can take to paste this together for Lane County doesn't allow full discussion.

The Science

The industry's position is that living tissue cannot be damaged by the non-ionizing radiation from cellular devices, essentially they pitch that: *"Non-ionizing radiation does not have sufficient power to displace an electron from its shell. Therefore it is impossible as a matter of well-understood physics for microwave radiation to cause any direct non-thermal **ionic** effect (meaning directly caused chemical change) in tissue."* To understand the industry argument it is necessary to remember valence from our high school chemistry classes. I hope scientists who read this, challenging or not, will feel that the industry point, ***which is the basis for the FCC safety standards***, has been fairly stated below:

1) The involved non-ionizing radiation does not have the ability to cause an electron to jump shell, so that:

2) Since an electron cannot be forced from shell, there is no change in the ratio between protons and electrons in the involved atoms, which ratio, in chemistry, is '***valence***.'

3) If there is no change in valence ratio, there is no possibility of forced ***ionic*** recombination at an atomic level. Without a change in valence there can be no forced "ionic," or direct chemical change.

The following definition which provides illustration: "***Ionic bonding** is the complete transfer of valence electron(s) between atoms. It is a type of chemical **bond** that generates two oppositely charged **ions**. In **ionic bonds**, the [metal] loses electrons to become a positively charged cation, whereas the nonmetal accepts those electrons to become a negatively charged anion.*"

In saying that it is impossible for non-ionizing radiation to force ionic injury to tissue, the industry has been making a correct general statement of physical principle, and then incorrectly extrapolating the industry **and now FCC** pitch that: *The only scientifically sensible explanation for damage to tissue is where prolonged close encounter caused microwave induced **thermal** damage to tissue.*

Contrary to the industry pitch, there exist scientifically supported separate mechanisms through which demonstrate that his non-ionizing radiation has sufficient power to tear apart living tissue. There is an annotated explanation of this in the Causation section of the July 19, 2017 letter submitted in opposition to SB 649, which can be found at www.greenswan.org .

The vibratory nature of DNA strand breakage is illustrated in the University of Maryland interferometer experiments of 1983. As I recall it, citations in the letter, the University of Maryland interferometer study showed that addition the of a 7.43 percent constituent of DNA into plain water (from DNA salts put into the resulting solution level of said 7.43 percent), caused a 24 fold (meaning ***24 times***) increase in Specific Absorption Rate (how much energy the fluid absorbed), ***which change in energy absorption was determined to be non-ionic, but rather 'acoustic.'*** Which means, to my understanding that: A transmitted vibration within a medium having the ability to do work at the recipient target within that same medium. In the interferometer study mentioned here, there was molecular change by DNA vibration (energy absorption in the DNA molecule, measured as comparison between the energy penetrating through the plain water compared to penetrating through the DNA solution). Call me sentimental if you want, but I still REALLY love the Ella Fitzgerald Memorex commercial from 1972, check it out.

All these years the industry had been saying, ' the vibration won't hurt you, no harm until you cook.' However, Dr. Henry Lai's findings from the University of Washington School of Medicine proved that DNA strand is broken by exposure to cellular signal, established beyond rational scientific doubt. Dr. Lai's findings have never been disproved, and if industry could have, they would have. It is very worth your time to Internet search for: 'Dr. Henry Lai Seattle Magazine,' and to find the part in that article about where a disclosed industry memo pitched that the company involved needed to 'war game,' against Dr. Lai, as part of a concerted and focused effort to discredit him. Some of these people are nothing more than manipulative materialists who care for nothing but stature and wealth.

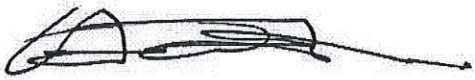
The calcium ion analysis from Dr. Martin Pall, late of the University of Washington School of Medicine proves cellular damage: Please see a 15 minute video of his 2015 presentation at The Commonwealth Club event organized by EMF

safety expert Camilla Rees, https://vimeo.com/132870272 . Dr. Pall's calcium ion conclusions show that tissue damage is multi-axial with DNA strand breakage and calcium ion cell damage both taking place. For access to Dr. Pall's scientific studies on the effects of EMF see: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3780531/ . For the scientist see: https://europaem.eu/attachments/article/131/2018-04_EU-EMF2018-5US.pdf .

Conclusion

This isn't a hobby or a game, this is serious, with the health of the residents of Lane County at stake. At the very least, all decisions on applications should be put off until the decision makers are up to speed on the science, and the outcome of the 9th Circuit litigation is known and understood. This letter will likely have errors I won't have the opportunity to edit out, please forgive due to the circumstances, on a break from Court, during which I personally typed this out.

Very truly yours,



Harry V. Lehmann

Law Offices of Harry V. Lehmann PC

Harry Vere Lehmann
Principal Attorney

4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

February 21, 2019

Marin County Supervisors
Room 329 Civic Center,
3501 Civic Center Drive
San Rafael, CA 94903

Re: Limiting the scope of Marin's financial risk for 5G litigation

Dear Supervisors -

This is the last of three letters, together sent as a gift with my kindly intent being to respectfully let your Board and County Counsel and our professional administrative policy makers know about emerging factors in EMF litigation risk, which new factors, if not skillfully addressed, will threaten the solvency of the County.

It was very decent of you to put on the Workshop and the turnout and messages spoken showed readily that there is massive constituent objection to 5G. Rather than complaining without suggested path, this letter offers a clearly defined strategy which is suggested as the safest course for minimizing litigation exposure. Maybe your people won't like it, I'm just pitching the best I can. In addition to the suggested overall strategy, actual listed defenses are respectfully listed as items A - G starting at page 9 of this letter.

I write to authenticate this advice; that the County's safest course for limited litigation exposure is, contrary to instinct, to immediately adopt an emergency moratorium on 5G permits and installations, including installations alleged as co-location.

Consider the situation of an aircraft in climb-out, if due to excessive nose-high attitude, it has entered into aerodynamic stall or has progressed beyond that to a spin. Flat spins result in high energy contact with terrain unless the spin is interrupted.

The pilot's instinct, not wanting to crash to earth, is to pull back on the yoke, to keep the nose in the instinctively desired direction, up hoping to get away from the approaching terrain. As you probably know, the actual procedure required to break out of an aerodynamic stall or resulting spin is to *go against instinct* and push the yoke *forward* to break the stall.

Based on clearly identifiable factors the current 5G risk posture of the County of Marin resembles that of an aircraft in high stall at the edge of spin, instinct says pull back on that yoke labeled 'settlement,' but the terrain rushing up at the County is an endless array of

ADA claims and other litigation if Marin ***voluntarily*** enters into a joint venture for 5G allowing telecom to merge microwave saturation machinery with publicly owned poles. The term 'merge' is used here in the Doctrine of Fixtures context. Please avoid that exposure.

The legal basis for Marin County's liability for Dangerous Condition of Public Property was presented in my letter to the Board dated February 4th and delivered to the offices of your Board on the morning of February 5th, which letter is incorporated herein as though more fully set forth. More explicitly, the County's risk comes from the math.

By the numbers.

After the Workshop and responsive to my letter, there was profuse Astroturfing with a higher shill ratio than poker at a Nevada casino. I avoided reading it, however a person whom I believe is known in her family as Starfleet Command was fascinated and read a few troll shots to me. One implied that I cared about my political chances, but that train left the station decades ago.

Another shill&troll, in a nicely focused hit piece, pitched that since in a legislative submission I'd claimed that 5G presents national security impairments, and also because in a 2017 letter against SB 649 I had once mentioned possible mass casualties, I must be an alarmist with claims to be laughed off. As it was read to me, an erudite person responded on the national security issue with reference to the back doors in Huawei equipment. As to the term 'mass casualties,' that's just arithmetic. Assume arguendo that three years from now 20,000,000 in California will be under constant saturation from 5G. Assume that only 3% of those people become symptomatic in the first half dozen years of operation; that's 600,000 people, and conveniently using six years in example that works out to a hundred thousand people a year. A phrase describing 'possible mass casualties' was just arithmetically descriptive of what happens when even a small percentage of our very large population is harmed. I don't know what that percentage will be, nobody can know the future for sure and the three percent figure is used only for illustration here, although I personally believe it to be justified, including through the findings of Dr. Olle Johansson of the Karolinska Institute, Stockholm. See the ÖRJAN HALLBERG AND GERD OBERFELD letter at ***Electromagnetic Biology and Medicine*, 25: 189–191, 2006**. Please consider the situation in Marin, even using that same small percentage.

There are a quarter million people in Marin. The percentage of us whom in the future will be electrosensitive to the point of material recognizable attributable symptoms is unknown. For arithmetic illustration only, not as a stated epidemiological conclusion, using the estimate of only 3% leads us to expect 7,500 Marin residents to be affected by microwave exposure sickness the point of symptom in the near term.. And even if it's only one percent, that's 2500 of our people. The connection between this radiation and the symptoms of microwave exposure disease is well established. The NTP proof of causation of cancers in rats was not surprising to professionals in this field, set as it was in the context of hundreds of other studies showing EMF damage (see the UCSD School of Medicine letter incorporated below citing 360 such sources), with other studies previously showing brain cancer causation, see in particular the Norway study by Hardell, if memory serves that was in the

September 2013 edition of the International Journal of Oncology. Since this cause of their illnesses is well known, injured people will seek legal relief. If the injured are 'only' 2500, and 'only' one in five of those files an ADA claim or other litigation, that's still 500 cases against Marin or other local pole owners. Yes, these are hypothetical extensions, no we can't no exactly, and yes, although the percentage of people explaining their illness experiences at the Workshop was clearly higher than three percent of those attending, that was not a random sampling. Yet the resulting numbers of cases in this scenario are so large that even if this situation whittled down to the claims resulting from one half of one percent of our people being rendered ill, and again one in five filed ADA, that's still a big number, and for the professional planner raises serious concern for the very reason that we can't project exactly what is going to happen here, so that we face exposures the limit of which cannot be assured.

When our Supervisors and senior policy people examine whether the '500' cases example just used for illustration is reasonable, consider that the arithmetic example was based on an assumption of *only one percent* of our Marin population being sickened to the point of material attributable symptoms, and *only one in five* of those hurt people pursuing an ADA or other approach. Please also contemplate what happens if the percentage of our Marin population with such alleged traceable symptoms is three percent, *thus generating 7500 hurt people and 1500 filed cases by the same math.* If those are spread over the six years hypothetically used above, that's 250 cases per year. The work of Dr. Henry Lai and a now by 2019 an overwhelming body of scientific evidence show a hazard level that was not even considered remotely a serious risk when that Bill passed, Senator McCain voting against it in tiny minority.

More than 360 peer-reviewed sources on microwave injury are attached.

In response to the natural desire of the policy-defining reader to have proof of scientific concern, attached to this letter is the entire August 18, 2017, 25 page letter in opposition to SB 649 issued by Beatrice Alexandra Golomb, MD, PhD, Professor of Medicine, UC San Diego School of Medicine. From a medical professional of impeccable credential, this studied letter describes the medical consequences of mass installation of 5G, with annotations supporting her conclusion that "**If this bill passes, many people will suffer greatly, and needlessly, as a direct result.**" Dr. Golomb's letter includes 360 citations to peer-reviewed studies showing microwave radiation medical consequences, with 21 pages out of 25 just for the citations.

I respectfully note that it solves for all variables in explaining a causation mechanism for mutagenic DNA change if, in physics terms, the damage is occurring through 'acoustic' means, which is not about music this time, and has everything to do with vibration.

Consider how a microwave works, as can be found in any encyclopedia, the next is from a World Book bought for our kids long ago: "**Microwave oven** is an appliance that heats food by penetratiang it with short radio waves. These waves cause molecules in food to vibrate rapidly. Friction among the moving molecules creates heat, which cooks the food." This is, at a molecular level, shaken baby syndrome for all your cells.

The last industry lobbyist I spoke with on this issue in Sacramento was painfully unstudied in his underlying science dialogue, though he seemed like he'd be a terrific grandfather. I will do my best next to fairly state the core telecom industry point on tissue damage causation from cellular microwave: *"Non-ionizing radiation does not have sufficient power to displace an electron from its shell. Therefore it is impossible as a matter of well-understood physics for microwave radiation to cause any direct non-thermal **ionic** effect (meaning directly caused chemical change) in tissue."*

To understand the industry argument it is necessary to remember valence from our high school chemistry classes. I hope scientists who read this, challenging or not, will feel that the industry point, ***which is the basis for the FCC safety standards***, has been fairly stated below:

1) The involved non-ionizing radiation does not have the ability to cause an electron to jump shell, so that:

2) Since an electron cannot be forced from shell, there is no change in the ratio between protons and electrons in the involved atoms, which ratio, in chemistry, is '***valence***.'

3) If there is no change in valence ratio, there is no possibility of forced ***ionic*** recombination at an atomic level. Without a change in valence there can be no forced "ionic," or direct chemical change.

I just found the following definition which gives us an adequate illustration: *"**Ionic bonding** is the complete transfer of valence electron(s) between atoms. It is a type of chemical **bond** that generates two oppositely charged **ions**. In **ionic bonds**, the [metal] loses electrons to become a positively charged cation, whereas the nonmetal accepts those electrons to become a negatively charged anion."*

In saying that it is impossible for non-ionizing radiation to force ionic injury to tissue, the industry has been making a correct general statement of physical principle, and then incorrectly extrapolating the industry pitch that: *The only scientifically sensible explanation for damage to tissue, due to the non-ionizing character of the radiation, would be where prolonged close encounter caused microwave induced thermal damage to tissue.* Their whole scientific house of cards is built on the foundation of that Joker.

There exist at least two rationally deduced and also scientifically supported separate mechanisms through which, in fact, this non-ionizing radiation has sufficient power to tear apart living tissue. There is an annotated explanation of this in the Causation section of the July 19, 2017 letter submitted in opposition to SB 649, which can be found at www.greenswan.org our embarrassingly out of date website, Green Swan is our very own 'involuntary non-profit,' but I believe that we'll do well

once the new products based on the patents reach the market. I won't try to condense that 10 page analysis from July of 2017 here, but today, as in that July 19 letter, the vibratory nature of DNA strand breakage appears illustrated from the University of Maryland interferometer experiments of 1983. As I recall it, citations in the letter, the University of Maryland interferometer study showed that addition the of a 7.43 percent constituent of DNA into plain water (from DNA salts put into the resulting solution level of said 7.43 percent), caused a 24 fold (meaning ***24 times***) increase in Specific Absorption Rate (how much energy the fluid absorbed), ***which change in energy absorption was determined to be non-ionic, but rather 'acoustic.'*** Which means, to my understanding and as best I can phrase it: A transmitted vibration within a medium having the ability to do work at the recipient target within that same medium. In the interferometer study mentioned here, there was molecular change by DNA vibration (energy absorption in the DNA molecule, measured as comparison between the energy penetrating through the plain water compared to penetrating through the DNA solution). Call me sentimental if you want, but I still REALLY love the Ella Fitzgerald Memorex commercial from 1972, check it out.

As said in the July 19 letter, I believe that Dr. Trevor Marshall's work had shown the core point of acoustic DNA damage before my conclusion was published, all consistent with the authorities therein, excepting that to my embarrassment I misspelled Dr. Andrew Goldsworthy's name, I haven't tried to correct that in such an already public document, but I apologize. Derivative from this absorptive quality of DNA and synthetic DNA materials, the US Patent and Trademark Office recognized issued U.S. Non-Provisional Utility Patent 9,960,799 on May 1, 2018.

All these years the industry had been saying, ' the vibration won't hurt you, no harm until you cook.' However, Dr. Henry Lai's findings from the University of Washington School of Medicine proved that DNA strand is broken by exposure to cellular signal, established beyond rational scientific doubt. Dr. Lai's findings have never been disproved, and if industry could have, they would have. It is very worth your time to Internet search for: 'Dr. Henry Lai Seattle Magazine,' and to find the part in that article about where a disclosed industry memo pitched that the company involved needed to 'war game,' against Dr. Lai, as part of a concerted and focused effort to discredit him. Some of these people are nothing more than manipulative materialists who care for nothing but stature and wealth.

There are solid reasons for respecting the calcium ion analysis from Dr. Martin Pall, late of the University of Washington School of Medicine: Please see a 15 minute video of his 2015 presentation at The Commonwealth Club event organized by EMF safety expert Camilla Rees, https://vimeo.com/132870272 . Dr. Pall is a credentialed scientist, I am not. I respectfully agree Dr. Pall's calcium ion conclusions, hardly surprising that tissue damage is multi-axial with DNA strand breakage and calcium ion cell damage both taking place. For compact access to Dr. Pall's scientific studies on the effects of EMF see: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3780531/ . For the

serious academic, see: https://europaem.eu/attachments/article/131/2018-04_EU-EMF2018-5US.pdf .

Please keep the scope of litigation narrow.

Marin County has talented lawyers at County Counsel, there are very many other employees of high talent in the building Litigating with telecom is narrow in scope and narrow in personnel necessary to address a small group of related cases which are no more challenging than any other set of a few coordinated important cases. If Marin is sued by telecom, that's only a few lawsuits.

Alternatively, in contractually allowing telecom permissively to use regional entity utility poles our county cannot comfortably rely on permit immunities and other traditional governmental defenses, because any such voluntarily compliant public entity has direct involvement ***as a participant in the tort***, due to joint venture, doctrine of fixtures et al, leaving pole owners permanently open to Claims for such WHO-defined injuries, cases unknowable number, without end.

Consolidation has taken place from the MDL and the transfer to the 9th. Marin's 5G litigation with Big Telecom (via the FCC puppets) ***is narrow in scope***, as it is now in the 9th Circuit. Should Big Telecom's really sue Marin over an emergency moratorium, they walk into the den of lions, and the scope of the suits involved, very likely consolidated, will be very narrow. Thus, the scope of litigation if Marin fights diligently only involves a handful of your skilled lawyers and/or limited outside counsel covered by the insurance pool.

I am personally aware of many people, including in Marin, each who has sufficient documentation of EMF sensitivity and negative medical consequence to morally and legally justify an ADA complaint, to mention just one possible course of action. That gentleman from Inverness tellingly testified about how microwave exposure causes potentially deadly variances in operation from titanium surgical instrument in his chest.

Our county faces a permanent multiplicity of long term litigation from microwave sickness claimants if Marin voluntarily cooperates with telecom on 5G. If our county will simply say no to 5G, the scope of litigation will remain narrow, at least for several years. Furthermore, if the county were ultimately ***forced*** by the federal government into 5G acceptance, such a forced local entity would have a stronger argument for federal reimbursement than an entity which just went along for the ride. Unfortunately the ultimate approach of such local 5G acceptance is that either the telecom's liability will be shifted to the local taxpayers, or in the instance of a reimbursement from the feds, telecom's liability exposure would be shifted to the federal government, in either instance a disastrous outcome.

Please consider the moral queasiness each Board member would forever after feel if in grasping for defenses against these avoidable lawsuits you were to resort to claiming, against the health of your constituents, that the 1996 Act also protects local governments as well.

Cooling the Mark - Big Telecom's Hidden Persuaders

Electromagnetic hypersensitivity refers to health effects attributed to electromagnetic fields (EMF) exposure and has been formally named "idiopathic environmental intolerance attributed to electromagnetic fields" by the World Health Organization. I am personally aware of substantial settlement awards in EMF workplace injury situations in California and awards for electromagnetic disability involving high degrees of expert diagnosis. I remember a teacher who can no longer teach in a faraway District from here, ***which District "tested" the WIFI in the classroom only when the students and their Chromebooks were absent, and therefore the routers were in standby state***. Similar forms of false 'scientific' testing have shown up in many counties, including in my opinion in Petaluma schools.

This isn't sunburn. ***Keep in mind that the NTP study specifically reported glioma cells***. Some claims will result from life-ruination glioblastoma cancers. And note that the positive finding in the NTP study of cancer causation in the NTP study, rather than being a surprise to those who have long studied in this issue, was a result long widely expected a few examples our of hundreds follow: The Lund University finding of violation of the blood-brain barrier in rodents at very low wattage was back in 2003, the extremely remarkable book by former Motorola antenna scientist Robert C. Kane, published in 2000, ***Cellular Telephone Russian Roulette*** which appeared impossibly scarce for a while but is now available used, is the most pioneering book of all on this subject. The first letter on WIFI dangers to the LAUSD by Dr. Herbert of the Harvard Medical School was way back in 2013, referencing more than a thousand studies showing EMF damage, the Norway study led by Hardell definitively showing an increased rate of brain cancer in cell phone users was published in the International Journal of Oncology in September of 2013. In the introduction to his heroic book, the late (brain cancer) Robert C. Kane notes: "***Never in human history has there been such a practice as we now encounter with the marketing and distribution of products hostile to the human biological system by an industry with foreknowledge of these effects.***" The fact of microwave damage to biology was well established long before the NTP report.

How is it possible not to recognize such a risk? The March 29, 2018 investigative report in The Nation, ***How Big Wireless Convinced Us Cell Phones Are Safe*** is the finest investigative journalism that I've seen in my life. For those who first thought of Woodward, be sure to read Len Colodny's history of Watergate, titled Silent Coup. Conditioned memes and legends are the biggest of big businesses. Our government was released from statutory restraint years ago and can now lawufully engage in propaganda to its citizens, and whether the blood flows into pockets from the Left or the Right, it comes through the beating heart of America's giant corporations, and some are outright dumb. Consider PG&E for example.

Precision advertising has taught us to shuffle concerns about microwave cancer into the round bin with the Fringe sign on it. Our societal tardiness to recognize this hazard results in large part from advertising and it's related appendage, industry sponsorship of

research. So part of this risk ignorance has been advertizing feedback so careful that Jacques Ellul, God rest his soul, would have appreciated the precision.

That's why CTIA ditched Dr. Carlo after he told them, 20 years ago, about the cancer risks he'd found. Please kindly read the 3/29/18 article from The Nation. Was it all in bad faith ? In 20-20 hindsight it is always easy to condemn past mistakes in the light of new insights, but the devotional team spirit cultivated within the wildly profitable field of telecom was often coupled with a sincere belief in the minds of competent engineers that the nature of the radiation involved meant it could not cause non-thermal damage to flesh. That issue has already been treated explicitly, and you already have exhaustive data from the contents of links supplied by many constituents besides me.

Based on the Workhop the constituent viewpoint is two hundred people in ratio to three out-of-town shills. Once the now available science information is understood by an interested person, there's no need for a sales pitch. I don't like being involved in this 5G issue, it is difficult and unhappy work which has presented personal security challenges but this is unavoidably necessary for me for moral grounds, study sometimes causes knowledge which inherently compels action by those concerned with their souls.

An understanding of group psychology is integral to serious modern corporate PR and political campaign practice and Big Telecom is glad to influence our views; best of all if the media-conditioned public has been sufficiently trained to treat polite dissenting views as 'fringe.' I'm old enough to have read Vance Packard when The Hidden Persuaders was new, of course there is Walter Lippman's bare statement that: "***The real environment is altogether too big, too complex, and too fleeting for direct acquaintance" between people and their environment. People construct a pseudo-environment that is a subjective, biased, and necessarily abridged mental image of the world*** **(Lippmann, 1922: 4)**." August Bullock's ***The Secret Sales Pitch*** is the best modern work I've seen. The reality is that a true expert campaigner can cause new phrases and outlooks to be long remembered. For example, the late great Lyn Nofziger used to horribly pun 'better a Harry Lehmann than a bald priest.' Please concentrate on forgetting that pun. That is an example of the same sort of skill that telecom is paying for to form your views. NMFR.

<u>Additional defenses for the County of Marin lawyers to contemplate for all EMF suits</u>.

Without even scant lip service to Due Process, the FCC is waging a national Condemnation campaign to seize property rights belonging to cities and counties, local Districts, and other public entities and private entities. The term 'Condemnation' is used in the normal legal descriptive sense of a public entity taking private property the owner of that property being entitled under Due Process to access to the courts for replevin, with such just compensation being essential both under statutory law in all State jurisdictions and also on Constitutional grounds. I make no attempt here to exhaustively provide all of the many defenses which are readily familiar. What follows, A through E, are five less obvious defense approaches.

A- The defense of moral conduct.

I respectfully suggest an additional lawful basis for rejection of 5G which is not prohibited by the 1996 Act, ***namely that the installation of 5G given the totality of circumstances, is immoral, and Marin elects not to allow 5G installation on moral grounds.*** What are they going to say to that? Will telecom come argue that morality no longer matters? And we certainly do have room in our laws for morality in civil matters, it is called 'equity.' It is complete seriousness suggested that if sued, in defense of its moratorium, the County of Marin may respond, so long as there is an actual record of proceedings to same effect that: 'Based on the totality of the circumstances, the County of Marin has placed a moratorium on 5G on moral grounds.' I know that your linear thinkers will cringe, but I've been an M. Scott Peck fan for almost 30 years, and WTF ***are*** they going to say to that one? It is mostly self-admitted ego defense for me to say this, but before you decide to reject any idea just because of initial perceived unusual level of novelty, please examine U.S. Patents as next listed: 9,997,824, 9,960,799, 9,747,884, 8,890,697, 9,191,055, 9,379,757, 9,564,680, and 9,065,900. None of those have to do with 5G, all of them have to do with portable equipment and their Applications were filed before I'd even heard the term '5G.' As a result of my study in that work, I am morally required object to radiation saturation of Marin.

There appears no moral wiggle room on this one, it is immoral to irradiate people in order to sell them instant access to Bonanza reruns. It came to our attention during the long hard fight against SB 649 that discussions were ongoing between telecom and the cable industry. I wasn't a fly on the wall, my then and current comprehension of the situation is that telcom's goal to be covert all of the services we may now subscribe and enjoy to 5G wireless. Cuts out a lot of cable people, for one example. It is in the nature of invention that the greatest accomplishments come from unexpected quadrants.

B- The defense of Separation of Powers.

Telecom's own bought and paid for smurf choir now chants that neither cities, counties nor citizens can have access to the courts over being fried by their signals. Telecom relies here on the odious 1996 Telecommunications Reform Act, Section 704, which has been often often interpreted by industry to prohibit the courts from even entertaining any claims based on adverse health consequences. This is a massive violation of the basic concept of Separation of Powers.

The FCC claims that their pet Act is so powerful that now the Executive Branch can preclude the courts from even having jurisdiction over any tower-siting issues. Our system of courts has never been perfect and never will be perfect, but the courts are the safety net protecting us from the excesses of governance. It is extremely important that the issue of Separation of Powers, in this instance the severe overreach of the federal Executive Branch be fought in any litigation over 5G with telecom.

C- A prohibition of environmental claims does not preclude claims for direct physical harm to humans.

Another example in good faith litigation is whether any language in the 1996 Act was generally understood at the time and context of its drafting, actually prohibits cases based on direct physical harm to a human beings, as opposed to harm to the 'environment' in which we all reside.

Here in Marin many of us may take a more Alan Watts view of the environment, and see us all human life as part of an interconnected whole. But the 1996 Act was written in DC from the generally prevailing Western outlook of individual separateness, which some would argue is a cornerstone of the individuality to which we are all entitled. In that view, the 'environment' is the surroundings we live ***in***, not something of which we humans are a part.

When the 1996 Act was passed, I respectfully submit that the generally prevailing Western approach of separateness, the all too often encountered 'us versus the environment in the name of wealth and progress,' was the common outlook. So the term 'environment' should not be interpreted as encompassing direct physical harm to humans, because in the Western view, which remains the generally prevailing view, we are not part of environment, but rather it's occupiers. The 1996 Act did not expressly prohibit claims for direct physical harm from microwave sources

D- The FCC is violating Due Process.

These FCC thumb puppets are saying to us all, 'skip the Due Process part' with the FCC asserting the position that even the Judicial Branch cannot stop this corporate-dictated irradiation of our population. Now is the time for all good people to come to the aid of their country. We have both statutory and Constitutional entitlements to Due Process when the government takes something of value from us. Every Due Process right that would normally attach in a Condemnation or Inverse Condemnation case, from our federal Constitution, from California's Constitution, and from both state and federal statute should be available to counties and cities and others who are about to have their property rights in these utility poles siezed. This a gross over-reach in terms of Due Process as well as Separation of Powers.

E - Equal Protection of the Law.

This letter is written with our professional public administration people in mind and in recognition that these high ranking professionals guide policy too. It has been demonstrated that credible science shows that physical harm will result to some or all of us from excessive microwave absorption. Most of the people reading this are very educated. You can read the data and reach the necessarily deductive conclusions just as well as I can. This isn't a hobby or a game, this is serious. Our professional administrators and all their staffs have their own life quality at stake with regard to microwave saturation. For one example, it is well established, I think first from Dr. Argawal late of Cleveland Clinic, now at Mayo, that there

is a 50% kill rate in sperm from smart phone proximity (front pants pocket) , the last Israel study I saw said '47%'.

F - Is there really a 'gap in coverage?'

I have worked with scientists in this field since being introduced to Dr. Devra Davis in late 2009, and as a result of being pressed into objection to 5G by the data in a meeting I had tried to dodge in March of 2017. I had spent more than seven years by then in study of this area, study of the same sort used for the Chevron aviation gas class action (new engines for 1647 aircraft), the Mobil Oil AV-1 litigation (850 aircraft get overhauled, rebuilt or new engines), or any other serious major case. After, literal nausea when I shook hands in March of 2017, with grudging reluctance recognizing that I was morally forced by my knowledge to work on stopping SB 649 and related telecom efforts. I studied for and prepared at least 15 written presentations, eleven of them to state legislators or our Governor. I have for years been in regular communication with people who have used state-of-the-art meters to check for signal strength. Consistently it has been found that telecom-alleged gaps in coverage are usually phantoms The experience is that, for personal communication as envisioned by the 1996 Act, claimed gaps in coverage are alleged but those allegations are very seldom found to be accurate. You can find data on this at http://www.scientists4wiredtech.org .

G- The allowance of federal preemption covers personal communication devices only, and does not cover what telecom is pitching to you as 5G (but which is actually densification of 4G with 5G upgrade intended.

The legislative intent and the actual wording of the 1996 Telecommunications Reform Act was to provide reliable coverage for personal communication devices, used for communication. Now the industry is telling you that it is necessary for us to install so-called 'small cell' antennas on every block. But Verizon's own CEO says this not necessary for 5G, see this video: https://www.youtube.com/watch?v=lYAufhIgkpI&feature=youtu.be&t=31. See also: https://www.youtube.com/watch?v=jnyG2bliKCs&feature=youtu.be&t=30s , in which a Verizon engineer shows that high density is not necessary for communication. And 5G is so toxic that phones are being designed to turn down signal if your fingers get near the antenna: Lenovo of China, owners of Motorola just released the following technology in their latest smartphone coming to the US so that: Device will shut down 5G radios upon detecting proximity and the device will shut down 5G radios at the smartphone surface where fingers would be covering some of 10 antennae in the device, to keep device's emissions under the allowed FCC's MPE levels:

https://www.theverge.com/2019/2/16/18227951/motorola-5g-moto-mod-fcc-millimeter-wave-proximity-z3-pro

Those who have followed this closely, particularly during the hearings in Sacramento on SB 649 conclude that a core motive for the anticipated '5G revolution' is the provision of entertainment through 5G, taking the place of cable. Because of the demonstrated strength of telecom's signals from the macro towers already in existence, see above convincing Verizon

videos, the only need which would demand the density is to supplant cable. ***That is not within the scope preemption as sought and stated in the 1996 Act***. Therefore, Section 704 does not apply to 5G. Verizon's own PR shows provision of cable-level 5G entertainment: https://www.verizonwireless.com/support/5g-home-faqs/?intcmp=vzwdom . It is impossible for telecom to truthfully claim that the federal preemption extends to 5G, because the Act was written only for personal communication devices, not the provision of TV shows.

Concluding statement.

Some groups will be more exposed to radiation than others, i.e., in public housing. It is reasonable to expect that the poor will bear a heavier burden. As the son of great dad who worked as a school custodian, I submit those who say they really care about assuring that the less advantaged are treated equally should fight against 5G from that perspective.

Due to density of living environment, those living in high density environments will be the most exposed. Imagine that you happen to live in a apartment with outside stairs at 8:30 p.m. , and just one person from each apartment in your 40 unit building is using the Internet via 5G; you now have the opportunity to be zapped by the subscriptions from your surrounding neighbors. Those who live on big lots and rural ranches will be less exposed.

After hearing so many coherent and sincere presentations at the Workshop, most of the long term trial lawyers who listened likely immediately recognized the potential for ADA claims, though a defense lawyer wouldn't have discussed that set of risks at a serious level until getting further data on the dimensions of exposure. As the Workshop went on we all witnessed many people of entire believability speak of the suffering they had witnessed and personally experienced from microwave exposure.

The microwave hazard to human health is well corroborated: See the collection of professional scientific data collection at the website of The Environmental Health Trust, founded by epidemiologist Dr. Devra Lee Davis, which is www.ehtrust.org, see the collection of data, and please see the collection of scientific positions to be founder under "Quotes from Experts and other well organized scientific data, including from Dr. Magna Havas, to be found at http://electromagnetichealth.org , which I believe was founded by the activist and expert Camilla Rees. Dr. Havas saved a vital trove of Navy documents from destruction, I have seen a 1972 Navy document on EMF exposure with 400 sources listed.

My law specialty is in engineering cases which require serial striving for competency in the depositions of the Ph.D. experts. I am donating this study effort because it is the best I can do with the time and background I can donate, sent as a gift in the hope of treasuring life.

Cordially,

Harry V. Lehmann

UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine
9500 Gilman Drive, #0995
La Jolla, CA 92093-0995
Phone: 858 558-4950 x201

August 18, 2017

To whom it may concern,

I urge in the strongest terms that you vigorously oppose California SB 649.

If this bill passes, many people will suffer greatly, and needlessly, as a direct result.

This sounds like hyperbole. It is not.
My research group at UC San Diego alone has received hundreds of communications from people who have developed serious health problems from electromagnetic radiation, following introduction of new technologies. Others with whom I am in communication, have independently received hundreds of similar reports. Most likely these are a tip of an iceberg of tens or perhaps hundreds of thousands of affected person. As each new technology leading to further exposure to electromagnetic radiation is introduced – and particularly introduced in a fashion that prevents vulnerable individuals from avoiding it – a new group become sensitized to health effects. This is particularly true for pulsed signals in the radiowave and microwave portion of the spectrum, the type for which the proposed bill SB 640 will bypass local control.

Mechanisms by which health effects are exerted have been shown to include oxidative stress (the type of injury against which antioxidants protect ,see optional section below), damage to mitochondria (the energy producing parts of cells), damage to cell membranes[1, 21], and via these mechanisms, an impaired "blood brain barrier"[3-5] (the blood brain barrier defends the brain against introduction of foreign substances and toxins; additionally, disruption can lead to brain edema[6]), constriction of blood vessels and impaired blood flow to the brain[7], and triggering of autoimmune reactions[8, 9]. Following a large exposure, that depresses antioxidant defenses, magnifying vulnerability to future exposures, some persons no longer tolerate many other forms and intensities of electromagnetic radiation that previously caused them no problem, and that currently cause others no problem. But this group deserves – nay needs -- the right to be able to avoid these exposures.

Affected individuals not only experience "symptoms" that "merely" cause them distress and suffering, when they are exposed – symptoms like headaches[10, 11], ringing ears[10, 11] and chest pain[10] from impaired blood flow, heart rhythm abnormalities[10, 11], and inability to sleep[10, 11]. These symptoms arise from physiological injury. Moreover, **many experience significant health problems that can include seizures[11], heart failure, hearing loss[12-14] and severe cognitive impairment[11, 15].** The mechanisms involved are those also involved in development and progression of neurodegenerative conditions including Alzheimer's disease[16].

Fully half who were employed when their problems developed lost their job because of the problem, among participants of a survey we conducted. They reported that their condition had cost them up to 2 million dollars to date. Many had lost their homes. A number became homeless, and have swelled the ranks of so-called "EMF refugees"[17-19]. Among those affected, many were previously high functioning individuals – engineers, doctors, lawyers. The best and the brightest are among those whose lives – and ability to contribute to society –will be destroyed. High profile individuals with acknowledged electrohypersensitivity include, for instance, Gro Harlem Brundtland – the former 3-time Prime Minister of Norway and former Director General of the World Health Organization[20]; Matti Niemela, former Nokia Technology chief[21]; as well as the wife of Frank Clegg[22], who formerly headed Microsoft Canada and is current head of Canadians for Safe Technology[23].

Each new roll-out of electromagnetic technology for which exposure is obligatory, swells the ranks of those who develop problems with electromagnetic fields (EMF).- particularly following a significant exposure to pulsed radiowave-microwave radiation, and particularly when people have no ability to avoid it.

Many state that they didn't give credence to the problem (if they had heard of it at all) **until they themselves fell prey to it.**

This is not a psychologically driven condition. Multiple objective physiological changes reflecting mechanisms of injury have been shown in persons with this condition[24, 25].

The role for oxidative stress, that has been shown in innumerable studies (below)**, is affirmed by evidence of a link of this condition to genetic variants in antioxidant defenses,** that are less avid in defending against oxidative stress[307]. People cannot manipulate their genes, to produce such an outcome by suggestibility.

An analysis by a University of Washington researcher showed that most studies funded by industry reported failure to show physiological effects. However, most studies without such industry bias affirmed effects. This is redolent of findings shown in medicine[26], regarding which the former editor in chief of the BMJ (the British Medical Journal), Richard Smith, noted, based on findings of a study, "This {result} suggests that, far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies."[27]. So where articles deny injury from nonionizing radiowave-microwave radiation, there is commonly a stake aligned with financial benefit from such denial.

Those who are affected are in desperate need of *protection* by our elected officials. They need creation of safe spaces and housing, and roadways to allow travel, not removal of any prospect of one; protection of local rights to make decisions - **not removal of any recourse or ability to avoid what injures them.** They are far more strongly in need of protections than a great many protected classes – their problems arose due to actions of others, against which they were given no control – *and can be reversed,* in most cases, if the assault on them is rolled back. Through no fault of their own, and in some cases against their will (e.g. before opt out was permitted with smart meters), they were subjected to an

exposure that has altered their lives as they knew them, and forced them – needlessly - to the margins of society.

Let our focus be on safer, wired and well shielded technology – not more wireless.

This legislation, if passed, and the resulting unrestricted roll-out of this technology, will predictably and directly injure and disable a new group, and add depth of suffering to those already affected.

In other spheres we abridge freedoms to protect the vulnerable few. We require that every schoolchild be vaccinated, supposedly to protect the vulnerable few who may not respond effectively to a vaccine. The need to protect the vulnerable group is deemed to be so great that it justifies the decision to abridge individual rights.

In contrast, this bill seeks to abridge individual freedoms, and local rights, in the service of *harming* a vulnerable group, and creating a new one.
(The common factor appears to be that in both cases, the direction is aligned with a powerful industry that influences political decisions.)
Luckily, no abridgment of individual rights and freedoms is required to protect,t here.

If any group can opt out (such as, I understand, firefighters*)[28]; **then *every* group deserves that equal right.** Others should not be second class citizens, subject to fewer protections.

It would go far to helping this cause if anyone complicit in promoting or passing the legislation (and then after that, *their* families) were required to be the first subjected, for a substantial test period, to the *greatest* amount of exposure that anyone *else* (and their families) may be subjected to, when new policies of this type are rolled out. It will still not do them equal damage; because they may not represent the vulnerabilities that others will have; but such a policy might help them to think twice. *That* is a bill I would strongly endorse.

Most who are now affected – were not, until they were. This may become you – or your child or grandchild. Moreover, if you have a child, or a grandchild, his sperm, or her eggs (all of which she will already have by the time she is a fetus in utero), will be affected by the oxidative stress damage created by the electromagnetic radiation, in a fashion that may affect your future generations irreparably.

It was noted above that, among survey completers, fully half of those who were employed at the time they developed electrosensitivity, lost employment *due to* this problem. (This may understate the scope of the tragedy, since this most-affected group may be least likely to be able to respond to an online survey.) **Many who previously had no problem navigating in the world are now restricted from access to basic services** like hospital care, post offices and libraries because of these problems. With each new introduction of technology that exposes many to yet a new nondiscretionary source of electromagnetic radiation, particularly (but not exclusively) that which emits pulsed radiation in the radiowave-microwave part of the spectrum, a new group of people are affected; and the suffering of those who are already affected increases greatly.

Please, defend the public and our future. Protect the rights of the individual and the locality, against a form of incursion that will lead to serious harm to some – and set a terrible precedent. **Vote no on California SB 649**, and urge that everyone else do the same.

Sincerely,

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine

*Comment on the fire fighter exemption:"The legislature granted an exemption from SB 649 to the firefighters who requested it for health reasons. Throughout California firefighters have long complained of often disabling symptoms from cell towers on their stations. Cities frequently rent out space on fire stations to add to city revenue. ...Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn't recall how to start the procedure over again...Prior to the installation of the tower on his station, this medic had not made a single mistake in 20 years. A pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse control in all 6 firefighters tested (https://ecfsapi.fcc.gov/file/7022117660.pdf). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada."[15 28]
Clearly, others who experience similar problems also deserve protections.

Optional – More on the Science

There is a robust literature showing that electromagnetic radiation, including in nonionizing frequencies, and at *levels*[29, 30] *below* those that are cause thermal effects (heating) – causes physiological effects, injury, and cell death –not only in humans but many animals and plants[3, 7, 31-49]. Unsurprisingly, industry has sought – against the tide of evidence to the contrary - to maintain that radiation must be ionizing or heating to cause injury.

Scores or hundreds of studies show that radiation, including specifically radiowave-microwave spectrum radiation, and including low-level exposure, can impair antioxidant defenses, increase "oxidative stress" (free radical injury) and damage mitochondria, the energy producing parts of cells[1, 2, 34, 50-6930, 70-104105-13646, 137-171]. These effects occur with ionizing and nonionizing radiation, at thermal and subthermal levels. (Indeed, much or most of the damage by ionizing radiation, and radiation above the thermal limit, occurs by mechanisms also documented to occur without ionization, and below the thermal limit.) These

mechanisms cohere with the mechanisms documented to play a role in symptoms and health conditions that are reported in those who are electrosensitive – extending to seizures[172-176], heart failure[177-184] and cognitive decline[5, 32, 57, 108, 185-195].

These mechanisms have known involvement in induction of **brain cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, and neurodegenerative conditions,** conditions that have exploded. In each case these have been linked, or presumptively linked, in some studies to electromagnetic radiation[8, 9, 16, 34, 196-219].

Such radiation also has effects on sperm[33, 100, 220-228]; and the DNA of sperm[229] (consistent with recent news reports of marked recent declines in sperm counts and function)..

Such radiation also has toxic effects in pregnancy[230]**, to the fetus and subsequent offspring**[231-235] **including at low levels**[236]**, and is tied to developmental problems in later life, including attention deficit and hyperactivity**[31, 235-241]. It is critical to defend pregnant women (and eggs of girls who may at a later time become pregnant) from exposures with such toxicity.

Electromagnetic radiation across much or most of the spectrum (not excluding visible light) has been shown to depress levels of melatonin[40, 72, 242-252], which is best known for its role in sleep (and indeed, impaired sleep is the most consistent symptom in affected individuals[10, 11]).

Melatonin is in fact a critical antioxidant that defends the body against harm from *many* toxic exposures[253-266] **including electromagnetic radiation itself** [61, 66, 67, 82, 101, 107, 118, 121, 138, 144, 151, 204, 249, 267-284]**- reducing the oxidative stress** that is implicated in cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, bipolar disorder and neurodegenerative conditions, and that also plays a role in heart attack and stroke[9, 285-329330-343].

Radiation, and specifically radiation in the radiowave-microwave portion of the spectrum can also depress levels of other critical antioxidant systems that also defend the body against chemical, radiation, and other sources of injury. These other antioxidant systems include the glutathione system, superoxide dismutase and catalase[81, 102, 115, 116, 233, 344-358] - which are also involved in defending against health problems.

This suggests that depression of antioxidant defenses due to electromagnetic radiation may magnify risk of chemically induced health effects (and depression of antioxidant systems due to some chemicals may amplify risk of harm from electromagnetic radiation). Indeed just such effects have been reported[359, 360].

BRIAN L. MICHAELS, PC
Attorney At Law
259 East 5th Avenue, Suite 300-D
Eugene, Oregon 97401
Telephone: 541.687.0578
Fax: 541.686.2137

December 29, 2015

TO: LANE COUNTY BOARD OF COMMISSIONERS
LANE COUNTY COUNSEL
125 East 8th Avenue
Eugene, Oregon 97401

RE: ORDINANCE 15-07; Chapter 6, Lane Code
Public Hearing And Testimony
December 15, 2015; 1:30

SSsooooo,

Finally got 'round to watching the video of the board meeting following my testimony. (I still blanch and shudder at the sight of me on video.) Thanks for listening.

Despite my overwhelming workload and schedule, and despite the fact the ordinance has passed, as well as the hope against hope that you will possess the time and interest to consider these notes, please accept this memo as my need to respond to two points in which I was and remain a party.

1.

At approximately 2:23:20 on the video, Mr. Dingle indicated that one of the things I was forgetting is that Ms. Valkyrie was on a release agreement that prohibited her from coming onto the county courthouse.

Well, it was not that I had forgotten, but rather there was nothing of the kind to forget. I do not know what Mr. Dingle told you folks, but nowhere in our email discussions did the subject of a release agreement or a restriction of a release agreement ever come up. This is made certain by our catalogue of emails on the topic of Ms. Valkyrie being threatened with a trespass arrest, three of which I have attached here.

Further evidence of there not being a release agreement issue

Would be that a release agreement is issued through the court hearing the pending criminal charge. A violation of the release agreement would be forwarded to the court and prosecutor to pursue an allegation of violating that release agreement.

Mr. Dingle would know this since he was a prosecuting attorney for many many years.

Further evidence of there not being a release agreement issue

There was never any notice, or threat of notice, that the release agreement was being violated. Nowhere did that process ever come up during the pending criminal charge. If there was an issue of violating the release agreement that would be the sole venue to pursue.

Mr. Dingle would know this since he was a prosecuting attorney for many many years.

Further evidence of there not being a release agreement issue

If there were such a release agreement and a release agreement restriction, such would not bestow upon the alleged 'victim' any right to arrest her for trespassing - only to report the release agreement violation to the appropriate venue and prosecutor. It's called due process. The police may be called, in this instance EPD, and determine for themselves if there is probable cause to arrest her for violating the release agreement. As can be readily seen from attached emails that was not mentioned to officer Mozan as the reason for arresting her.

Mr. Dingle would know this since he was a prosecuting attorney for many many years.

Further evidence of there not being a release agreement issue

If there were a release agreement, the alleged 'victim' is not bestowed with the authority to modify that release agreement by allowing her to go here, go there, escorted or not escorted. A release agreement may only be modified by the court that issued the release agreement, not unilaterally by Mr. Dingle or anyone else. The fact he advised the Board to modify her permission to be in the county courthouse belies the fact he knew there was no release agreement.

Mr. Dingle would know this since he was a prosecuting attorney for many many years.

In closing, allow me to point out three excerpts from the emails attached.

Thursday, January 17, 2013 5:14 PM. Among the recipients is the city of Eugene, including the then prosecutor Mr. Dan Barkovic, he asked Liane Richardson this question:

> **Liane, what would you like with Ms. Valkyrie? Exclusion**? Escort? If Liane is ok with the escort, would the City be willing to escort her? What will the City do if she ignores the County conditions **or Liane excludes her altogether from the building**?

(Emphasis added)

Needless to say, no mention to Mr. Barkovic of any release agreement.

In a separate email, including the city and the city prosecutor, with the subject, "Valkyrie exclusion":

> From: DINGLE Stephen E [Stephen.DINGLE@co.lane.or.us]
> Sent: Thursday, January 17, 2013 8:44 PM
> To: KLEIN Glenn; BARKOVIC Dan J; BROTHERTON Kathryn
> Subject: Valkyrie exclusion
>
> **Liane is asking that she be excluded** because the name clearing hearing is being recorded and can be reviewed and there is no general public participation.

(Emphasis added)

Needless to say, no mention to Mr. Barkovic of any release agreement.

Monday, January 28, 2013 6:53 AM, in an email to Ms. Valkyrie:

> If you are present in the Public Service Building or Harris Hall for County functions without specific written permission from either the County Administrative Officer or **County Counsel** you will be subject to arrest.

(Emphasis added)

Needless to say, no mention of any release agreement.

There is a separate email from Mr. Dingle to the city of Eugene seeking guidance on how to lawfully trespass someone, which, in these few moments, I have been unable to locate. In the event Mr. Dingle denies there is such an email, and if requested, I will gladly take the time to locate.

2.

In response to Commissioner Chair Jay Bozievich's reference to ORS 164.205, identifying these sections:

> (3) Enter or remain unlawfully means:
> (a) To enter or remain in or upon premises when the premises, at the time of such entry or remaining, are not open to the public or when the entrant is not otherwise licensed or privileged to do so;
> (b) To fail to leave premises that are open to the public after being **lawfully directed** to do so by the person in charge;
> (c) To enter premises that are open to the public after being **lawfully directed** not to enter the premises; or
> * * *

(Emphasis added)

Allow me to point out the state did not does not and will not have these criteria for one being 'lawfully directed':

> (4) It shall be presumed that a person is acting without a lawful purpose if:
> * * *
> (b) Said person is in or upon any County owned building or premises **and upon request of a duly authorized officer refuses to disclose said person's purpose of being there or refuses to leave said building or premises.**

(Emphasis added; ORDINANCE 15-07; Chapter 6, Lane Code)

The problem is that this ordinance provides a false sense of 'a lawful order,' resulting in 'authorized officer' believing they can follow the very terms of the ordinance to believe they may remove people lawfully. After all, it's written into the Ordinance.

If you have gotten past the 'release agreement' storied basis for arresting Ms. Valkyrie, then you can plainly see how this ordinance will be subject to misuse and abuse. Ask yourselves this: if Ms. Valkyrie was *not* threatened with arrest because of some release agreement, then because of what??

Thank you for the time you have taken to review this material.

DINGLE Stephen E

From: DINGLE Stephen E
Sent: Thursday, January 17, 2013 5:14 PM
To: RICHARDSON Liane I (CAO); ZIKE Madilyn L
Cc: KLEIN Glenn; BARKOVIC Dan J; BROTHERTON Kathryn
Subject: FW: Notification of Intention to Access Public Service Building

Importance: High

Dear City of Eugene folks,

Do you have any information about her assertions regarding Mayor Piercy. I am sorry, but I was unaware that she had intervened in our conflict and not permit the County to restrict citizens from Council meetings. She also references "other demands" made the mayor/ Glenn I know from our conversation that the actions and statements attributed to the mayor earlier by the SLEEPS group were inaccurate. The name clearing hearing is a County, not a City meeting.

Liane, what would you like with Ms. Valkyrie? Exclusion? Escort? If Liane is ok with the escort, would the City be willing to escort her? What will the City do if she ignores the County conditions or Liane excludes her altogether from the building?

Please let me know your thoughts so I can formulate a response.

Steve

From: Alley Valkyrie [mailto:alley@practicalrabbit.com]
Sent: Thursday, January 17, 2013 4:32 PM
To: DINGLE Stephen E
Subject: Notification of Intention to Access Public Service Building

Mr. Dingle,

I am writing to inform you that I plan on attending tomorrow's public hearing regarding Mark Kardell at 11am. I can find no indication that this hearing is being publicly broadcast and I have a legal right to attend. If you strongly feel that I need to be escorted, I will be more than happy to meet an escort outside the building. Please let me know your preference on this matter, preferably before 10 am tomorrow.

I also wish to reiterate and clarify my position regarding my right to access the property as well as inform you as to my future intentions. As you are undoubtedly aware, last week Mayor Piercy intervened in our conflict and made it clear that she would not permit the County to restrict citizens from City Council meetings and that all citizens were welcome to attend City meetings. I attended last Monday's Council meeting at the Mayor's invitation and I plan on attending all City Council meetings and work sessions in the future. I expect that the County will not interfere with my legal rights or the Mayor's demands in this matter. I am not opposed to informing you ahead of time and accepting an escort to these meetings, although I personally feel that its a pointless measure that reflects badly upon the County, especially considering the recent press and public reaction around this issue. However, I trust you will inform me with reasonable notice if you feel the need to have me accompanied by an escort.

Respectfully,

DINGLE Stephen E

From: DINGLE Stephen E
Sent: Monday, January 28, 2013 6:53 AM
To: alley@practicalrabbit.com
Subject: Lane County PSB Exclusion

Dear Ms. Valkyrie,

I want to make sure that you understand that your presence at the Marc Kardell name clearing hearing did not result in your arrest for trespass because of a miscommunication. Specifically, I want to make sure that you understand this is not a waiver of the previously imposed exclusion order. I have now had the opportunity to check with the City of Eugene regarding the assertions you made in your last email and I learned nothing that would change the County's position. If you are present in the Public Service Building or Harris Hall for County functions without specific written permission from either the County Administrative Officer or County Counsel you will be subject to arrest.

Lane County does not have the resources to provide an escort. You may continue to enter the PSB or Harris Hall for city-related business as outlined in my earlier email.

Stephen E. Dingle
County Counsel
Lane County Office of County Counsel
125 East 8th Avenue
Eugene, Oregon 97401
541-682-6561

DINGLE Stephen E

From: MOZAN Doug L <Doug.L.Mozan@ci.eugene.or.us>
Sent: Friday, January 18, 2013 8:56 AM
To: KLEIN Glenn; DINGLE Stephen E
Cc: KLINKO Eric E; KERNS Pete M
Subject: RE: Valkyrie exclusion

As far as EPD is concerned, if Ms. Valkyrie is not at a City function, then the County is within their rights to exclude her. If she trespasses, call us and we'll respond. We do not have the resources to be involved in escorting Ms. Valkyrie to any function, however.

Lt. Doug Mozan, Daytime Watch Commander
(541) 682-5164 Desk
PROTECT.SERVE.CARE.

From: KLEIN Glenn
Sent: Thursday, January 17, 2013 21:03
To: KERNS Pete M; MOZAN Doug L; FELLMAN Scott R
Cc: BROTHERTON Kathryn; BARKOVIC Dan J
Subject: FW: Valkyrie exclusion
Importance: High

This is a related email to the one I just sent you.

From: DINGLE Stephen E [Stephen.DINGLE@co.lane.or.us]
Sent: Thursday, January 17, 2013 8:44 PM
To: KLEIN Glenn; BARKOVIC Dan J; BROTHERTON Kathryn
Subject: Valkyrie exclusion

All,

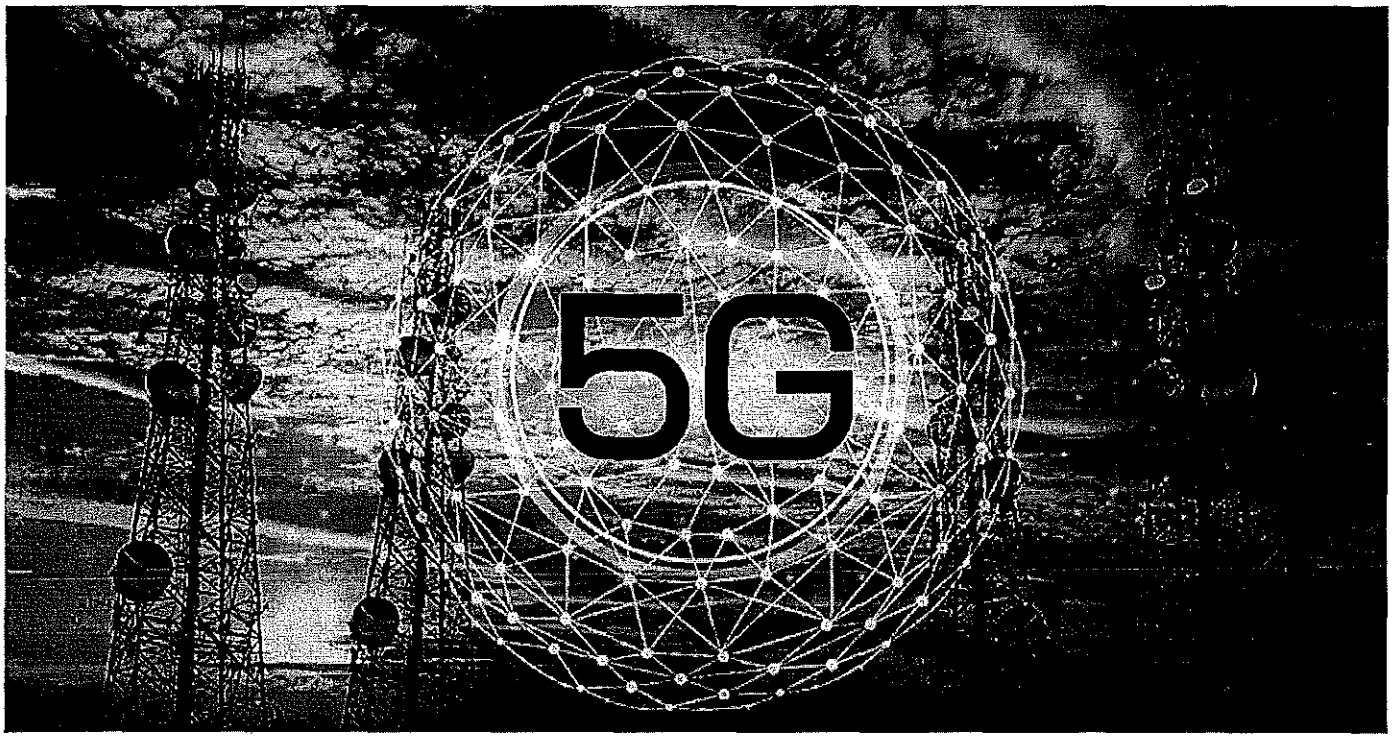
Liane is asking that she be excluded because the name clearing hearing is being recorded and can be reviewed and there is no general public participation. What will you instruct EPD to do if she shows up at the name clearing hearing after I send her an email advising her of the exclusion.

Thanks.

Stephen E. Dingle
County Counsel
Lane County Office of County Counsel
125 East 8th Avenue
Eugene, Oregon 97401
541-682-6561

The Dangers of 5G to Children's Health

February 13, 2019



By the Children's Health Defense Team

Mobile and wireless technologies are a ubiquitous feature of modern life. Most U.S. adults own smartphones, a growing proportion are "smartphone-only" Internet users and over a fourth report being online "almost constantly." As for children, a 2014 survey of high-income nations reported that almost seven in ten children used a mobile phone, and two-thirds of those had a smartphone, usually by age 10. As described by Nielsen, it is now as common to see "a kid with a smartphone in their hand" as it was to see "a kid playing with a yo-yo in the years before the digital age."

The enthusiasm with which the public has embraced each new mobile and

wireless technology—most of which have never undergone any appropriate safety testing or standards development—suggests that consumers rarely stop to consider the health implications of the infrastructure shoring up their ability to browse, stream and download anytime and "on the go." Consumers are not entirely to blame for their lack of awareness—it is not easy to disentangle the technologies' health risks in the face of the telecommunications industry's steady and calculated disinformation efforts and a captured Federal Communications Commission (FCC) that "follows the script of fabulously wealthy, bullying, billion-dollar beneficiaries of wireless."

... powerful 5G (fifth-generation) networks and technology are about to subject everyone, on a continuous basis, to unprecedented forms and amounts of mandatory irradiation—without prior study of the potential health impact or any assurance of safety.

Now, however, a global 5G "frenzy" is upon us and is coming into full force. The rollout of "blazing fast" 5G technology will "dramatically increase the number of transmitters sending signals to cellphones and a host of new Internet-enabled devices." The time is ripe for greater grassroots awareness of the undisclosed tradeoffs between convenience and 5G's potentially catastrophic health effects. Far from a simple "next-gen" upgrade, powerful 5G (fifth-generation) networks and technology are about to subject everyone, on a continuous basis, to unprecedented forms and amounts of what retired U.S. government physicist Dr. Ronald Powell calls "mandatory irradiation"—without "prior study of the potential health impact" or any assurance of safety. Considering that young people (with their smaller body mass and developing brains) are particularly vulnerable to radiation, the Environmental Health Trust has termed 5G "the next great unknown experiment on our children"—and the entire human population.

Early warnings

In fact, the "giant uncontrolled experiment" on children and adults has already begun, despite an urgent international appeal by tens of thousands of scientists, doctors, environmental organizations and citizens calling for a halt to 5G deployment. In 2018, telecom carriers in the U.S. and Europe began rolling out 5G technology in dozens of cities. Focusing (for now) on "dense urban and high-traffic areas" in the U.S., AT&T began positioning its 5G infrastructure in major cities in eight states, and Verizon started offering 5G home broadband service in "select neighborhoods" in a handful of cities.

... health problems such as insomnia, miscarriage, memory problems and other neurological issues, and there are widespread reports of annihilation of insect and bird populations.

For the most part, health concerns have ranked as a tiny footnote in the midst of the massive hoopla about 5G's speed and capacity, although trade magazines admit that there may be "some objections" to 5G due to "concerns over potential health risks." In both Europe and the U.S., however, individuals living and working in proximity to newly installed 5G towers and antennas are telling a different story. Many have immediately started experiencing health problems such as insomnia, miscarriage, memory problems and other neurological issues, and there are widespread reports of annihilation of insect and bird populations.

A United Nations whistleblower recently drew attention to 5G's dramatic impact on health in a widely circulated series of comments about 5G's "seemingly overnight" rollout in Vienna, Austria. Describing 5G as a "silent war," she commented:

> *"...Children are the most vulnerable to 5G depredation because of their little bodies. Friends and acquaintances and their children in Vienna are* ***already reporting the classic symptoms of EMR [electromagnetic radiation] poisoning:*** *nosebleeds,* ***headaches,*** *eye pains, chest pains, nausea,* ***fatigue,*** *vomiting, tinnitus, dizziness, flu-like symptoms, and cardiac pain. They also report a tight band around the head; pressure on the top of the head; short, stabbing pains around the body; and buzzing internal organs."*

Current reports about 5G's health risks should have been anticipated based on warning signs dating back to 2G cellular technology. In a 2004 pilot study involving functional brain scans of fire fighters who had worked for up to five years in fire stations with 2G cell towers, the researchers concluded that the only plausible explanation for the firefighters' symptoms—"slowed reaction time, lack of focus, lack of impulse control, severe headaches, anesthesia-like sleep, sleep deprivation, depression, and tremors"—was the radiofrequency radiation exposure from the towers. The International Association of Fire Fighters then went on record as opposing "the use of fire stations as base stations for towers and/or antennas for the conduction of cell phone transmissions until a study with the highest scientific merit and integrity...is conducted and it is proven that such sightings are not hazardous to the health of our members."

Above and below

One of the novel dangers introduced by 5G technology is its reliance on high-frequency millimeter waves (MMWs), a bountiful and not previously commercialized portion of the electromagnetic spectrum. While 5G's enthusiasts are quick to promise support for literally billions of devices, there is one catch—the shorter millimeter wavelengths cannot travel as far as the lower frequencies used for earlier generations of mobile technology. Thus,

while there were about 300,000 wireless antennas on U.S. cell towers and buildings as of 2016 (a doubling since 2002), 5G will require "exponentially more"—*millions* of small cell towers every 500 feet "on every street corner."

... even in the home environment, 5G technology [will] blast through walls and cribs, making a mockery of the notion that 'your home is your castle' in which you are supposed to be safe.

Organizations concerned about the health hazards of wireless radiation note that "Right now, you don't have to live next to a cell tower....but once they have these [5G] cell antennas everywhere, you won't be able to [move away]." Unfortunately, the "nowhere to hide" aspects of 5G are even more serious, because ground-based 5G systems will be supplemented by satellite-based systems. In March, 2018, the FCC approved the initial launch of over 4,400 low-Earth-orbit 5G communication satellites, to be followed by thousands more over the next two years—with the eventual result being 11 times more satellites orbiting the Earth than currently. The satellites will send "tightly focused beams of intense microwave radiation at each specific 5G device that is on the Earth," while each device then sends "a beam of radiation back to the satellite."

In practical terms, this means that in crowded locations such as airports, individuals' bodies "will be penetrated by numerous beams of radiation as they walk or as other people walk around them with their 5G smartphones." But even in the home environment, "5G technology [will] blast through walls and cribs," making a mockery of "the notion that 'your home is your castle' in which you are supposed to be safe."

More than skin-deep

Scientists, doctors and experts from around the world have issued repeated

warnings about 5G's risks, drawing on published research on MMWs as well as thousands of studies showing the harms caused by other mobile and wireless technologies.

In this context, industry and government claims that 5G technology is safe are completely disingenuous. In fact, the health effects of MMWs are already quite familiar to the U.S. military and defense agencies around the world. The U.S. has at its disposal non-lethal crowd control weapon systems (euphemistically named Active Denial Systems) that use millimeter waves to penetrate the skin of targeted individuals, "instantly producing an intolerable heating sensation that causes them to flee." In research commissioned by the U.S. Army "to find out why people ran away when the beam touched them," they discovered that targets "feel like [their] body is on fire." Researchers also have warned that "the same parts of the human skin that allow us to sweat also respond to 5G radiation much like an antenna that can receive signals."

Moratorium urgently needed

When the FCC endorsed the transition to 5G in 2016, then-Chairman Tom Wheeler (a former telecom industry lobbyist) vowed "to allow new [5G] technologies and innovations to evolve and flourish without needlessly prescriptive regulations." Thus, even though 5G represented a radical shift in technology, the FCC proposed no further safety studies, instead continuing to rely on its "outdated, excessively permissive, and thus widely criticized, radiation-exposure guidelines that...are based primarily on a 30-year-old analysis...many years before the emergence of most of the digital wireless technology in use today." A recent government study by the National Toxicology Program—which determined that cell phone radiation causes cancer—deemed the three-decade-old guidelines "unprotective."

... children who began using either cordless or mobile phones

regularly before age 20 had more than a fourfold increased brain tumor risk.

5G poses risks to all life on the planet—people, animals, insects and plants. However, it is clear that fetuses and children are among the most vulnerable members of the human population. Even prior to 5G, Swedish researchers concluded that "children are indeed more susceptible to the effects of EMF exposure at microwave frequencies" and reported that children who began using "either cordless or mobile phones regularly before age 20" had more than a fourfold increased brain tumor risk. Describing brain cancer as "the proverbial 'tip of the iceberg,'" the researchers also observed that "no other environmental carcinogen has produced evidence of an increased risk in just one decade."

The UN whistleblower states, "People's first reaction to the idea that 5G may be an existential threat to all life on Earth is usually disbelief and/or cognitive dissonance. Once they examine the facts, however, their second reaction is often terror. We need to transcend this in order to see 5G as an opportunity to empower ourselves, take responsibility and take action." Some of the actions that people have taken include signing the International Appeal; learning about the multiple reasons to be concerned about 5G radiation and telling others; talking to legislators about why rushing legislation that streamlines the deployment of 5G small cells is a bad idea (and also raising the awareness of legislators and state utility commissions about the risks of smart meters); and changing their relationship to their devices, including using wired rather than wireless Internet connections (or turning off WiFi routers at night) and adopting other simple steps.

5G promises to create an even "denser soup of electrosmog," with incalculable health effects. In fact, any sane person who examines the evidence must concur with the authors and over 40,000 signatories of the International

Appeal to Stop 5G on Earth and in Space, who agree that the rush to blanket the planet with 5G "constitutes an experiment on humanity and the environment that is defined as a crime under international law."

Republishing Guidelines

Sign up for free news and updates from Robert F. Kennedy, Jr. and the Children's Health Defense. CHD is planning many strategies, including legal, in an effort to defend the health of our children and obtain justice for those already injured. Your support is essential to CHD's successful mission.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF NEW MEXICO

SANTA FE ALLIANCE FOR PUBLIC HEALTH AND SAFETY, ARTHUR FIRSTENBERG, and MONIKA STEINHOFF,

Plaintiffs,

vs. No. 18-1209

CITY OF SANTA FE, NEW MEXICO; HECTOR BALDERAS, Attorney General of New Mexico; and the UNITED STATES OF AMERICA,

Defendants.

COMPLAINT FOR DECLARATORY JUDGMENT AND INJUNCTIVE RELIEF

COME NOW the SANTA FE ALLIANCE FOR PUBLIC HEALTH AND SAFETY ("ALLIANCE") and MONIKA STEINHOFF by and through their attorney, and ARTHUR FIRSTENBERG, pro se, and in their Complaint against the CITY OF SANTA FE ("CITY"), NEW MEXICO ATTORNEY GENERAL HECTOR BALDERAS, and the UNITED STATES OF AMERICA ("UNITED STATES"), state as follows:

INTRODUCTION

1. For at least fifty years, the United States of America has known that radio frequency ("RF") radiation, even at extremely low levels of exposure, is injurious to human health and the environment, and that the continuous expansion of wireless telecommunications would endanger its population, including Plaintiffs, and the ecosystems and natural resources upon which they depend for their

wellbeing and survival. Despite this knowledge, the United States enacted a law *prohibiting* States and municipalities from regulating wireless telecommunications on the basis of their environmental effects, which has been assumed to include health effects. This law is Section 704 of the Telecommunications Act of 1996, 47 U.S.C. § 332(c)(7)(B)(iv) and (v) ("Section 704").

2. For at least twenty years, the City of Santa Fe has known that RF radiation, even at extremely low levels of exposure, is injurious to health and environment, and that the continuous expansion of wireless telecommunications would endanger Plaintiffs and the ecosystems and natural resources upon which they depend for their wellbeing and survival. Despite this knowledge, the City has dismantled all of the protections it previously put in place to protect its residents from harm. It has repealed all land use regulations that previously ensured that RF radiation-emitting antennas could not be placed on sidewalks in front of homes and businesses, and it has repealed all notice requirements and all means of public participation in decisions that endanger their health and their environment. The ordinances by which these protections were repealed are Ordinances No. 2016-42 and 2017-18. Further, on November 21, 2017, the Mayor of Santa Fe issued the first of three unlawful executive Proclamations, which suspended the Land Development Code, including public notice requirements, with respect to telecommunications facilities on City-owned property. Seven short cell towers have been built on City land with no public process at all under the Proclamations.

3. For at least a decade, the State of New Mexico has known that RF radiation, even at extremely low levels of exposure, is injurious to health and environment, and that the continuous expansion of wireless telecommunications would endanger Plaintiffs and the ecosystems and natural resources upon which they depend for their wellbeing and survival. Despite this knowledge, the State of New Mexico passed a law providing that RF radiation-emitting antennas in the public rights-of-way are a permitted use, not subject to land use review, throughout New Mexico. This law, which went into effect on September 1, 2018, is the Wireless Consumer Advanced Infrastructure Investment Act ("WCAIIA"). Sections 4(C) and 5(B) of WCAIIA exempt both new antennas and new supporting structures for antennas from land use review. NMSA 1978 §§ 63-9I-4(C) and 63-9I-5(B).

4. Telecommunications companies, enabled by laws prohibiting the public from participating in decisions affecting their health, environment, and survival, are poised right now to roll out the fifth-generation wireless network (5G). This is acknowledged and advertised to bring unprecedented societal change on a global scale. We will have "smart" homes, "smart" businesses, "smart" highways, "smart" cities and self-driving cars. Virtually everything we own and buy, from refrigerators and washing machines to milk cartons, hairbrushes and infants' diapers, will contain antennas and microchips and will be connected wirelessly to the Internet. Every person on Earth will have instant access to super-high-speed, low-latency wireless communications from any point on the planet, even in rainforests, mid-ocean and the Antarctic.

5. What is known to governments and to scientists working in the field of bioelectromagnetics, but is not widely known to the general public, is that this will also result in unprecedented *environmental* change on a global scale. The planned density of radio frequency ("RF") transmitters is extraordinary. In addition to millions of new 5G base stations on Earth and 20,000 new satellites in space, 200 billion transmitting objects, according to estimates, will be part of the Internet of Things by 2020, and one *trillion* objects a few years later.

6. In order to transmit the enormous amounts of data required for the Internet of Things, 5G technology, when fully deployed, will use millimeter waves, which are poorly transmitted through solid material. This will require every carrier to install base stations (also referred to herein as "cell towers") every 100 meters in every urban area in the world. The existence of multiple competing carriers means there will be a base station in front of every third to fifth house. Unlike previous generations of wireless technology, in which a single antenna broadcasts over a wide area, 5G base stations and 5G devices will have multiple antennas arranged in "phased arrays," that work together to emit focused, steerable, laser-like beams that track each other.

7. Each 5G phone will contain dozens of tiny antennas, all working together to track and aim a narrowly focused beam at the nearest base station. The Federal Communications Commission ("FCC") has adopted rules permitting the effective power of those beams to be as much as 20 watts, ten times more powerful than the levels permitted for current phones.

8. Each 5G base station will contain hundreds or thousands of antennas aiming multiple laser-like beams simultaneously at all cell phones and user devices in its service area. This technology is called "multiple input multiple output" or MIMO. FCC rules permit the effective radiated power of a 5G base station's beams to be as much as 30,000 watts per 100 MHz of spectrum, or equivalently 300,000 watts per GHz of spectrum, tens to hundreds of times more powerful than the levels permitted for current base stations.

9. The FCC regulates the technical aspects of telecommunications only, has no statutory authority over health, and has repeatedly disclaimed any expertise or authority over health or environment. Its RF exposure guidelines are neither mandatory nor enforceable. They are procedural only and serve only to determine whether an FCC licensee must file an Environmental Assessment or not. Health and safety are State functions, and as a zoning authority the City is obligated to safeguard the health of its citizens and may not abdicate this responsibility.

10. Even before 5G was proposed, scientists working in this field globally have presented dozens of declarations, petitions and appeals to their governments calling for a halt to the expansion of wireless technology and a moratorium on new base stations. Already in 2002, the Freiburger Appeal, signed by over 3,000 physicians, warned that radiation from cell phones and cell towers was causing serious health impacts including "heart attacks and strokes among an increasingly younger population."

11. In 2015, 215 scientists from 41 countries, all of them researchers engaged in the study of biological and health effects of electromagnetic fields, communicated their alarm to the United Nations and World Health Organization ("WHO"). They stated that "numerous recent scientific publications have shown that EMF [electromagnetic fields] affects living organisms at levels well below most international and national guidelines."

12. More than 10,000 peer-reviewed scientific studies demonstrate harm to human health from low-level RF radiation. Effects include:

- Alteration of heart rhythm
- Altered gene expression
- Altered metabolism
- Altered stem cell development
- Cancers
- Cardiovascular disease
- Cataracts
- Cognitive impairment
- Diabetes
- DNA damage
- Impacts on general well-being
- Increased free radicals
- Learning and memory deficits
- Impaired sperm function and male infertility

- Miscarriage
- Neurological damage
- Obesity and diabetes
- Oxidative stress

13. Effects in children include autism, attention deficit hyperactivity disorder ("ADHD") and asthma.

14. Damage goes well beyond the human race, as there is abundant evidence of harm to diverse plant- and wildlife and laboratory animals, including:

- **Ants.** *Exposure to cell phones, cordless phones, or WiFi in the laboratory causes behavioral disturbances and mortality.*
- **Birds.** *Proximity to cell towers impairs reproduction and diminishes populations.*
- **Forests.** *RF radiation causes forest dieback, mimicking the effects of acid rain.*
- **Amphibians.** *Proximity to a cell tower in an urban laboratory caused 95 percent mortality; RF radiation has contributed to the extinction of scores of species worldwide.*
- **Fruit flies.** *Exposure to a cell phone in the laboratory impairs reproduction and causes mortality and genetic abnormalities.*
- **Honey bees.** *A ten-minute exposure to a cell phone in the laboratory causes digestion of food to come to a complete halt at the*

cellular level; RF radiation causes swarming and is a primary cause of colony collapse disorder.

- **Insects.** *Insect populations in nature preserves and rainforests plummeted when cell towers were erected nearby.*
- **Farm Animals.** *Proximity to cell towers causes heart and circulatory failure and internal bleeding in cows, and abortions and reproductive failure in cows and pigs.*
- **Mice.** *Proximity to a cell tower in an urban laboratory impaired reproduction and caused irreversible sterility within five generations.*
- **Plants.** *RF radiation shortens life-span, impairs growth, and causes developmental abnormalities in duckweed plants.*
- **Rats.** *A two-hour exposure to a cell phone causes permanent brain damage.*
- **Trees.** *Aspen trees throughout Colorado no longer grow normally; only when shielded from RF radiation do they display the fall colors they were once famous for.*

15. These studies have been performed by the following:

- United States Army
- United States Navy
- United States Air Force
- United States Environmental Protection Agency ("EPA")
- Governments of other nations

- Thousands of scientists and researchers worldwide

16. The results of this medical and scientific research are publicly available and may be found in

- Senate Reports
- House of Representative Reports
- EPA Reports
- Peer-reviewed scientific journals published worldwide

17. The EPA has stated repeatedly that the human exposure guidelines that were adopted by the FCC on August 6, 1996 are protective only against shocks, burns, and gross heating and do not protect against chronic and low-level exposure. An EPA letter dated October 8, 1996 stated that the guidelines "are thermally based, and do not apply to chronic, nonthermal exposure situations." Again on March 8, 2002, the EPA stated that "The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-Ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations."

18. A June 17, 1999 letter, signed by the entire Radiofrequency Interagency Work Group ("RFIAWG"), whose members represented the FCC, EPA, Food and Drug Administration, National Institute of Occupational Safety and Health, Occupational Safety and Health Administration, and National Technical Information Agency, stated that the FCC's guidelines are based on "thermal effects" and "acute exposures" and do not consider "chronic exposure to RF radiation,

including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc., that does not elevate tissue temperature on a macroscopic scale."

19. Peer-reviewed studies have recently been published, predicting thermal skin burns in humans from 5G radiation and resonant absorption by insects, which absorb up to 100 times as much radiation at millimeter wavelengths as they do at wavelengths presently in use. Since insect populations have declined by 75 to 98 percent since the 1970s, even in protected nature areas, 5G radiation could have catastrophic effects on insect populations as well as birds and other species that depend on them. A 1986 study by Om Gandhi at the University of Utah warned that millimeter waves are strongly absorbed by the cornea of the eye, and that ordinary clothing, being of millimeter-size thickness, increases the absorption of energy by the skin by a resonance-type effect.

20. Together, the new City ordinances, the new State Act, and Section 704 remove all public protection from injurious facilities in the public rights-of-way, infringe on the public's right to speak about a danger to their own health, eliminate all public participation into the siting of such facilities, and deprive injured parties of any remedy for their injuries. Plaintiffs are such injured parties. Plaintiffs and Plaintiff's members have been previously injured by RF radiation from cell towers, have been deprived of any remedy for their injuries, and have been deprived of any means of preventing further injury. They have been deprived of their right to due process guaranteed to them under the Fifth and Fourteenth Amendments to the

United States Constitution. Additionally they have been deprived of their right to free speech and their right to petition the government for redress of grievances, guaranteed to them under the First Amendment. This Court is Plaintiffs' last resort to ensure their safety and their future from the harm perpetrated by Defendants.

21. Plaintiffs hereby seek a declaration that these laws, and any other laws that may be enacted by their City, their State, or the United States, that would deprive them of any means of protecting themselves from RF radiation and of any remedy for injury by such radiation, are unconstitutional, and to enjoin the enforcement of these laws.

PARTIES

22. Plaintiff **Alliance** is an unincorporated organization of physicians, health care practitioners, psychotherapists, educators, artists and other citizens who reside and/or do business in the City of Santa Fe, and who have been personally and financially injured by wireless telecommunications facilities. The Alliance was formed in 2005 to educate the public about the health and environmental effects of electromagnetic radiation (EMR) from telecommunications facilities, and advocate for policies and laws that protect the public health and environment from such radiation. Many of its members are refugees from homes that they had to abandon when a cell tower was erected.

23. **Alliance member Janice R. Olch** is an architect. She and her daughter were injured by cell phone antennas on a water tank near her home in

Hondo Hills. She sold her home and they moved to a more remote area in Santa Fe County where cell phone reception is poor and the lots are large enough that they are not exposed to WiFi signals from the neighbors. **Alliance member John McPhee** is an official with the New Mexico Department of Health. He and his wife were injured by a community wireless transmitter in 2005 while residing in the Eldorado Subdivision south of Santa Fe. They moved back into the City in 2007 and took up residence on West Alameda Street. When the cell towers on the hill above their house were upgraded to 4G, they both began to experience headaches, nausea, chronic insomnia and loud ringing in their ears, and his wife started having seizures. Finally they purchased and moved into a house near Santa Fe High School, which gave them both relief and immediately reduced both the frequency and severity of his wife's seizures. **Alliance member Forrest Reed** is a civil engineer and environmental planner who used to work for the City of Santa Fe. She was injured in 2005 when Verizon Wireless concealed a cell tower, for which it had neither a building permit nor zoning permission, on the roof of a one-story building. The building was and is just a few houses away from Ms. Reed, and four of the cell tower's antennas are aimed toward at her home. Ms. Reed, who still lives in her home and cannot afford to move, hears the radiation, developed respiratory, neurological and cardiac problems after that cell tower was erected, and more recently has developed an unusual form of lung cancer. **Alliance member Lynn Jacob** was a caseworker for the City of New York for 22 years. She becomes irritable, tired and weak if she spends time in the vicinity of a cell tower or is

exposed to WiFi. She has thyroid cancer which is presently stable and is afraid that any increase in radiation will encourage the growth and spread of her cancer. **Alliance member Nina Zelevansky** is a retired psychotherapist and an artist who has lived in the City for many years. Like most of the members of the Alliance, she is unable to use a cell phone because when she does, her face feels like it is on fire and she cannot think. She is presently homeless because she has not been able to finding housing which is not exposed to WiFi and/or a cell tower. **The Alliance also includes** a psychologist and author who was homeless for the same reason for five years, a world class athlete who was homeless for the same reason for eight years who now lives in a remote area south of the City, a physicist who lives in the City who had to leave his job at Los Alamos National Laboratory and almost became homeless for the same reason, and many others. The Alliance also includes physicians who have patients who were injured and/or made homeless by cell towers. Most members of the Alliance have had their mobility and access to City services and functions restricted by the new towers that have been erected pursuant to the Mayor's Proclamations.

24. Plaintiff **Arthur Firstenberg** is the president of the Alliance and a homeowner and taxpayer within the City. He is a refugee from cell tower radiation. Until 1996 he lived in an apartment on the top floor of a six-story building in Brooklyn, New York. On November 14, 1996, Omnipoint Communications (now T-Mobile) began offering the first ever digital cell phone service in the city, provided by 600 newly erected cell towers, one of which was on the roof of a neighboring

building. Immediately he was in agony and after November 18, 1996 was completely unable to eat or sleep. During the night of November 21, 1996, he experienced paroxysmal laryngospasm: his vocal cords went into spasm three times so that he could not take a breath in or out. The next morning he left his apartment and the city to save his life. The relief he experienced was immediate. He moved upstate to the town of Norwich, New York and lived there for two years. When a cell tower was built near his home in Norwich he moved to the tiny village of Mendocino, California, where he lived from 1999-2004. When cell phone antennas were installed under the deck of a house across Mendocino Bay, aimed directly at the village, he had to move back into his car. He arrived in Santa Fe in the summer of 2004 and rented a room in a house on Camino Principe. One year later Verizon Wireless added antennas to an existing cell tower a few blocks away at 1214 Camino Carlos Rey and he was forced into his car again. He lived in his car in Santa Fe for the next three years while searching for a place to live that did not threaten his life. In addition to the aforementioned laryngospasm, his life-threatening injuries include cardiac arrhythmia and elevated cardiac enzymes, indicative of damage to cardiac and/or skeletal muscle. His physician will testify to these facts. He purchased his present home in 2008. Several of the towers built under the Mayor's Proclamations have now restricted his mobility and his access to City services and functions: the new tower on the roof of the Convention Center denies him access to that building, and the new antenna aimed at Council Chambers restricts his access to City government; the new tower between the

Water Division and the Chocolate Maven denies him access to City offices and a popular restaurant; the new tower at Fort Marcy Park denies him access to that park and the recreation facilities therein; the new tower in front of the Genoveva Chavez Community Center denies him access to that recreation center as well as government functions and public meetings held therein.

25. Firstenberg is president of the nonprofit organization Cellular Phone Task Force, which he co-founded in 1996 to call attention to the problem that had cost him his home and almost cost him his life. Today he communicates with ten thousand individuals and five hundred organizations representing refugees from wireless telecommunications facilities.

26. Plaintiff **Monika Steinhoff** is a homeowner and taxpayer within the City and an artist and owner of an art gallery. She was first injured by wireless technology when her cell phone started causing her hand to become numb and gave her an odd discomfort in her ear. In August 2010 she moved her art gallery to the Arcade on the Plaza but often was dizzy and nauseous there. She was well at home, where there was no cell phone service, but at work, where she was exposed to more than 20 WiFi signals from neighbors, she was exhausted at the end of the day, had migraines and heart palpitations, and started having internal bleeding. She also experienced severe insomnia. She left in October 2010, moving the gallery to her house for several months. In the spring of 2011, she moved her gallery to Guadalupe Street in the Railyard district, one block from Hotel Santa Fe. Business and sales were good, but a cell tower was erected on the roof of Hotel Santa Fe in

2013. She shielded the roof of her gallery as well as the large windows, which reduced the radiation. But she still felt unwell inside, and worse outside in the street, and was forced to find yet another location for her gallery, on Canyon Road. Her doctor will testify that RF radiation is the primary cause of the aforementioned diagnoses, as well as the cause of her more recently elevated blood pressure. Several of the towers built under the Mayor's Proclamations have now restricted her mobility and her access to City services and functions: the new tower on the Convention Center denies her access to City Hall; she used to swim and work out at the Fort Marcy Complex but the new tower there denies her access; she is used to frequenting the Lensic Performing Arts Center for cultural and civic events at least once a month, but the new antennas across the street on the Sandoval Street Parking Garage have now made that impossible.

27. Defendant **City of Santa Fe** is a home rule municipality organized and incorporated pursuant to the laws of the State of New Mexico. Under these laws, the City is a zoning authority that controls all land uses within its borders and is obligated to protect the public health, safety and welfare. As a result of both its exercise of control over land use and its failure to exercise control over land use, the City has caused injurious levels of RF radiation to blanket its population and has failed in its duty to protect the public health, safety and welfare as well as in its duty to protect the rights of its citizens under the New Mexico and United States Constitutions.

28. Defendant **Hector Balderas** is the Attorney General of the State of New Mexico and is responsible for enforcing its laws. Because the Wireless Consumer Advanced Infrastructure Investment Act, NMSA 1978 § 63-9I (2018) ("WCAIIA") contains no enforcement provisions, failure of the City to comply with its provisions could only be remedied by a mandamus action or other enforcement action by the Attorney General. WCAIIA contravenes the obligation of the State of New Mexico under its Constitution to operate for the public good, to control pollution and to protect the public health, safety and general welfare. As a result of WCAIIA, the State is causing injurious levels of RF radiation to blanket New Mexico and its beautiful environment, and is failing in its duty to protect the public health, safety and welfare as well as in its duty to protect the rights of its citizens under the New Mexico and United States Constitutions.

29. Defendant **United States of America** is the sovereign trustee of natural national resources, including forests and wildlife. Under its Constitution, the United States regulates interstate commerce. Under its Constitution, the United States is obligated to promote the public welfare. As a result of both its exercise of control over interstate commerce and its failure to exercise control over interstate commerce, the United States has caused injurious levels of RF radiation to blanket the nation, has substantially impaired its natural resources, has failed in its duty to promote the public welfare, and has deprived Plaintiffs of fundamental constitutional rights. Plaintiffs may not be deprived of their life, liberty and property without due process of law. U.S. Constitution, Amendment Five.

JURISDICTION AND VENUE

30. This action is brought pursuant to the United States Constitution. It is authorized by Article III, Section 2, which extends the federal judicial power to all cases arising in equity under the Constitution and to controversies to which the United States is a party. A controversy exists between Plaintiffs and Defendants because Defendants have placed Plaintiffs in a dangerous situation, continue to infringe upon Plaintiffs' constitutional rights, and have abrogated their duty of care to ensure Plaintiffs' reasonable safety, among other violations of law. Plaintiffs have no adequate remedy at law to redress the harms herein.

31. This Court has jurisdiction under 28 U.S.C., § 1331 (federal question); 28 U.S.C. §§ 2201 and 2202 (the Declaratory Judgment Act); 28 U.S.C. § 1343(a)(3), giving the federal district courts original jurisdiction of any civil action to redress the deprivation, under color of any State law, statute, ordinance, regulation, custom or usage, of any right, privilege or immunity secured by the Constitution of the United States; and 28 U.S.C. § 1367 (supplemental jurisdiction). Plaintiffs' federal claims raise questions under the Telecommunications Act of 1996, 47 U.S.C. § 151 *et seq.* and Amendments One, Five, and Fourteen of the United States Constitution.

32. Venue is proper in this judicial district by virtue of 28 U.S.C. § 1391(b). All Plaintiffs reside in this judicial district, all Defendants have offices in this judicial district, and the events, omissions and harms giving rise to this action arise in substantial part in this judicial district.

STATEMENT OF FACTS

33. Wireless telecommunications facilities emit RF radiation, which penetrates into houses and endangers life and safety. RF radiation causes acute effects including headaches, dizziness, nausea, eye pain, insomnia, tachycardia, hypertension, irregular heartbeat, anxiety, depression, memory loss, nosebleeds, digestive problems, and ringing in the ears. RF radiation causes chronic illness including diabetes, cancer, and heart disease. The acute effects have driven an estimated 20 million people from their homes worldwide, based on government surveys and data from 500 organizations with whom Plaintiffs here correspond, and have created a large class of environmental refugees.

34. When the City drafted its first Telecommunications Facilities Ordinance in 1998, it included protections from the dangers of cell towers. It required that the City:

a. "Ameliorate any impacts upon residents of the city of Santa Fe and the municipality of expanding needs for telecommunications facilities";

b. "Minimize any adverse impacts of towers and antennas on residential areas and land uses";

c. "Encourage the location of towers in nonresidential areas";

d. "Minimize the total number of towers throughout the community";

e. "Gather information and provide remedies for the public health and safety impacts of communication towers";

f. "Avoid potential damage to adjacent properties from towers;"

Santa Fe City Ord. No. 1998-16, § 15(F), (H), (I), (J), (N), and (O).

35. The 1998 ordinance applied to "[a]ll towers or antennas located within the city limits whether upon private or public lands," Santa Fe City Ord. No. 1998-16, § 17. Towers and antennas in residential or historic districts required a Special Exception and were not a permitted use in any zoning district. There were application requirements, notice requirements, noise requirements, height limitations, and setback requirements. A new tower had to be a minimum distance of one thousand feet from any existing tower.

36. The ordinance provided that antennas and towers in the public rights-of-way had to comply with all of the same land use requirements as antennas and towers on private land, except that there was an additional requirement that the applicant had to obtain a lease from the City, and that in deciding whether to grant or deny the lease the City had to consider the "effects... on public health, safety and welfare," Ord. No. 1998-16, § 41(E).

37. The Santa Fe Task Force on Microwave Antennas, formed in February 2000, worked with the City for several years to minimize the impact of cell towers on public health. The Santa Fe Alliance for Public Health and Safety, a Plaintiff in this case, formed in 2005; its members have participated in every approval process and testified at every public hearing for every proposed ordinance and every telecommunications facility erected in Santa Fe from 2005 until the present day. Arthur Firstenberg, a Plaintiff in this case, was appointed by the Mayor in 2007 to a

steering committee to advise the Information Technology and Telecommunications Department of the City of Santa Fe on the health effects of wireless Internet.

38. Despite knowing that RF radiation is hazardous, and despite additional knowledge about these hazards being supplied to the City by a succession of citizens' groups and their experts, the City began in 2010 to deliberately dismantle the protections of the public health, safety, and welfare that it had encoded in the 1998 ordinance and to systematically eliminate every reference to the health effects of RF radiation from the City Code. It revised Chapter 27 of the Santa Fe City Code ("Chapter 27") to exempt telecommunications facilities in the public rights-of-way from the land use regulations of Santa Fe City Code, Chapter 14 ("Chapter 14"). It revised Chapter 14 to eliminate the requirements that the City gather information and provide remedies for the health and safety impacts of communication towers. The requirement to minimize "*any* adverse impacts of antennas and towers" was changed to "*land use* impacts of antennas and towers." Antennas, which were previously not a permitted use in *any* zoning district, were now made a permitted use in *all* zoning districts. Leases were replaced with franchises, and franchisees no longer had to get approval of antennas on a site-by-site basis.

39. Chapter 27, as revised in 2010, still required that applicants for wireless telecommunications facilities in the public rights-of-way provide specific information about their RF emissions; required that any subsequent increase in RF emissions be subject to approval by the City; required applicants to certify

compliance with the FCC's RF exposure guidelines; and authorized the City to retain an independent radio frequency engineer to verify such compliance. Exhibit C-2, attached hereto, §§ 27-2.13(F)(1)(c) and 27-2.13(O) (2010). However, in a pair of ordinances, adopted November 9, 2016 and August 30, 2017, the City repealed every one of those requirements, along with almost all notice, hearing, and application requirements, for telecommunications facilities in the public rights-of-way.

- New wireless facilities no longer require submittal of an application at all if they conform to existing design standards
- New facilities no longer require review by the Planning commission
- Facilities in historic districts no longer require review by the Historic Districts Review Board
- Information regarding radio frequency emission is no longer required
- Proof, or even self-certification, of compliance with the FCC's radio-frequency exposure guidelines is no longer required
- Public notice is no longer required
- Notice to neighbors of planned facilities is no longer required

Santa Fe City Ordinances No. 2016-42 and 2017-18.

40. The only requirement left for putting telecommunications facilities on Santa Fe's streets and sidewalks is the possession of a franchise. Franchises will be awarded to all telecommunications providers on a non-discriminatory basis, and

franchisees will be permitted to erect unlimited numbers of antennas and towers wherever they please in the public rights-of-way with no public hearings, no public comment, no public notice, no notice to neighbors, no setback requirements, no certification of compliance with the FCC's safety regulations, and without even submitting an application to the City. All they will have to do under the amended City Code is tell the City that their facilities will comply with design guidelines that the City will have adopted. Santa Fe City Code § 27-2.19(C)(1)(a) (2018). But even this minimal requirement is no longer being enforced because under the new State law, WCAIIA, such facilities are exempt from *all* land use requirements. The result is a complete free-for-all. City residents will have no warning before cell tower transmitters suddenly appear in front of their homes and businesses or outside their children's bedroom windows and school classrooms, and they will have no recourse.

41. At the present time, almost all wireless telecommunications facilities in Santa Fe are on private property or City-owned property, and not in the public rights-of-way where people walk. ***None are located in front of homes and businesses.*** Because of previous litigation and the invalidation of successive versions of Chapter 27 by successive court decisions, no applications for telecommunications facilities in the public rights-of-way were processed by the City until 2018.

PRIOR LITIGATION

42. On December 8, 2016, Plaintiffs here, Alliance and Firstenberg, filed a Complaint for Declaratory Relief in state court, Case No. D-101-CV-2016-02801 in the First Judicial District of New Mexico, asking the court to issue an order declaring Chapter 27 as amended by Ordinance No. 2016-42 void and unenforceable and asking for injunctive relief. The Complaint was dismissed by the court as not ripe for review because no franchises had yet been awarded.

43. On November 21, 2017, the threat to Plaintiffs' lives was made more immediate when Mayor Javier Gonzales signed the first of three Proclamation declaring a "State of Emergency" due to bad cell phone service. The Proclamations suspended the Land Development Code, including public notice requirements, with respect to telecommunications facilities on City-owned property. Seven cell towers have been built under the Proclamations—one at Fire Station 4 at 1130 Arroyo Chamiso Road; one at the City's Water Division at 801 West San Mateo Road in the driveway between the Water Division and the Chocolate Maven; one at Fort Marcy Park next to the Fort Marcy Complex recreation center; one in the parking lot in front of the Genoveva Chavez Community Center, 3221 Rodeo Road; one on the roof of the Sandoval Street Parking Garage at 220 West San Francisco Street: one at the City's water treatment plant at 1780 Upper Canyon Road; and one at 201 West Marcy Street on the roof of the elevator structure of the Santa Fe Community Convention Center's parking garage, next to City Hall. One of the antennas on top

of the elevator structure is aimed directly at Council Chambers, endangering the health of everyone who wants to participate in City government.

44. On January 11, 2018, Plaintiffs filed a complaint in this Federal District Court, Case No. 1:18-cv-00032, asking the Court to intervene to protect their homes and properties and to protect the public health, safety, and welfare that was immediately endangered.

45. On April 6, 2018, the Court dismissed the complaint without prejudice for lack of jurisdiction. The Court ruled that Plaintiffs had not alleged sufficient facts to support standing.

46. On May 7, 2018, Plaintiffs filed an amended complaint and a Rule 59 motion asking the Court to reconsider and reopen its judgment of April 6, 2018, having added additional allegations and greater detail to remedy the deficiencies pointed out by the Court.

47. On May 9, 2018, the factual and legal situation changed. The City awarded franchises to five telecommunications companies under the new City ordinances. At the public hearing, City officials discussed the implications of the new State law, the Wireless Consumer Advanced Infrastructure Investment Act, NMSA 1978 § 63-9I ("WCAIIA"), which was signed on March 2, 2018 and was due to go into effect on September 1, 2018. Large portions of the City's new ordinances, they said, were being preempted. At the same time, a number of bills were being introduced into Congress at the Federal level, whose purpose was to prohibit States

and municipalities nationwide from regulating wireless telecommunications facilities in the public rights-of-way at all.

48. On May 23, 2018, since the Court had dismissed their complaint without prejudice, and because either the State of New Mexico *or* its Attorney General was now a necessary party, Plaintiffs withdrew their Rule 59 motion and prepared to draft this fresh complaint, incorporating the new set of facts and laws and adding both the New Mexico Attorney General and the United States as defendants.

49. The installation of 5G throughout Santa Fe is imminent. Cyber Mesa, one of the new franchisees, intends to have 5G operating at the four corners of the Santa Fe Plaza by December 31, 2018; Mobilitie, another of the new franchisees and contractor for Sprint, is preparing to install the first four of hundreds of lamppost installations on the sidewalks of Santa Fe as this complaint is being filed; and the City is right now processing additional applications for franchises from additional telecommunications providers.

50. Plaintiffs file this new complaint today against the City of Santa Fe, the New Mexico Attorney General, and the United States of America. Since both the City and the State have now passed laws removing all public protection, all public process, and all notice requirements for injurious facilities in the public rights-of-way, both the City and the State or its Attorney General are necessary parties defendant. In addition, Section 704 of the Telecommunications Act of 1996, 47 U.S.C. § 332(c)(7)(B)(iv) and (v) prohibits states and municipalities from regulating

telecommunications facilities on the basis of environment, which has been interpreted as meaning health. Injured parties, such as Plaintiffs here, have been foreclosed from filing state tort actions for injury by such facilities, and no substitute federal remedy has been provided. Moreover, several bills have been introduced into Congress that would deprive states and local governments nationwide of the power to apply land use regulations to wireless facilities in the public rights way at all, and the FCC has adopted regulations exempting wireless facilities in the public rights of way nationwide from the National Environmental Policy Act and the National Historic Preservation Act.

51. Together, the new City Ordinances (No. 2016-42 and No. 2017-18), the new State Act (WCAIIA), and Section 704 remove all public protection from injurious facilities in the public rights-of-way and deprive injured parties of any remedy for their injuries. The new FCC regulations compound this denial of constitutional rights, and the pending Congressional bills would compound it even more. Plaintiffs are such injured parties. Plaintiffs ask the Court to issue an emergency injunction and restraining order preventing the construction of an entirely new generation of radiating facilities on the sidewalks throughout Santa Fe, directly in front of homes and businesses, while this case goes to trial. Plaintiffs will prove, through the testimony of experts in various fields of medicine and science, that these facilities pose an immediate threat to the health, wellbeing and future of all Santa Fe residents.

52. Attached hereto for the Court's convenience are Chapter 27 as adopted in 1998 (Exhibit C-1); Chapter 27 as revised in 2010 (Exhibit C-2); City Ordinance No. 2016-42 (Exhibit C-3); City Ordinance No. 2017-18 (Exhibit C-4); the Mayor's first proclamation of emergency (Exhibit C-5); the Mayor's second proclamation of emergency (Exhibit C-6); the Mayor's third proclamation of emergency (Exhibit C-7); The Wireless Consumer Advanced Infrastructure Investment Act (Exhibit C-8); and 47 U.S.C. § 332(c)(7)(B)(iv) and (v) (Exhibit C-9).

LEGAL CLAIMS

53. The City, as a zoning authority, has the responsibility to regulate telecommunications facilities for the public good. In fulfilling this responsibility, the City may not violate the fundamental Constitutional rights of its citizens. Any State law or federal law that requires the City to violate the Constitution, is itself unconstitutional, and therefore is not a bar to any of Plaintiffs' claims against the City.

Due Process

FIRST CAUSE OF ACTION
(U.S. Constitution, Amendment Fourteen, and New Mexico Constitution, Article II, Section 18)

CHAPTER 27 AS AMENDED, AND WCAIIA, VIOLATE PROCEDURAL AND SUBSTANTIVE DUE PROCESS

54. All previous paragraphs are incorporated herein by reference.

55. Under Chapter 27 as amended by Ordinances 2016-42 and 2017-18, and also under WCAIIA, the construction of wireless telecommunications facilities on private property in all zoning districts is subject to at least notice and comment prior to construction, and an appeals process afterwards, but the construction of

most telecommunications facilities in the public rights-of-way in the same districts are not subject to notice, comment, or an appeals process. Notice and an opportunity to be heard are the minimum requirements for Procedural Due Process.

56. Chapter 27 as amended, and WCAIIA, also violate Substantive Due Process. The U.S. Constitution and the New Mexico Constitution guarantee the fundamental right of citizens to be free from government actions that harm life, liberty, and property. These inherent and inalienable rights reflect a basic societal contract. The rights to life, liberty, and property have evolved and continue to evolve as technological advances pose new threats to these fundamental rights.

57. In enacting Ordinances Nos. 2016-42 and 2017-18, and in enacting WCAIIA, the City has determined to authorize, and the State has determined to require, the unrestrained and unprotected siting of wireless telecommunications facilities in front of thousands of residences and businesses despite knowing that the results of their acts endanger Plaintiffs' lives, liberties, and properties. Plaintiffs will no longer be safe at home or work or while traveling on the public streets.

58. For at least the past twenty years, the City has known about the danger to Plaintiffs' health and safety created by RF radiation, yet has repealed all protections from that danger. For at least the past ten years, the State has known about the danger. These deliberate actions by the City and State have resulted in injurious levels of RF radiation, which deprive Plaintiffs of their fundamental rights to life, liberty and property, their capacity to earn a living, safely raise families, and

provide for their basic human needs. The City and State have each acted with deliberate indifference to the known danger. Given that the dangers are so substantial, the City's and State's deliberate indifference shocks the conscience.

59. The actions of the City and the State, separately and jointly, have deprived Plaintiffs of the reasonable expectation of a home without radiation. These acts of the City and State cannot and do not operate to secure a more compelling state interest than Plaintiffs' fundamental, constitutionally guaranteed rights to life, liberty, and property.

SECOND CAUSE OF ACTION
(U.S. Constitution, Amendment Fourteen, and New Mexico Constitution, Article II, Section 18)

THE MAYOR'S PROCLAMATIONS OF EMERGENCY VIOLATED DUE PROCESS

60. All previous paragraphs are incorporated herein by reference.

61. Under the Mayor's Proclamations of Emergency, the City suspended all land use regulations for cell towers on City-owned land for six months, regardless of height, aesthetics, zoning district, proximity to homes or businesses, or anything else, and regardless of whether they conformed to design standards or not. Under the Proclamations of Emergency, the City not only suspended land use regulations but signed a contract with Verizon Wireless for the erection of wireless telecommunications facilities on City-owned land without notice to anyone or an opportunity for anyone to be heard, as required by City zoning regulations and the U.S. and New Mexico Constitutions.

3 **THIRD CAUSE OF ACTION**
(U.S. Constitution, Amendments Five and Fourteen) VIOLATION

CHAPTER 27 AS AMENDED AND WCAIIA ARE AN UNCONSTITUTIONAL TAKING

62. All previous paragraphs are incorporated herein by reference.

63. In enacting Ordinances Nos. 2016-42 and 2017-18, and in enacting WCAIIA, the City has determined to award, and the State has determine to require, franchises authorizing the placement of wireless telecommunications facilities anywhere on the streets and sidewalks of Santa Fe without regard to their proximity to homes and businesses.

64. The placement of wireless telecommunications facilities on the sidewalk directly in front of Plaintiffs' homes and businesses will render their homes and businesses uninhabitable and unusable.

65. These actions by the City and State, separately and jointly, constitute a taking without just compensation, in violation of the Fifth and Fourteenth Amendments.

4 **FOURTH CAUSE OF ACTION**
(U.S. Constitution, Amendment One)

CHAPTER 27 AS AMENDED, WCAIIA, AND SECTION 704 VIOLATE THE RIGHT TO PETITION

66. All previous paragraphs are incorporated herein by reference.

67. Section 27 as amended and WCAIIA deprive people threatened with injury by RF radiation from wireless telecommunications facilities of the right to

protest such facilities, receive notice before such facilities are erected, or exercise their due process rights before such facilities are erected.

68. Section 704 deprives people of the right to testify about such injury, and deprives their local governments of the power to protect them from the injurious effects of RF radiation. Section 704 deprives people injured, sickened, and/or killed by such radiation of access to state courts for redress for their injuries, and provides them no substitute federal remedy.

69. Separately and collectively, Section 27 as amended, WCAIIA, and Section 704 violate the First Amendment's guarantee of the Right to Petition the Government for Redress of Grievances.

FIFTH CAUSE OF ACTION
(NMSA 1978 § 3-21-1(A) (2007))

THE CITY HAS ABDICATED ITS RESPONSIBILITIES AS A ZONING AUTHORITY

70. All previous paragraphs are incorporated herein by reference.

71. Cities have traditionally regulated utilities that occupy their rights-of-way in two ways: either by site-specific leases, by which the city retains control over the location of proposed facilities, or by franchises, by which cities give up that control.

72. In amending Chapter 27 by Ordinances 2016-42 and 2017-18, the City of Santa Fe not only has chosen franchises over leases, but has effectively eliminated all other land use regulations, such that an application for a franchise is the only requirement before a telecommunications company can begin erecting unlimited numbers of telecommunications facilities in the City's public rights-of-

way. The City has enacted an all-or-nothing ordinance. If the City grants a franchise, the applicant can erect unlimited numbers of antennas and towers without further interference. If the City denies a franchise, the applicant cannot operate in the City.

73. Under the federal Telecommunications Act ("TCA"), 47 U.S.C. §§ 253 and 332(c)(7)(B)(i)(I) and (II), a municipality's regulations may not (a) have the effect of denying telecommunications service, and (b) may not discriminate between providers of functionally equivalent services. Therefore, the way Chapter 27 is now structured, the denial of any franchise to any telecommunications company would violate federal law. The City has given up all control over its streets and sidewalks.

74. State law provides that the City "is a zoning authority" for the purpose of "promoting health, safety, morals or the general welfare." NMSA 1978, § 3-21-1(A) (2007). Furthermore, the City Code states as follows: "The purposes of Chapter 14 are to: (A) implement the purposes of the general plan, including guiding and accomplishing a coordinated, adjusted and harmonious development of Santa Fe that will best promote health, safety, order, convenience, prosperity and the general welfare . . . ." Santa Fe City Code § 14-1.3(A) (2011). In addition, the City Code provides that "[t]he provisions of Chapter 14 apply to all land, buildings and other structures, and their uses, located within the corporate limits of Santa Fe, including land owned by local, county, state or federal agencies to the extent allowed by law." Santa Fe City Code § 14-1.6 (2011).

75. The public rights of way in Santa Fe are enjoyed by all residents, and nearly every home or business has frontage on one or more public rights of way. The evisceration of land use regulations and zoning regarding public rights of way renders meaningless laws intended to protect the public health and safety.

SIXTH CAUSE OF ACTION
(NMSA 1978, Section 3-21-1(B)(2) (2007))

CHAPTER 27 AS AMENDED PROVIDES FOR NON-UNIFORM ZONING REGULATIONS

76. All previous paragraphs are incorporated herein by reference.

77. State law provides that the City as a zoning authority may "regulate or restrict the erection, construction, reconstruction, alteration, repair or use of buildings, structures or land in each district. *All such regulations shall be uniform for each class or kind of buildings within each district....*" NMSA 1978, Section 3-21-1(B)(2) (2007). (Emphasis added).

78. The purpose of uniform zoning laws is to protect private property and maintain order. Therefore "industries and structures likely to create nuisances" are excluded from residential districts. *Village of Euclid v. Amber Realty Co.*, 272 U.S. 365, 388 (1926). A person who purchases a home in a residential district has the right to rely on a single, uniform set of zoning regulations that apply throughout that district, not just on three sides of his or her property but on *all* sides. Setback requirements, for example, that were enacted for reasons of health and safety would become meaningless if they applied only on three sides of a person's property and did not apply on the side abutting the public right-of-way.

79. Under Chapter 27 as amended by Ordinances Nos. 2016-42 and 2017-18 and under WCAIIA, telecommunications facilities in the public rights-of-way are exempt from the zoning regulations in SFCC 1987, Section 14-6.2(E) (2011) that apply to all other telecommunications facilities, as well as from the zoning regulations in SFCC 1987, Section 14-5.2 that apply to all other buildings and structures in historic districts. Chapter 27 as amended therefore provides two-tier zoning regulations for every district in Santa Fe: one set of regulations that apply to structures on private property, and a second, more relaxed set of regulations that apply to structures in the public rights-of-way.

80. Under Chapter 27 as amended, a tower or antenna on private land abutting one's property requires a site-specific application containing all the elements required by Section 14-6.2(E) including: notification of all neighbors within 200 feet of the antenna or tower; compliance with setback requirements from property lines; for new towers in a residential district, an early neighborhood notification meeting and a public hearing before the planning commission; and for towers and antennas in a historic district, a public hearing before the historic districts review board. A tower or antenna in the public right-of-way in the same district abutting the same property requires neither a separate application, notification of neighbors, setback requirements from property lines, early neighborhood notification meeting, nor public hearing.

81. Chapter 27 as amended violates NMSA 1978, Section 3-21-1(B)(2) (2007).

SEVENTH CAUSE OF ACTION
(N.M. Const., Article II, Section 4)

82. All previous paragraphs are incorporated herein by reference.

83. Article II, Section 4 of the New Mexico Constitution states: "All persons are born equally free, and have certain natural, inherent and inalienable rights, among which are the rights of enjoying and defending life and liberty, of acquiring, possessing and protecting property, and of seeking and obtaining safety and happiness."

THE RIGHT TO PROTECTION OF PROPERTY

84. Ordinances Nos. 2016-42 and 2017-18 and WCAIIA deprive property owners of prior notice, an opportunity to comment and/or testify at a public hearing, a minimum setback distance from their property lines, and other protections from dangerous facilities being built on the sidewalk in front of their house.

85. Chapter 27 as amended by Ordinances Nos. 2016-42 and 2017-18 and WCAIIA, separately and jointly, violate the inalienable right to protect property possessed by all persons under Article II, Section 4 of the New Mexico Constitution.

THE RIGHT TO SAFETY AND THE RIGHT TO DEFEND LIFE

86. Chapter 27 as amended and WCAIIA repeal all previous restraints on the pollution of private property with types of radiation proven harmful to life.

87. Chapter 27 as amended by Ordinances Nos. 2016-42 and 2017-18 and WCAIIA, separately and jointly, violate the inalienable rights to safety and to defend life possessed by all persons under Article II, Section 4 of the New Mexico Constitution.

EIGHTH CAUSE OF ACTION
(N.M. Const., Art. XX, § 21)

CHAPTER 27 AS AMENDED AND WCAIIA VIOLATE POLLUTION CONTROL REQUIREMENTS

88. All previous paragraphs are incorporated herein by reference.

89. Article XX, section 21 of the New Mexico Constitution is titled "Pollution control" and states: "The protection of the state's beautiful and healthful environment is hereby declared to be of fundamental importance to the public interest, health, safety and the general welfare. The legislature shall provide for control of pollution and control of despoilment of the air, water and other natural resources of this state, consistent with the use and development of these resources for the maximum benefit of the people."

90. Ordinances No. 2016-42 and 2017-18 and WCAIIA repeal all previous restraints on the pollution of the environment with types of radiation proven to be harmful to life and safety. It even repeals self-certification of compliance with the non-mandatory safety guidelines set by the FCC for human exposure to RF radiation.

91. Chapter 27 as amended and WCAIIA, separately and jointly, abdicate the responsibility of government under Article XX, section 21 of the New Mexico Constitution to control pollution.

9

NINTH CAUSE OF ACTION
(NMSA 1978, §§ 3-21-1(A) and 3-21-5(A)(3) (1970)),
SFCC §§ 14-1.3 and 14-4.1(A)(2))

CHAPTER 27 AS AMENDED AND WCAIIA DAMAGE HEALTH, SAFETY, AND THE GENERAL WELFARE

92. All previous paragraphs are incorporated herein by reference.

93. The protection of health, safety, and welfare is so fundamental to the function of government that this function is encoded in numerous provisions of law at every government level.

94. Section 3-21-1(A) of the New Mexico Statutes states: "For the purpose of promoting health, safety, morals or the general welfare, a county or municipality is a zoning authority...."

95. Section 3-21-5(A)(3) of the New Mexico Statutes states: "The regulations and restrictions of the county or municipal zoning authority are to be in accordance with a comprehensive plan and be designed to... (3) promote health and the general welfare."

96. Section 14-1.3 of the Santa Fe City Code states that "[T]he purposes of chapter 14 are to: (A) implement the purposes of the general plan, including guiding and accomplishing a coordinated, adjusted and harmonious development of Santa Fe that will best promote health, safety, order, convenience, prosperity and the general welfare...."

97. Section 14-4.1(A)(2) of the Code states that the "regulations for the development and use of structures and land" in the City's zoning districts "are made

in accordance with the general plan and are designed to ... promote health and the general welfare..."

98. Chapter 27 as amended and WCAIIA, separately and jointly, damage health, safety, and the general welfare, in violation of the fundamental responsibilities of government and numerous State and City laws.

10

TENTH CAUSE OF ACTION
(NMSA 1978 § 3-21-6(B) (1970))

ORDINANCES 2016-42 AND 2017-18
ADOPTED ZONING CHANGES WITHOUT NOTICE TO NEIGHBORS

99. All previous paragraphs are incorporated herein by reference.

100. Section 3-21-6(B) of the New Mexico Statutes requires that "[w]henever a change in zoning is proposed for an area of more than one block, notice of the public hearing shall be mailed by first class mail to the owners, as shown by the records of the county treasurer, of lots or [of] land within the area proposed to be changed by a zoning regulation and within one hundred feet, excluding public right-of-way, of the area proposed to be changed by zoning regulation."

101. Ordinances 2016-42 and 2017-18 effected changes in zoning for public rights-of-way without any notice to owners of lots of land within one hundred feet of such rights of way, in violation of NMSA 1978, § 3-21-6(B) (1970).

ELEVENTH CAUSE OF ACTION
(Santa Fe City Charter, § 2.02)

CHAPTER 27 AS AMENDED VIOLATES THE HUMAN AND CIVIL RIGHTS OF THE RESIDENTS OF SANTA FE

102. All previous paragraphs are incorporated herein by reference.

103. Chapter 27 as amended deprives the residents of Santa Fe of the ability to protect themselves against types of radiation proven to be harmful to life and safety, contrary to Section 2.02 of the Santa Fe City Charter, which states that "[t]he human and civil rights of the residents of Santa Fe ***are inviolate*** and ***shall not be diminished or otherwise infringed.***" (Emphasis added).

104. Many residents of Santa Fe, including Plaintiffs and their members, are refugees from RF radiation elsewhere. Their ability to remain healthy, earn a living, raise their families, provide for their needs, and continue to live in Santa Fe is dependent on non-exposure to RF radiation.

105. Chapter 27 as amended deprives Plaintiffs of their human and civil rights in violation of section 2.02 of the Santa Fe City Charter.

TWELFTH CAUSE OF ACTION
(Santa Fe City Charter, § 2.03)

CHAPTER 27 AS AMENDED DAMAGES THE CITY'S ENVIRONMENT

106. All previous paragraphs are incorporated herein by reference.

107. Section 2.03 of the Santa Fe City Charter, titled "Environmental protection," requires that "the governing body shall protect, preserve and enhance

the city's natural endowments... and promote and maintain an aesthetic and humane urban environment."

108. Chapter 27 as amended damages the City's environment in violation of section 2.03 of the Santa Fe City Charter.

THIRTEENTH CAUSE OF ACTION
(NMSA 1978, § 30-8-1 (1963) and SFCC §§ 10-9.3 and 23-1.2(B)(3))

CHAPTER 27 AS AMENDED PROVIDES FOR THE CREATION OF PUBLIC NUISANCES

109. All previous paragraphs are incorporated herein by reference.

110. The amendments to Chapter 27 were adopted without lawful authority.

111. Under NMSA 1978, § 30-8-1, a public nuisance is a misdemeanor that consists of "knowingly creating, performing or maintaining anything affecting any number of citizens without lawful authority which is either: A. injurious to public health, safety, morals or welfare; or B. interferes with the exercise and enjoyment of public rights, including the right to use public property."

112. Under Section 10-9.3(E) of the Santa Fe City Code, a public nuisance as "knowingly creating, performing or maintaining anything affecting any number of citizens without lawful authority which is either (1) Injurious to public health, safety, morals or welfare; or (2) Interferes with the exercise and enjoyment of public rights, including the right to use public or private property."

113. Under Section 23-1.2(B)(3) of the Santa Fe City Code, a public nuisance is "any activity, function, status, or the result of such activity, function, or

status whether participated in by one person or several, whether caused by machines, persons, or other devices, which affects the health, safety, and welfare of an individual, a neighborhood or community and degrades the quality of life for such individual, neighborhood or community," without regard for whether the nuisance was created by lawful authority.

114. Section 10-9.2 of the Santa Fe City Code requires "[t]he abatement of public nuisances for the protection of public health, safety, and welfare...."

115. Chapter 27 as amended provides for the creation of public nuisances, not their abatement, in violation of State and City law.

FOURTEENTH CAUSE OF ACTION
(Ultra Vires)

MAYOR'S PROCLAMATIONS

116. All previous paragraphs are incorporated herein by reference.

117. The Mayor's Proclamations fall beyond the scope of his authority under the City Code, the City Charter, and State law.

118. The Mayor may proclaim a state of emergency pursuant to Section 20-1 of the City Code, the Riot Control Ordinance, if he "determines that a public disorder, riot, disaster or emergency exists in the municipality." Once an emergency is declared, the Mayor is authorized to "prohibit . . . activities the mayor reasonably believes should be prohibited to help maintain life, property or the public peace." Acts that may be so prohibited include being on the street after curfew, *see* § 20-1.2(A); any designated number of people from assembling or gathering, *see* § 20-1.2(B); the manufacture, use, or transportation of explosives, *see*

§ 20-1.2(C); the transportation, possession or use of combustible materials except for normal home or commercial use, *see* § 20-1.2(D); the possession of firearms in public, *see* § 20.1-2(E); the sale of alcoholic beverages, *see* § 20.1-2(F); or the use of designated streets of highways. *See* § 20.1-2(G). This authority does not include ordering the installation of wireless telecommunications facilities in public rights of way while land use regulations are suspended. The fire chief and two deputy police chiefs stated to the media that there is no emergency and no interruption of police of fire service due to insufficient telecommunications facilities. Section 20-1.4 of the Santa Fe City Code provides that a state of emergency "terminates automatically at noon on the third day after it becomes effective unless sooner terminated by proclamation of the mayor." (The Mayor is not authorized to declare that any state of emergency will last for six months.)

119. Section 5.01 of the City Charter and Section 2-1.3 of the City Code command the Mayor to "cause the ordinances and regulations of the city to be faithfully and constantly obeyed," not to unilaterally suspend them. They allow the Mayor to "perform other duties compatible with the nature of the office as the governing body may from time to time require," not as he unilaterally may decide. They give the Mayor "the power conferred on the sheriffs of counties to suppress disorders and keep the peace"; the sheriffs are not conferred with the authority to order cell towers to be built.

120. The Proclamations are null and void.

15

FIFTEENTH CAUSE OF ACTION
(Injunctive Relief)

CHAPTER 27 AND WCAIIA

121. All previous paragraphs are incorporated herein by reference.

122. The enforcement of Chapter 27 as amended and WCAIIA should be preliminarily and permanently enjoined because of violations of City, State, and Federal laws, charter, and constitutions.

123. Plaintiffs and their members include persons previously physically injured and/or deprived of their homes and businesses by RF radiation from wireless telecommunications facilities. Until now they have enjoyed protection from further injury because such facilities have not been permitted in the public rights-of-way close to homes and businesses. Plaintiffs have already been further injured by the seven towers erected under the unlawful mayoral proclamations, and are threatened with more serious injury by the imminent erection of such facilities on the streets and sidewalks of Santa Fe in front of or in close proximity to their homes and businesses pursuant to chapter 27 as amended and WCAIIA.

124. Absent injunctive relief, citizens will have close-range RF radiation coming into their homes and bodies without notice, resulting in irreparable harm that is not remediable by monetary damages.

SIXTEENTH CAUSE OF ACTION
(Injunctive relief)

MAYOR'S PROCLAMATIONS

125. All previous paragraphs are incorporated herein by reference.

126. Under the Mayor's Proclamations of Emergency, without any public process whatsoever and in total disregard of the Land Development Code, a contract was signed with Verizon Wireless, under which seven towers were erected on public property. The fact that the City subsequently conducted *pro forma* public proceedings on those seven towers does not legitimize a contract entered into illegally, nor legalize the seven towers erected without due process.

127. The contract with Verizon should be declared void, and operation of the seven towers built under that contract should be preliminarily and permanently enjoined.

SEVENTEENTH CAUSE OF ACTION

"ENVIRONMENT" DOES NOT MEAN "HEALTH" IN SECTION 704 OF THE TELECOMMUNICATIONS ACT OF 1996

128. All previous paragraphs are incorporated herein by reference.

129. Section 704 of the Telecommunications Act of 1996, 47 U.S.C. § 332(c)(7)(B)(iv) ("Section 704"), prohibits states from adopting stricter regulations than the FCC regarding "the environmental effects of RF radiation."

130. If Congress had meant health it would have said so plainly.

131. The question of whether "environment" means health in Section 704 has never been litigated. According to the common meaning of the words, as

defined in Merriam-Webster's dictionary, "environment" does not mean or include "health."[1] If environment is interpreted to mean health in Section 704, this raises serious questions as to the constitutionality of Section 704. Therefore courts should interpret "environment" *not* to mean "health" per Webster's dictionary so as to avoid the serious questions as to the constitutionality of Section 704.[2]

132. Section 704 is not a bar to any of Plaintiffs' Claims for Relief against the City because by plain language "environment" does not mean "health."

EIGHTEENTH CAUSE OF ACTION
(U.S. CONSTITUTION, AMENDMENT FIVE)

SECTION 704 OF THE TELECOMMUNICATIONS ACT OF 1996, 47 U.S.C. § 332(C)(7)(B)(IV) AND (V)

133. All previous paragraphs are incorporated herein by reference.

134. The FCC has no statutory authority over human health and its RF exposure guidelines are neither mandatory nor enforceable.

135. The FCC has stated repeatedly that its RF exposure guidelines are procedural only and serve only to determine whether an FCC licensee must file an Environmental Assessment or not. Non-mandatory regulations cannot have

[1] "**environment** 1a. The totality of the natural world, often excluding humans." *The American Heritage Dictionary*, Fifth Edition 596 (2011);
"**environmental** 1. Relating or associated with the environment. 2. Relating to or concerned with the impact of human activities on the natural world." *Id.* at p. 596.
"**health** 1. The overall condition of an organism at a given time." *Id.* at p. 810.

[2] Even though Plaintiffs' position is that the plain meaning of the word "environment"—which does not include "health"—is applicable to Section 704, this in no way is to be construed to mean that destroying the environment survives constitutional scrutiny. *See Juliana v. United States*, 217 F. Supp. 3d 1224, 1261 (D. Or. 2016):

> This action is of a different order than the typical environmental case. It alleges that defendants' actions and inactions—whether or not they violate any specific statutory duty—have so profoundly damaged our home planet that they threaten plaintiffs' fundamental constitutional rights to life and liberty.

preemptive effect. Yet, Section 704 gives these regulations preemptive authority, prohibiting States and local governments from adopting any regulations more stringent than those adopted by the FCC.

136. Section 704 prohibits States and local governments from providing any remedy for injury by RF radiation without providing a substitute federal remedy. This prohibition violates Substantive Due Process because it forecloses any and all remedies for injury by RF radiation.

137. Section 704 is not a bar to any of Plaintiffs' Claims for Relief against the City because Section 704 violates the Fifth Amendment.

NINETEENTH CAUSE OF ACTION
(U.S. Constitution, Amendment One – Freedom of Speech)

SECTION 704 OF THE TELECOMMUNICATIONS ACT OF 1996, 47 U.S.C. § 332(C)(7)(B)(IV) AND (V)

138. All previous paragraphs are incorporated herein by reference.

139. Section 704 prohibits States and local governments from regulating RF radiation *on the basis of* its environmental effects.

140. If the public gives voice to their concerns about RF radiation from a proposed telecommunications facility and their city council subsequently denies the application, Section 704 provides that the applicant can "commence an action in any court of competent jurisdiction." 47 U.S.C. § 332(c)(7)(B)(v). *See Cellular Telephone Company v. Town of Oyster Bay*, 166 F.3d 490, 495 (2nd Cir. 1999) ("A review of the record before us of the two hearings reveals that the bulk of the testimony addressed citizens' fears of adverse health effects from the cell sites...").

141. If a city councilor gives voice to his or her concerns about RF radiation, the telecommunications company can likewise sue the city in any court of competent jurisdiction. *See T-Mobile Northeast LLC v. Town of Ramapo*, 701 F.Supp.2d 446, 460 (S.D.N.Y. 2009):

> "[T]he Town has now admitted that one of the Planning Board's three stated reasons for denying T–Mobile's application was that the proposal raised health concerns... In Planning Board hearings on July 11, September 12, and October 17, 2006, town residents repeatedly spoke of their concern that T–Mobile's proposed facility would create a health hazard... The Court has no trouble concluding that the Town's decision was at least partly based on the environmental effects of the proposed tower's radio frequency emissions...

142. This prohibition is nothing more than a burden on the content of speech.

143. Section 704 is not a bar to any of Plaintiffs' Claims for Relief against the City because Section 704 violates the First Amendment right to Free Speech.

TWENTIETH CAUSE OF ACTION
(First Amendment – Right to Petition)

(SECTION 704 OF THE TELECOMMUNICATIONS ACT OF 1996, 47 U.S.C. § 332(C)(7)(B)(IV) AND (V))

144. All previous paragraphs are incorporated herein by reference.

145. Section 704 bars deprives persons threatened with injury of the right to be notified, of the right to participate in the decision, of the right to protest that decision, of the right to appeal that decision, and, when they are injured, of the right to tort relief or any remedy whatsoever for their injuries.

146. Section 704 is not a bar to any of Plaintiffs' Claims for Relief against the City because Section 704 violates the First Amendment Right to Petition the Government for Redress of Grievances.

21

TWENTY-FIRST CAUSE OF ACTION
(Injunctive Relief)

147. All previous paragraphs are incorporated herein by reference.

148. Pending before Congress right now are a number of bills, including Senate Bill 3759, designed to streamline the deployment of 5G by exempting wireless facilities in the public rights-of-way from land use regulations nationwide.

149. The passage of any such federal bill would work the same violations of Free Speech, Due Process and the Right to Petition as the amended Chapter 27, WCAIIA, and Section 704.

150. The United States should be enjoined from passing or enforcing any bill that declares that local land use regulations do not apply to all wireless telecommunications facilities located in the public rights-of-way.

22

TWENTY-SECOND CAUSE OF ACTION
(Injunctive Relief)

SECTION 704 OF THE TELECOMMUNICATIONS ACT OF 1996, 47 U.S.C. § 332(C)(7)(B)(IV) AND (V)

151. All previous paragraphs are incorporated herein by reference.

152. The operation of 47 U.S.C. § 332(c)(7)(B)(iv) which prohibits the consideration of environmental and health effects, should be temporarily and permanently enjoined.

153. The operation of 47 U.S.C. § 332(c)(7)(B)(v), which provides that any telecommunications company that is adversely affected by a local government's regulation of cell towers on the basis of health may be heard in any court of competent jurisdiction on an expedited basis—but that any citizen who is adversely affected by a local government's decision *not* to regulate cell towers on the basis of health may not be heard in any court whatsoever—should be temporarily and permanently enjoined.

REQUESTS FOR RELIEF

WHEREFORE, Plaintiffs respectfully request that this Court issue an Order and Judgment:

1. Declaring that Chapter 27 as amended by Ordinances Nos. 2016-42 and 2017-18 and WCAIIA, individually and jointly, violate the Procedural and Substantive Due Process requirements of the United States and New Mexico Constitutions.

2. Declaring that the Mayor's Proclamations of Emergency violated Procedural and Substantive Due Process.

3. Declaring that Chapter 27 as amended and WCAIIA, individually and jointly, are a taking without just compensation, in violation of the Fifth and Fourteenth Amendments.

4. Declaring that by requiring franchises instead of leases, the City has unlawfully abdicated its responsibilities as a zoning authority.

5. Declaring that Chapter 27 as amended provides non-uniform zoning regulations for every zoning district, in violation of state law.

6. Declaring that Chapter 27 as amended and WCAIIA, individually and jointly, violate the inalienable right to safety guaranteed in New Mexico's Constitution.

7. Declaring that Chapter 27 as amended and WCAIIA, individually and jointly, violate the inalienable right to protect property guaranteed in New Mexico's Constitution.

8. Declaring that Chapter 27 as amended and WCAIIA, individually and jointly, violate the inalienable right to defend life guaranteed in New Mexico's Constitution.

9. Declaring that Chapter 27 as amended and WCAIIA, individually and jointly, damage the health, safety, general welfare, and environment in violation of Article XX, section 21 of New Mexico's Constitution.

10. Declaring that Chapter 27 as amended and WCAIIA, individually and collectively, abdicate the responsibility of government under Article XX, section 21 of the New Mexico Constitution to control pollution.

11. Declaring that Chapter 27 as amended and WCAIIA, individually and collectively, damage health, safety and the general welfare in violation of NMSA 1978, section 3-21-1(A) and 3-21-5(A)(3), as well as sections 14-1.3 and 14-4.1(A)(2) of the Santa Fe City Code.

12. Declaring that Ordinances 2016-42 and 2017-18 unlawfully adopted zoning changes without notice to neighbors.

13. Declaring that Chapter 27 as amended violates the human and civil rights of the residents of Santa Fe in violation of the Santa Fe City Charter.

14. Declaring that Chapter 27 as amended damages the City's environment in violation of the Santa Fe City Charter.

15. Declaring that Chapter 27 provides for the creation of public nuisances in violation of City and State law.

16. Declaring that the Mayor's Proclamations, and the contract with Verizon Wireless entered into thereunder are null and void.

17. Declaring that "environment" does not mean "health" in Section 704 of the Telecommunications Act of 1996.

18. Declaring that Section 704 violates Due Process and Free Speech guaranteed by the United States Constitution.

19. Declaring that Chapter 27 as amended, WCAIIA, and Section 704, individually and collectively, violate the Right to Petition guaranteed by the First Amendment of the United States Constitution.

20. Preliminarily and permanently enjoining the City, its officers, agents, servants, employees, and attorneys and those persons in active concert or participation with it who receive actual notice of the Order by personal service or otherwise, from enforcing Chapter 27 SFCC 1987 as amended by Ordinances 2016-42 and 2017-18; prohibiting the granting of any additional franchises pending the

outcome of this lawsuit; and prohibiting the operation of any cell towers or antennas erected under existing franchises pending the outcome of this lawsuit.

21. Enjoining the operation of any and all cell towers erected pursuant to the Mayor's Proclamations and the contract with Verizon Wireless entered into thereunder pending the outcome of this lawsuit.

22. Preliminarily and permanently enjoining Attorney General Balderas from enforcing WCAIIA pending the outcome of this lawsuit.

23. Preliminarily and permanently enjoining the United States, its officers, agents, servants, employees, and attorneys and those persons in active concert or participation with it who receive actual notice of the Order by personal service or otherwise, from enforcing 47 U.S.C. §§ 332(c)(7)(B)(iv) and (v) pending the outcome of this lawsuit.

24. Preliminarily and permanently enjoining the United States, its officers, agents, servants, employees, and attorneys and those persons in active concert or participation with it who receive actual notice of the Order by personal service or otherwise, from adopting or enforcing any law that prohibits States or local governments, with respect to wireless telecommunications facilities, from enforcing land use regulations in the public rights-of-way that would otherwise apply pending the outcome of this lawsuit.

25. Awarding costs, and reasonable attorneys' fees as provided under law.

26. Awarding such other relief as this Court considers just and proper.

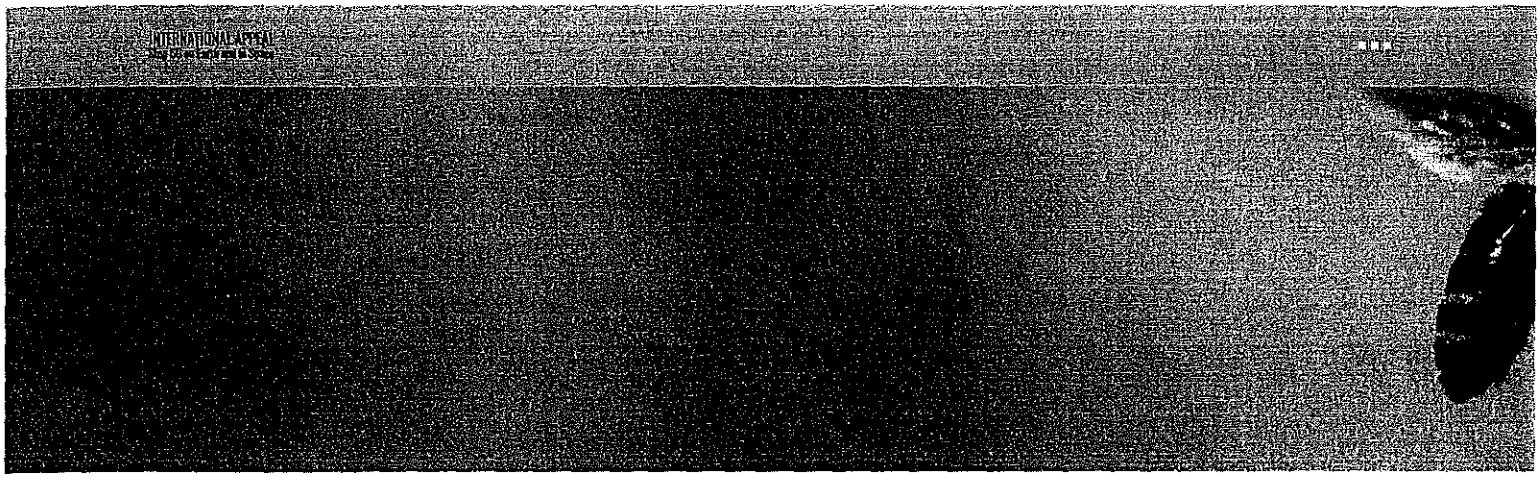
Respectfully submitted,

/s/ Kathleen M. Prlich

Kathleen M. Prlich, Esq.
Attorney for Monika Steinhoff and Santa Fe Alliance for Public Health and Safety
1704-B Llano St. #150
Santa Fe, NM 87505
(301) 455-7043

Arthur Firstenberg

Arthur Firstenberg, pro se
P.O. Box 6216
Santa Fe, NM 87502
(505) 471-0129



INTERNATIONAL APPEAL
Stop 5G on Earth and in Space

Read as PDF in:

中文

Deutsch

English

Français

Ελληνική

Русский

To the UN, WHO, EU, Council of Europe and governments of all nations

We the undersigned scientists, doctors, environmental organizations and citizens from (__) countries, urgently call for a halt to the deployment of the 5G (fifth generation) wireless network, including 5G from space satellites. 5G will massively increase exposure to radio frequency (RF) radiation on top of the 2G, 3G and 4G networks for telecommunications already in place. RF

radiation has been proven harmful for humans and the environment. The deployment of 5G constitutes an experiment on humanity and the environment that is defined as a crime under international law.

Executive summary

Telecommunications companies worldwide, with the support of governments, are poised within the next two years to roll out the fifth-generation wireless network (5G). This is set to deliver what is acknowledged to be unprecedented societal change on a global scale. We will have "smart" homes, "smart" businesses, "smart" highways, "smart" cities and self-driving cars. Virtually everything we own and buy, from refrigerators and washing machines to milk cartons, hairbrushes and infants' diapers, will contain antennas and microchips and will be connected wirelessly to the Internet. Every person on Earth will have instant access to super-high-speed, low-latency wireless communications from any point on the planet, even in rainforests, mid-ocean and the Antarctic.

What is not widely acknowledged is that this will also result in unprecedented environmental change on a global scale. The planned density of radio frequency transmitters is impossible to envisage. In addition to millions of new 5G base stations on Earth and 20,000 new satellites in space, 200 billion transmitting objects, according to estimates, will be part of the Internet of Things by 2020, and one trillion objects a few years later. Commercial 5G at lower frequencies and slower speeds was deployed in Qatar, Finland and Estonia in mid-2018. The rollout of 5G at extremely high (millimetre

wave) frequencies is planned to begin at the end of 2018.

Despite widespread denial, the evidence that radio frequency (RF) radiation is harmful to life is already overwhelming. The accumulated clinical evidence of sick and injured human beings, experimental evidence of damage to DNA, cells and organ systems in a wide variety of plants and animals, and epidemiological evidence that the major diseases of modern civilization—cancer, heart disease and diabetes—are in large part caused by electromagnetic pollution, forms a literature base of well over 10,000 peer-reviewed studies.

If the telecommunications industry's plans for 5G come to fruition, no person, no animal, no bird, no insect and no plant on Earth will be able to avoid exposure, 24 hours a day, 365 days a year, to levels of RF radiation that are tens to hundreds of times greater than what exists today, without any possibility of escape anywhere on the planet. These 5G plans threaten to provoke serious, irreversible effects on humans and permanent damage to all of the Earth's ecosystems.

Immediate measures must be taken to protect humanity and the environment, in accordance with ethical imperatives and international agreements.

5G will result in a massive increase in inescapable, involuntary exposure to wireless radiation

Ground-based 5G

In order to transmit the enormous amounts of data required for the Internet of Things (IoT), 5G technology, when fully deployed, will use millimetre waves, which are poorly transmitted through solid material. This will require every carrier to install base stations every 100 metres[1] in every urban area in the world. Unlike previous generations of wireless technology, in which a single antenna broadcasts over a wide area, 5G base stations and 5G devices will have multiple antennas arranged in "phased arrays" [2],[3] that work together to emit focused, steerable, laser-like beams that track each other.

Each 5G phone will contain dozens of tiny antennas, all working together to track and aim a narrowly focused beam at the nearest cell tower. The US Federal Communications Commission (FCC) has adopted rules [4] permitting the effective power of those beams to be as much as 20 watts, ten times more powerful than the levels permitted for current phones.

Each 5G base station will contain hundreds or thousands of antennas aiming multiple laser-like beams simultaneously at all cell phones and user devices in its service area. This technology is called "multiple input multiple output" or MIMO. FCC rules permit the effective radiated power of a 5G base station's beams to be as much as 30,000 watts per 100 MHz of spectrum,[2] or equivalently 300,000 watts per GHz of spectrum, tens to hundreds of times more powerful than the levels permitted for current base stations.

Space-based 5G

At least five companies[5] are proposing to provide 5G from space from a combined 20,000 satellites in low- and medium-Earth orbit that will blanket the Earth with powerful, focused, steerable beams. Each satellite will emit millimetre waves with an effective radiated power of up to 5 million watts[6] from thousands of antennas arranged in a phased array. Although the energy reaching the ground from satellites will be less than that from ground-based antennas, it will irradiate areas of the Earth not reached by other transmitters and will be additional to ground-based 5G transmissions from billions of IoT objects. Even more importantly, the satellites will be located in the Earth's magnetosphere, which exerts a significant influence over the electrical properties of the atmosphere. **The alteration of the Earth's electromagnetic environment may be an even greater threat to life than the radiation from ground-based antennas (see below).**

Harmful effects of radio frequency radiation are already proven

Even before 5G was proposed, dozens of petitions and appeals[7] by international scientists, including the Freiburger Appeal signed by over 3,000 physicians, called for a halt to the expansion of wireless technology and a moratorium on new base stations.[8]

In 2015, 215 scientists from 41 countries communicated their alarm to the United Nations (UN) and World Health Organization (WHO).[9] They stated that "numerous recent scientific publications have shown that EMF

[electromagnetic fields] affects living organisms at levels well below most international and national guidelines". More than 10,000 peer-reviewed scientific studies demonstrate harm to human health from RF radiation.[10] [11] Effects include:

- Alteration of heart rhythm[12]
- Altered gene expression[13]
- Altered metabolism[14]
- Altered stem cell development[15]
- Cancers[16]
- Cardiovascular disease[17]
- Cognitive impairment[18]
- DNA damage[19]
- Impacts on general well-being[20]
- Increased free radicals[21]
- Learning and memory deficits[22]
- Impaired sperm function and quality[23]
- Miscarriage[24]
- Neurological damage[25]
- Obesity and diabetes[26]
- Oxidative stress[27]

Effects in children include autism,[28] attention deficit hyperactivity disorder (ADHD)[29][30] and asthma.[31]

Damage goes well beyond the human race, as there is abundant evidence of harm to diverse plant- and wildlife[32][33] and laboratory animals, including:

- Ants[34]
- Birds[35][36]
- Forests[37]
- Frogs[38]
- Fruit flies[39]
- Insects[41]
- Mammals[42]
- Mice[43][44]
- Plants[45]
- Rats[46]

- Honey bees[40]
- Trees[47]

Negative microbiological effects[48] have also been recorded.

The WHO's International Agency for Research on Cancer (IARC) concluded in 2011 that RF radiation of frequencies 30 kHz - 300 GHz are possibly carcinogenic to humans (Group 2B).[49] However, recent evidence, including the latest studies on cell phone use and brain cancer risks, indicate that RF radiation is proven carcinogenic to humans[50] and should now be classified as a "Group 1 carcinogen" along with tobacco smoke and asbestos.

Most contemporary wireless signals are pulse-modulated. Harm is caused by both the high-frequency carrier wave and the low-frequency pulsations.[51]

The deployment of 5G satellites must be prohibited

The Earth, the ionosphere and the lower atmosphere form the global electric circuit[52] in which we live. It is well established that biological rhythms—of humans,[53][54] birds,[55] hamsters,[56] and spiders[57][58]—are controlled by the Earth's natural electromagnetic environment and that the well-being of all organisms depends on the stability of this environment, including the electrical properties of the atmosphere.[59][60][61][62] Cherry, in a groundbreaking paper,[63] explained the importance of the Schumann resonances[64] and why ionospheric disturbances can alter blood pressure and melatonin and cause "cancer, reproductive, cardiac and neurological disease and death".

These elements of our electromagnetic environment have already been altered by radiation from power lines. Power line harmonic radiation[65] reaches the Earth's ionosphere and magnetosphere, where it is amplified by wave-particle interactions.[66][67] In 1985, Dr. Robert O. Becker warned that power line harmonic radiation had already changed the structure of the magnetosphere, and that the continued expansion of this effect "threatens the viability of all life on Earth".[68] The placement of tens of thousands of satellites directly in both the ionosphere and magnetosphere, emitting modulated signals at millions of watts and millions of frequencies, is likely to alter our electromagnetic environment beyond our ability to adapt.[69]

Informal monitoring has already provided evidence indicating serious effects on humans and animals from the approximately 100 satellites that have provided 2G and 3G phone service from low orbit since 1998. Such effects cannot be understood only from consideration of the low levels of radiation on the ground. Knowledge from other relevant scientific disciplines must be taken into account, including the fields of atmospheric physics and acupuncture.[70][71][72][73] Adding 20,000 5G satellites will further pollute the global electric circuit[74][75] and could alter the Schumann resonances,[76] with which all life on Earth has evolved. The effects will be universal and may be profoundly damaging.

5G is qualitatively and quantitatively different from 4G

The idea that we will tolerate tens to hundreds of times more radiation at

millimetre wavelengths is based on faulty modelling of the human body as a shell filled with a homogeneous liquid.[77][78] The assumption that millimetre waves do not penetrate beyond the skin completely ignores nerves,[79] blood vessels[80][81] and other electrically conducting structures that can carry radiation-induced currents deep into the body.[82][83][84] Another, potentially more serious error is that phased arrays are not ordinary antennas. When an ordinary electromagnetic field enters the body, it causes charges to move and currents to flow. But when extremely short electromagnetic pulses enter the body, something else happens: the moving charges themselves become little antennas that reradiate the electromagnetic field and send it deeper into the body. These reradiated waves are called Brillouin precursors.[85] They become significant when either the power or the phase of the waves changes rapidly enough.[86] 5G will probably satisfy both criteria.

In addition, shallow penetration in itself poses a unique danger to eyes and to the largest organ of the body, the skin, as well as to very small creatures. Peer-reviewed studies have recently been published, predicting thermal skin burns[87] in humans from 5G radiation and resonant absorption by insects,[88] which absorb up to 100 times as much radiation at millimetre wavelengths as they do at wavelengths presently in use. Since populations of flying insects have declined by 75-80 per cent since 1989 even in protected nature areas,[89] 5G radiation could have catastrophic effects on insect populations worldwide. A 1986 study by Om Gandhi warned that millimetre waves are strongly absorbed by the cornea of the eye, and that

ordinary clothing, being of millimetre-size thickness, increases the absorption of energy by the skin by a resonance-type effect.[90] Russell (2018) reviews the known effects of millimetre waves on skin, eyes (including cataracts), heart rate, immune system and DNA.

Regulators have deliberately excluded the scientific evidence of harm

Stakeholders thus far in the development of 5G have been industry and governments, while renowned international EMF scientists who have documented biological effects on humans, animals, insects and plants, and alarming effects on health and the environment in thousands of peer-reviewed studies have been excluded. The reason for the current inadequate safety guidelines is that conflicts of interest of standard-setting bodies "due to their relationships with telecommunications or electric companies undermine the impartiality that should govern the regulation of Public Exposure Standards for non-ionizing radiation". [91] Professor Emeritus Martin L. Pall lays out the conflicts of interest in detail, and the lists of important studies that have been excluded, in his literature review. [92]

The thermal hypothesis is obsolete—new safety standards are needed

Current safety guidelines are based on the obsolete hypothesis that heating is the only harmful effect of EMFs. As Markov and Grigoriev have stated, "Today standards do not consider the real pollution of the environment with nonionizing radiation".[93]

Hundreds of scientists, including many signatories to this appeal, have proven that many different kinds of acute and chronic illnesses and injuries are caused without heating ("non-thermal effect") from radiation levels far below international guidelines.[9] Biological effects occur even at near-zero power levels. Effects that have been found at 0.02 picowatts (trillionths of a watt) per square centimetre or less include altered genetic structure in E. coli[94] and in rats,[95] altered EEG in humans,[96] growth stimulation in bean plants,[97] and stimulation of ovulation in chickens.[98]

To protect against non-thermal effects, duration of exposure must be considered. 5G will expose everyone to many more transmissions simultaneously and continuously, day and night without cessation. New safety standards are needed and should be based on *cumulative exposure* and *not only on power levels* but also on frequency, bandwidth, modulation, waveform, pulse width and other properties that are biologically important. Antennas must be confined to specific, publicly identified locations. To protect humans, antennas must be located far from where people live and work, and excluded from the public rights-of-way where people walk. To protect wildlife, they must be excluded from wilderness sanctuaries and strictly minimized in remote areas of the Earth. To protect all life, commercial communications satellites must be limited in number and prohibited in low- and medium-Earth orbits. Phased arrays must be prohibited on Earth and in space.

RF radiation has both acute and chronic effects

RF radiation has both immediate and long-term effects. Cancer and heart disease are examples of long-term effects. Alteration of heart rhythm[99] and changes in brain function (EEG)[100] are examples of immediate effects. A syndrome that was called radiowave sickness[101] in the former Soviet Union and is called electromagnetic hypersensitivity (EHS) around the world today[102] can be either acute or chronic. Professor Dr. Karl Hecht has published a detailed history of these syndromes, compiled from a review of more than 1,500 Russian scientific papers and the clinical histories of more than 1,000 of his own patients in Germany. Objective findings include sleep disorders, abnormal blood pressure and heart rate, digestive disorders, hair loss, tinnitus and skin rash. Subjective symptoms include dizziness, nausea, headache, memory loss, inability to concentrate, fatigue, flu-like symptoms and cardiac pain. [103]

The EUROPAEM EMF Guideline 2016 states that EHS develops when people are "continuously exposed in their daily life" to increasing levels of EMFs, and that "reduction and prevention of EMF exposure" is necessary to restore these patients to health. [104] EHS should no longer be considered a disease, but an injury by a toxic environment that affects an increasingly large portion of the population, estimated already at 100 million people worldwide,[105][106] and that may soon affect everyone[107] if the worldwide rollout of 5G is permitted.

The International Scientific Declaration on EHS and multiple chemical sensitivity (MCS), Brussels, declared in 2015 that "*[i]naction is a*

cost to society and is not an option any more... [W]e unanimously acknowledge this serious hazard to public health... [urgently requiring] that major *primary prevention measures are adopted and prioritized, to face this worldwide pan-epidemic in perspective*" (emphasis added).[108]

World governments are failing in their duty of care to the populations they govern

In their haste to implement 5G and to encourage the unconstrained use of outer space, the European Union, United States and national governments worldwide are taking steps to ensure a "barrier-free" regulatory environment.[109] They are prohibiting local authorities from enforcing environmental laws,[110] and "in the interest of speedy and cost-effective deployment", removing "unnecessary burdens... such as local planning procedures [and] the variety of specific limits on electromagnetic field (EMF) emissions and of the methods required to aggregate them". [111]

Governments are also enacting laws to make wireless facilities a permitted use in all public rights-of-way.[112] To date, most wireless facilities have been located on private property at some distance from homes and businesses. In order for them to be spaced less than 100 metres apart as required by 5G, however, they will now be located on the sidewalk directly in front of homes and businesses and close above the heads of pedestrians, including mothers with babies.

Public notice requirements and public hearings are being eliminated. Even if there were a hearing and 100 scientific experts were to testify against 5G, laws have been passed making it illegal for local authorities to take their testimony into consideration. US law, for example, prohibits local governments from regulating wireless technology "on the basis of the environmental effects of radio frequency radiation",[113] and courts have reversed regulatory decisions about cell tower placement simply because most of the public testimony was about health.[114] Insurers will not provide coverage against EMF risks,[115] and there is zero clarity as to what entity will bear legal responsibility for damage to life, limb and property arising from exposure to 5G, whether ground- or space-based.[116]

In the absence of an agreed comprehensive legal regime governing activities in outer space, legal liability for those activities is non-existent, despite the prospect of whole continents, the atmosphere and the oceans being put at risk by them.

International agreements are being violated

Children and duty of care

The United Nations Convention on the Rights of the Child: States shall "undertake to ensure the child such protection and care as is necessary for his or her well-being" (art. 3), "ensure... the survival and development of the child" (art. 6) and "take appropriate measures to combat disease... taking into consideration the dangers and risks of

environmental pollution" (art. 24(c)).

The Nuremberg Code (1949) applies to all experiments on humans, thus including the deployment of 5G with new, higher RF radiation exposure that has not been pre-market tested for safety. "The voluntary consent of the human subject is absolutely essential" (art. 1). Exposure to 5G will be involuntary. "No experiment should be conducted, where there is an a priori reason to believe that death or disabling injury will occur" (art. 5). The findings of over 10,000 scientific studies and the voices of hundreds of international organizations representing hundreds of thousands of members who have suffered disabling injury and been displaced from their homes by already-existing wireless telecommunications facilities, are "a priori reasons to believe that death or disabling injury will occur".

Duty to inform and EMFs

The World Telecommunication Standardization Assembly (2012) of the International Telecommunication Union (ITU) stated that "[t]here is a need to inform the public of the potential effects of exposure to electromagnetic fields (EMFs)" and invited Member States "to adopt suitable measures in order to ensure compliance with relevant international recommendations to protect health against the adverse effect of EMF".

The Mid-term review of the European Environment and Health Action Plan 2004-2010 (2008): "The European Parliament... [n]otes that the limits on exposure to electromagnetic fields which have been set for the general public are obsolete, ... obviously take no account of developments in

information and communication technologies, of the recommendations issued by the European Environment Agency or of the stricter emission standards adopted, for example, by Belgium, Italy and Austria, and do not address the issue of vulnerable groups, such as pregnant women, newborn babies and children."

Resolution 1815 (Council of Europe, 2011): "Take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people."

Environment

The Declaration of the United Nations Conference on the Human Environment (1972): "The discharge of toxic substances... in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems" (principle 6).

The World Charter for Nature (1982): "Activities which are likely to cause irreversible damage to nature shall be avoided... [W]here potential adverse effects are not fully understood, the activities should not proceed" (art. 11).

The Rio Declaration on Environment and Development (1992): "States have... the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction" (principle 2).

The United Nations World Summit on Sustainable Development (2002): "There is an urgent need to... create more effective national and regional policy responses to environmental threats to human health" (para. 54(k)).

The African Convention on the Conservation of Nature and Natural Resources (2017): "The Parties shall... take all appropriate measures to prevent, mitigate and eliminate to the maximum extent possible, detrimental effects on the environment, in particular from radioactive, toxic, and other hazardous substances and wastes" (art. 13).

Health and human rights

The Universal Declaration of Human Rights: "Everyone has the right to life, liberty and security of person" (art. 3).

The United Nations Global Strategy for Women's, Children's and Adolescents' Health(2016-2030) has as objectives and targets to "transform", by expanding enabling environments; to "survive", by reducing maternal and newborn mortality; and to "thrive" by ensuring health and well-being and reducing pollution-related deaths and illnesses.

Space

The Outer Space Treaty (1967) requires that the use of outer space be conducted "so as to avoid [its] harmful contamination and also adverse changes in the environment of the Earth"(art. IX).

The United Nations Guidelines for The Long-Term Sustainability of Outer Space Activities

(2018): "States and international intergovernmental organizations should address... risks to people, property, public health and the environment associated with the launch, in-orbit operation and re-entry of space objects" (guideline 2.2(c)).

World governments are playing dice with life on Earth

Albert Einstein famously asserted that "God does not play dice".[117] Yet by pursuing the broadcast on Earth and from space of 5G, an unprecedented technology of millimetre waves previously used as an energy weapon in military operations and crowd control,[118] world governments are recklessly playing dice with the future of life on Earth.

To refuse to accept and apply relevant and valid scientific knowledge is ethically unacceptable. Existing research shows that 5G—and especially space-based 5G—contravenes principles enshrined in a host of international agreements.

We call upon the UN, WHO, EU, Council of Europe and governments of all nations,

(a) *To take* immediate measures to halt the

deployment of 5G on Earth and in space in order to protect all humankind, especially the unborn, infants, children, adolescents and pregnant women, as well as the environment;

(b) *To follow* the United Nations Convention on the Rights of the Child and Council of Europe Resolution 1815 by informing citizens, including teachers and physicians, about the health risks (to adults and children) from RF radiation, and why they should and how they can avoid wireless communication and base stations, particularly in or near day-care centres, schools, hospitals, homes and workplaces;

(c) *To favour and implement* wired telecommunications instead of wireless;

(d) *To prohibit* the wireless/telecommunications industry through its lobbying organizations from persuading officials to make decisions permitting further expansion of RF radiation, including ground- and space-based 5G;

(e) *To appoint* immediately—without industry influence—international groups of independent, truly impartial EMF and health scientists with no conflicts of interest, [119] for the purpose of establishing new international safety standards for RF radiation that are not based only on power levels, that consider cumulative exposure, and that protect against *all* health and environmental effects, not just thermal effects and not just effects on humans;

(f) *To appoint* immediately—without industry influence—international groups of scientists with expertise in EMFs, health, biology and atmospheric physics, for the purpose of developing a comprehensive regulatory

framework that will ensure that the uses of outer space are safe for humans and the environment, taking into account RF radiation, rocket exhaust gases, black soot, and space debris and their impacts on ozone, [120] global warming, [121] the atmosphere and the preservation of life on Earth. Not only ground-based but also space-based technology must be sustainable [122] for adults and children, animals and plants.

Please respond before 1 December 2018,

detailing the measures you intend to take to protect the global population against RF radiation exposure, especially 5G radiation. **Your response should be sent to the Appeal Administrator listed below.**

This appeal and your response will be publicly available on www.5gSpaceAppeal.org.

Respectfully submitted,

Arthur Firstenberg, Appeal Administrator,
info@5gSpaceAppeal.org

Initial signatories

AFRICA

Lauraine Margaret Helen Vivian, PhD, Anthropology and Psychiatry; Honorary

Research Associate, Faculty of Health and Medical Sciences, University of Copenhagen, Denmark. Signatory for **South Africa**

ASIA

Girish Kumar, PhD, Professor, Electrical Engineering Department, Indian Institute of Technology Bombay, Powai, Mumbai, **India**

AUSTRALIA

Don Maisch, PhD, Independent researcher, author of "The Procrustean Approach", Lindisfarne, Tasmania, **Australia**

EUROPE

Alfonso Balmori, BSc, Master in Environmental Education, Biologist. Valladolid, **Spain**

Klaus Buchner, Dr. rer. nat., Professor, MEP – Member of the European Parliament, Kompetenzinitiative zum Schutz von Mensch, Umwelt und Demokratie e.V., München, **Germany**

Daniel Favre, Dr. phil. nat., Biologist, A.R.A. (Association Romande Alerte aux Ondes Electromagnétiques), **Switzerland**

Annie Sasco, MD, DrPH, SM, HDR, former Chief of Research Unit of Epidemiology for Cancer Prevention at the International Agency for Research on Cancer (IARC), Lyon; former Acting Chief, Programme for Cancer Control of the World Health Organization (WHO); former Director of Research at the Institut National de la Santé et de la Recherche Médicale (INSERM); **France**

NORTH AMERICA

Martin Pall, Professor Emeritus of Biochemistry and Basic Medical Sciences, Washington State University, residing in Portland, Oregon, **USA**

Kate Showers, PhD, Soil Science, Senior Research Fellow, Centre for World Environmental History, University of Sussex, Falmer, Brighton, UK, residing in Bolton-Est, Québec, **Canada**

SOUTH AMERICA

Carlos Sosa, MD, University of Antioquia, Medellín, **Colombia**

SIGN IT (INDIVIDUAL)	SIGN IT (ORGANIZATION)

References

[1] De Grasse M. AT&T outlines 5G network architecture. RCR Wireless News, Oct. 20, 2016. https://www.rcrwireless.com/20161020/network-infrastructure/att-outlines-5g-network-architecture-tag4. Accessed July 9, 2018.

[2] Hong W, Jiang ZH, Yu C, et al. Multibeam antenna technologies for 5G wireless communications. IEEE Tr Ant Prop.

2017;65(12):6231-6249. doi: 10.1109/TAP.2017.2712819.

[3] Chou H-T. Design Methodology for the Multi-Beam Phased Array of Antennas with Relatively Arbitrary Coverage Sector. Conference paper: 2017 11th European Conference on Antennas and Propagation; Paris, France. doi: 10.23919/EuCAP.2017.7928095.

[4] 47 CFR § 30.202 — Power limits.

[5] SpaceX, WorldVu, Boeing, Telesat Canada, and Iridium.

[6] Federal Communications Commission. Pending Application for Satellite Space and Earth Station Authorization. Schedule S, Technical Report. Dated April 2016, filed March 1, 2017. http://licensing.fcc.gov/myibfs/download.do?attachment_key=1200245. Accessed June 17, 2018.

[7] Governments and organizations that ban or warn against wireless technology. Cellular Phone Task Force website. http://www.cellphonetaskforce.org/governments-and-organizations-that-ban-or-warn-against-wireless-technology/. Accessed June 10, 2018. Continually updated.

[8] The International Doctors' Appeal (Freiburger Appeal). http://freiburger-appell-2012.info/en/home.php?lang=EN. Published in 2012. Accessed June 10, 2018.

[9] International appeal: scientists call for

protection from non-ionizing electromagnetic field exposure. International EMF Scientist Appeal website. https://emfscientist.org/index.php/emf-scientist-appeal. Published May 11, 2015. Accessed June 10, 2018. As of March 2018, 237 EMF scientists from 41 nations had signed the Appeal.

[10] Glaser Z. Cumulated index to the bibliography of reported biological phenofmena ('effects') and clinical manifestations attributed to microwave and radio-frequency radiation: report, supplements (no. 1-9).BEMS newsletter (B-1 through B-464), 1971-1981. http://www.cellphonetaskforce.org/wp-content/uploads/2018/06/Zory-Glasers-index.pdf. Accessed June 26, 2018. Report and 9 supplements issued by Naval Medical Research Institute, Bethesda, MD; Research Division, Bureau of Medicine & Surgery, Dept. of the Navy, Washington, DC; Electromagnetic Radiation Project Office, Naval Medical Research & Development Command, Bethesda, MD; Naval Surface Weapons Center, Dahlgren, VA; and National Institute for Occupational Safety and Health, Rockville, MD. Index by Julie Moore and Associates, Riverside, CA, 1984. Lt. Zorach Glaser, PhD, catalogued 5,083 studies, books and conference reports for the US Navy through 1981.

[11] Sage C, Carpenter D., eds. BioInitiative Report: A Rationale for a Biologically-Based Public Exposure Standard for Electromagnetic Radiation. Sage Associates; 2012. www.bioinitiative.org. Accessed June 10, 2018. The 1,470-page BioInitiative Report,

authored by an international group of 29 experts, has reviewed more than 1,800 new studies and is continually updated.

[12] Grigoriev Y. Bioeffects of modulated electromagnetic fields in the acute experiments (results of Russian researches). Annu Russ Natl Comm Non-Ionising Radiat Protect. 2004:16-73. http://bemri.org/publications/biological-effects-of-non-ionizing-radiation/78-grigoriev-bioeffects07/file.html. Accessed June 17, 2018.

[13] Obajuluwa AO, Akinyemi AJ, Afolabi OB, et al. Exposure to radio-frequency electromagnetic waves alters acetylcholinesterase gene expression, exploratory and motor coordination-linked behaviour in male rats.Toxicol Rep. 2017;4:530-534. https://www.sciencedirect.com/science/article/pii/S221475001730063X/pdfft?md5=0af5af76124b1f89f6d23c90c5c7764f&pid=1-s2.0-S221475001730063X-main.pdf. Accessed June 17, 2018.

[14] Volkow ND, Tomasi D, Wang G-J, et al. Effects of cell phone radiofrequency signal exposure on brain glucose metabolism. JAMA. 2012;305(8):808-813. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3184892. Accessed June 17, 2018.

[15] Eghlidospour M, Ghanbari A, Mortazavi S, Azari H. Effects of radiofrequency exposure emitted from a GSM mobile phone on proliferation, differentiation, and apoptosis of neural stem cells. Anat Cell Biol. 2017;50(2):115-123. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5509895.

Accessed June 17, 2018.

[16] Hardell L, Carlberg C. Mobile phones, cordless phones and the risk for brain tumors. Int J Oncol.2009;35(1):5-17. https://www.spandidos-publications.com/ijo/35/1/5/download. Accessed June 17, 2018.

[17] Bandara P, Weller S. Cardiovascular disease: Time to identify emerging environmental risk factors. Eur J Prev Cardiol. 2017;24(17):1819-1823. http://journals.sagepub.com/doi/10.1177/2047487317734898. Accessed June 17, 2018.

[18] Deshmukh P et al. Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. Int J Toxicol. 2015;34(3):284-290. doi: 10.1177/1091581815574348.

[19] Zothansiama, Zosangzuali M, Lalramdinpuii M, Jagetia GC. Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations. Electromag Biol Med. 2017;36(3):295-305. doi: 10.1080/15368378.2017.1350584.

[20] Zwamborn A, Vossen S, van Leersum B, Ouwens M, Mäkel W. Effects of Global Communication system radio-frequency fields on Well Being and Cognitive Functions of human subjects with and without subjective complaints. TNO Report FEL-03-C148. The Hague: TNO Physics and Electronics Laboratory; 2003. http://www.milieugezondheid.be/dossiers/gsm/TNO_rapport_Nederland_sept_20

Accessed June 16, 2018.

[21] Havas M. When theory and observation collide: Can non-ionizing radiation cause cancer? Environ Pollut. 2017;221:501-505. doi: 10.1016/j.envpol.2016.10.018.

[22] Narayanan SN, Kumar RS, Potu BK, Nayak S, Mailankot M. Spatial memory performance of Wistar rats exposed to mobile phone. Clinics. 2009;64(3):231-234. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2666459. Accessed June 17, 2018.

[23] Houston BJ, Nixon B, King BV, De Iuliis GN, Aitken RJ. The effects of radiofrequency electromagnetic radiation on sperm function. Reproduction. 2016;152(6):R263-R266. http://www.reproduction-online.org/content/152/6/R263.long. Accessed June 17, 2018.

[24] Han J, Cao Z, Liu X, Zhang W, Zhang S. Effect of early pregnancy electromagnetic field exposure on embryo growth ceasing. Wei Sheng Yan Jiu. 2010;39(3):349-52 (in Chinese). https://www.ncbi.nlm.nih.gov/pubmed/20568468.

[25] Salford LG, Brun AE, Eberhardt JL, Malmgren L, Persson BRR. Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. Environ Health Perspect. 2003;111(7):881-883. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1241519/pdf/ehp0111-000881.pdf. Accessed June 17, 2018.

[26] Milham S. Evidence that dirty electricity

is causing the worldwide epidemics of obesity and diabetes. Electromagn Biol Med. 2014;33(1):75-78. doi: 10.3109/15368378.2013.783853.

[27] Yakymenko I, Tsybulin O, Sidorik E, Henshel D, Kyrylenko O, Kyrylenko S. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. Electromagn Biol Med. 2016;35(2):186-202. doi: 10.3109/15368378.2015.1043557.

[28] Herbert M, Sage C. Findings in autism (ASD) consistent with electromagnetic fields (EMF) and radiofrequency radiation (RFR). In: Sage C, Carpenter D., eds. BioInitiative Report: A Rationale for a Biologically-Based Public Exposure Standard for Electromagnetic Radiation. Sec. 20. Sage Associates; 2012. http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec20_2012_Findings_in_Autism.pdf. Accessed June 29, 2018.

[29] Divan HA, Kheifets L, Obel C, Olsen J. Prenatal and postnatal exposure to cell phone use and behavioral problems in children. Epidemiology 2008;19: 523–529. http://www.wifiinschools.com/uploads/3/0/4/2/3042232/divan_08_prenatal_post_cell_phone_use.pdf. Accessed June 29, 2018.

[30] Divan HA, Kheifets L, Obel C, Olsen J. Cell phone use and behavioural problems in young children. J Epidemiol Community Health. 2010;66(6):524-529. doi: 10.1136/jech.2010.115402. Accessed July 16, 2018.

[31] Li D-K, Chen H, Odouli R. Maternal exposure to magnetic fields during pregnancy in relation to the risk of asthma in offspring. Arch Pediatr Adolesc Med. 2011;165(10):945-950. https://jamanetwork.com/journals/jamapediatrics/fullarticle/1107612. Accessed June 29, 2018.

[32] Warnke U. Bees, Birds and Mankind: Destroying Nature by 'Electrosmog.' Competence Initiative for the Protection of Humanity, Environment and Democracy; 2009. www.naturalscience.org/wp-content/uploads/2015/01/kompetenzinitiative-ev_study_bees-birds-and-mankind_04-08_english.pdf. Accessed June 10, 2018.

[33] Balmori A. Electromagnetic pollution from phone masts. Effects on wildlife. Pathophysiology. 2009;16:191-199. doi:10.1016/j.pathophys.2009.01.007. Accessed June 10, 2018.

[34] Cammaerts MC, Johansson O. Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus. Electromagn Biol Med. 2014;33(4):282-288. doi: 10.3109/15368378.2013.817336.

[35] Broomhall M. Report detailing the exodus of species from the Mt. Nardi area of the Nightcap National Park World Heritage Area during a 15-year period (2000-2015). Report for the United Nations Educational Scientific and Cultural Organization (UNESCO). https://ehtrust.org/wp-content/uploads/Mt-Nardi-Wildlife-Report-to-UNESCO-FINAL.pdf. Accessed June 17,

2018.

[36] Kordas D. Birds and Trees of Northern Greece: Changes since the Advent of 4G Wireless. 2017. https://einarflydal.files.wordpress.com/2017/08/kordas-birds-and-trees-of-northern-greece-2017-final.pdf. Accessed June 29, 2018.

[37] Waldmann-Selsam C, Balmori-de la Puente A, Breunig H, Balmori A. Radiofrequency radiation injures trees around mobile phone base stations. Sci Total Environ. 2016;572:554-569. doi: 10.1016/j.scitotenv.2016.08.045.

[38] Balmori A. Mobile phone mast effects on common frog (Rana temporaria) tadpoles: The city turned into a laboratory. Electromagn Biol Med. 2010(1-2):31-35. doi: 10.3109/15368371003685363.

[39] Margaritis LH, Manta AK, Kokkaliaris KD, et al. Drosophila oogenesis as a bio-marker responding to EMF sources. Electromagn Biol Med. 2014;33(3):165-189. doi: 10.3109/15368378.2013.800102.

[40] Kumar NR, Sangwan S, Badotra P. Exposure to cell phone radiations produces biochemical changes in worker honey bees. Toxicol Int. 2011;18(1):70-72. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3052591. Accessed June 17, 2018.

[41] Balmori A. Efectos de las radiaciones electromagnéticas de la telefonía móvil sobre los insectos.Ecosistemas. 2006;15(1):87-95. https://www.revistaecosistemas.net/index.php/ecosistemas/article/

download/520/495. Accessed June 17, 2018.

[42] Balmori A. The incidence of electromagnetic pollution on wild mammals: A new "poison" with a sloweffect on nature? Environmentalist. 2010;30(1):90-97. doi: 10.1007/s10669-009-9248-y

[43] Magras IN, Xenos TD. RF radiation-induced changes in the prenatal development of mice.Bioelectromagnetics 1997;18(6):455-461. http://collectiveactionquebec.com/uploads/8/0/9/7/80976394/exhibit_r-62_magras_mice_study.pdf. Accessed June 17, 2018.

[44] Otitoloju AA, Osunkalu VO, Oduware R, et al. Haematological effects of radiofrequency radiation from GSM base stations on four successive generations (F1 – F4) of albino mice, Mus Musculus. J Environ Occup Sci. 2012;1(1):17-22. https://www.ejmanager.com/mnstemps/62/62-1332160631.pdf?t=1532966199. Accessed July 30, 2018.

[45] Magone I. The effect of electromagnetic radiation from the Skrunda Radio Location Station on Spirodela polyrhiza (L.) Schleiden cultures. Sci Total Environ. 1996;180(1):75-80. doi: 0048-9697(95)04922-3.

[46] Nittby H, Brun A, Strömblad S, et al. Nonthermal GSM RF and ELF EMF effects upon rat BBB permeability.Environmentalist. 2011;31(2):140-148. doi: 10.1007/s10669-011-9307-z.

[47] Haggerty K. Adverse influence of radio

frequency background on trembling aspen seedlings: Preliminary observations. International Journal of Forestry Research. 2010; Article ID 836278. http://downloads.hindawi.com/journals/ijfr/2010/836278.pdf. Accessed June 17, 2018.

[48] Taheri M, Mortazavi SM, Moradi M, et al. Evaluation of the effect of radiofrequency radiation emitted from Wi-Fi router and mobile phone simulator on the antibacterial susceptibility of pathogenic bacteria Listeria monocytogenes and Escherichia coli. Dose Response. 2017;15(1):1559325816688527. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5298474. Accessed June 18, 2018.

[49] International Agency for Research on Cancer. Non-ionizing radiation, part 2: radiofrequency electromagnetic fields. In: IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Vol 102. Lyon, France: WHO Press; 2013. http://monographs.iarc.fr/ENG/Monographs/vol102/mono102.pdf. Accessed July 2, 2018.

[50] Carlberg M, Hardell L. Evaluation of mobile phone and cordless phone use and glioma risk using the Bradford Hill viewpoints from 1965 on association and causation. Biomed Res Int. 2017:9218486. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5376454. Accessed June 17, 2018.

[51] Blackman CF. Evidence for disruption by the modulating signal. In: Sage C, Carpenter D., eds. BioInitiative Report: A Rationale for a Biologically-Based Public Exposure Standard for Electromagnetic Radiation. Sec. 15. Sage Associates; 2012.

http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec15_2007_Modulation_Blackman.pdf. Accessed June 19, 2018.

[52] Williams ER. The global electrical circuit: a review. Atmos Res. 2009;91(2):140-152. doi:10.1016/j.atmosres.2008.05.018.

[53] Wever R. Human circadian rhythms under the influence of weak electric fields and the different aspects of these studies. Int J Biometeorol. 1973;17(3):227-232. www.vitatec.com/docs/referenz-umgebungsstrahlung/wever-1973.pdf. Accessed June 10, 2018.

[54] Wever R. ELF-effects on human circadian rhythms. In: ELF and VLF Electromagnetic Field Effects. (Persinger M, ed.) New York: Plenum; 1974:101-144.

[55] Engels S, Schneider N-L, Lefeldt N, et al. Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. Nature. 2014;509:353-356. doi:10.1038/nature13290.

[56] Ludwig W, Mecke R. Wirkung künstlicher Atmospherics auf Säuger. Archiv für Meteorologie, Geophysik und Bioklimatologie Serie B (Archives for Meteorology Geophysics and Bioclimatology Series B Theoretical and Applied Climatology). 1968;16(2-3):251-261. doi:10.1007/BF02243273.

[57] Morley EL, Robert D. Electric fields elicit ballooning in spiders. Current Biology. 2018;28:1-7. https://www.cell.com/current-

biology/pdf/S0960-9822(18)30693-6.pdf. Accessed July 14, 2018.

[58] Weber J. Die Spinnen sind Deuter des kommenden Wetters (Spiders Are Predictors of the Coming Weather). 1800; Landshut, Germany. "The electrical material works always in the atmosphere; no seasoncan retard its action. Its effects on the weather are almost undisputed; spiders sense it, and alter theirbehaviour accordingly."

[59] König H. Biological effects of extremely low frequency electrical phenomena in the atmosphere. J Interdiscipl Cycle Res. 2(3):317-323. www.tandfonline.com/doi/abs/10.1080/09291017109359276. Accessed June 10, 2018.

[60] Sulman F. The Effect of Air Ionization, Electric Fields, Atmospherics, and Other Electric Phenomena On Man and Animal. American lecture series. Vol 1029. Springfield, Ill: Thomas; 1980.

[61] König HL, Krüger, AP, Lang S, Sönning, W. Biologic Effects of Environmental Electromagnetism. New York: Springer-Verlag; 1981. doi: 10.1007/978-1-4612-5859-9.

[62] Sazanova E, Sazanov A, Sergeenko N, Ionova V, Varakin Y. Influence of near earth electromagnetic resonances on human cerebrovascular system in time of heliogeophysical disturbances. Progress in Electromagnetics Research Symposium. August 2013:1661-1665.

[63] Cherry N. Schumann resonances, a plausible biophysical mechanism for the human health effects of solar/geomagnetic activity. Natural Hazards. 2002;26(3):279-331. doi:10.1023/A:1015637127504.

[64] Polk C. Schumann resonances. In Volland H, ed. CRC Handbook of Atmospherics. Vol. 1. Boca Raton, Fla: CRC Press; 1982:111-178. https://archive.org/stream/in.ernet.dli.2015.132044/2015.132044.Crc-Handbook-Of-Atmospherics-Vol-1#page/n115/mode/2up/search/polk. Accessed June 18, 2018.

[65] Park C, Helliwell R. Magnetospheric effects of power line radiation. Science. 1978;200(4343):727-730. doi:10.1126/science.200.4343.727.

[66] Bullough K, Kaiser TR, Strangeways HJ. Unintentional man-made modification effects in the magnetosphere. J Atm Terr Phys. 1985;47(12):1211-1223.

[67] Luette JP, Park CG, Helliwell RA. The control of the magnetosphere by power line radiation. J Geophys Res. 1979;84:2657-2660.

[68] Becker RO, Selden G. The Body Electric: Electromagnetism and the Foundation of Life. New York: Morrow; 1985:325-326.

[69] Firstenberg A. Planetary Emergency. Cellular Phone Task Force website. http://www.cellphonetaskforce.org/planetary-emergency. Published 2018. Accessed June 10, 2018.

[70] Becker RO. The basic biological data transmission and control system influenced by electrical forces. Ann NY Acad Sci. 1974;238:236-241. doi: 10.1111/j.1749-6632.1974.tb26793.x.

[71] Maxey ES, Beal JB. The electrophysiology of acupuncture; How terrestrial electric and magnetic fields influence air ion energy exchanges through acupuncture points. International Journal of Biometeorology. 1975;19(Supp. 1):124. doi:10.1007/BF01737335.

[72] Ćosić I, Cvetković D, Fang Q, Jovanov E, Lazoura H. Human electrophysiological signal responses to ELFSchumann resonance and artificial electromagnetic fields. FME Transactions. 2006;34:93-103. http://scindeks-clanci.ceon.rs/data/pdf/1450-8230/2006/1450-82300602093C.pdf. Accessed July 18, 2018.

[73] Cohen M, Behrenbruch C, Ćosić I. Is there a link between acupuncture meridians, earth-ionosphere resonances and cerebral activity? Proceedings of the 2nd International Conference on Bioelectromagnetism, Melbourne, Australia. 1998:173-174. doi: 10.1109/ICBEM.1998.666451.

[74] Chevalier G, Mori K, Oschman JL. The effect of earthing (grounding) on human physiology. European Biology and Bioelectromagnetics. January 2006:600-621. http://162.214.7.219/~earthio0/wp-content/uploads/2016/07/Effects-of-Earthing-on-Human-Physiology-Part-1.pdf. Accessed June 10, 2018. "Highly significant EEG, EMG and BVP results demonstrate that

restoring the natural electrical potential of the earth to the human body (earthing) rapidly affects human electrophysiological and physiological parameters. The extreme rapidity of these changes indicates a physical/bioelectrical mechanism ratherthan a biochemical change."

[75] Firstenberg A. Earth's Electric Envelope. In: The Invisible Rainbow: A History of Electricity and Life. Santa Fe, NM: AGB Press; 2017: 113-131.

[76] Cannon PS, Rycroft MJ. Schumann resonance frequency variations during sudden ionospheric disturbances. J Atmos Sol Terr Phys. 1982;44(2):201-206. doi:10.1016/0021-9169(82)90124-6.

[77] Technical Report. European Telecommunications Standards Institute; 2007:7. http://www.etsi.org/deliver/etsi_tr/125900_125999/125914/07.00.00_60/tr_125914v070000p.pdf. Accessed June 10, 2018. "The Specific Anthropomorphic Mannequin (SAM) is used for radiated performancemeasurements [and is] filled with tissue simulating liquid."

[78] Research on technology to evaluate compliance with RF protection guidelines. Electromagnetic Compatibility Laboratory, Tokyo. http://emc.nict.go.jp/bio/phantom/index_e.html. Accessed July 18, 2018."SAR is measured by filling phantom liquid that has the same electrical properties as those of the human body in a container made in the shape of the human body, and scanning the inside using an SAR probe."

[79] Becker RO, Marino AA. Electromagnetism and Life. Albany: State University of New York Press; 1982:39."The evidence seems to be quite conclusive that there are steady DC electric currents flowing outside of the neurones proper in the entire nervous system."

[80] Nordenström B. Biologically Closed Electric Circuits. Stockholm: Nordic Medical Publications; 1983.

[81] Nordenström B. Impact of biologically closed electric circuits (BCEC) on structure and function. Integr Physiol Behav Sci. 1992;27(4):285-303. doi:10.1007/BF02691165.

[82] Devyatkov ND, ed. Non-Thermal Effects of Millimeter Radiation. Moscow: USSR Acad. Sci.; 1981 (Russian).

[83] Devyatkov ND, Golant MB, Betskiy OV. Millimeter Waves and Their Role in the Processes of Life. (Millimetrovye volny i ikh rol' v protsessakh zhiznedeyatel'nosti). Moscow: Radio i svyaz' (Radio and Communication); 1991 (Russian).

[84] Betskii OV. Biological effects of low-intensity millimetre waves (Review). Journal of Biomedical Electronics. 2015(1):31-47. http://www.radiotec.ru/article/15678. Accessed July 31, 2018.

[85] Albanese R, Blaschak J, Medina R, Penn J. Ultrashort electromagnetic signals: Biophysical questions,safety issues and

medical opportunities," Aviat Space Environ Med. 1994;65(5 Supp):A116-A120. http://www.dtic.mil/dtic/tr/fulltext/u2/a282990.pdf. Accessed June 18, 2018.

[86] Pepe D, Aluigi L, Zito D. Sub-100 ps monocycle pulses for 5G UWB communications. 10th European Conference on Antennas and Propagation (EuCAP). 2016;1-4. doi: 10.1109/EuCAP.2016.7481123.

[87] Nasim I, Kim S. Human exposure to RF fields in 5G downlink. arXiv:1711.03683v1.https://arxiv.org/pdf/1711.03683. Accessed June 17, 2018.

[88] Thielens A, Bell D, Mortimore DB. Exposure of insects to radio-frequency electromagnetic fields from 2 to 120 GHz. Nature/Scientific Reports. 2018;8:3924. https://www.nature.com/articles/s41598-018-22271-3.pdf. Accessed June 17, 2018.

[89] Hallmann CA, Sorg M, Jongejans E. More than 75 per cent decline over 27 years in total flying insect biomass in protected areas. PLOS One. 2017;12(10):e0185809. http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0185809&type=printable. Accessed June 17, 2018.

[90] Gandhi O, Riazi A. Absorption of millimeter waves by human beings and its biological implications. IEEE Trans Microw Theory Tech. 1986;34(2):228-235. doi:10.1109/TMTT.1986.1133316.

[91] Hardell L. World Health Organization, radiofrequency radiation and health—a hard

nut to crack (review). Int J Oncol. 2017;51:405-413. doi:10.3892/ijo.2017.4046.

[92] Pall M. 5G: Great risk for EU, U.S. and international health: Compelling evidence for eight distinct types of great harm caused by electromagnetic field (EMF) exposures and the mechanism that causes them. European Academy for Environmental Medicine. http://www.5gappeal.eu/wp-content/uploads/2018/06/pall_2018.pdf. Published May 2018. Accessed June 22, 2018.

[93] Markov M, Grigoriev Y. Wi-Fi technology: An uncontrolled global experiment on the health of mankind,Electromagn Biol Med. 2013;32(2):200-208. http://www.avaate.org/IMG/pdf/Wi-fi_Technology_-_An_Uncontrolled_Global_Experiment_on_the_Health_of_Mankind_-_Marko_Markov_Yuri_G._Grigoriev.pdf. Accessed June 23, 2018.

[94] Belyaev I, Alipov Y, Shcheglov V, Polunin V, Aizenberg O. Cooperative response of Escherichia coli cells to the resonance effect of millimeter waves at super low intensity. Electromagn Biol Med. 1994;13(1):53-66. doi:10.3109/15368379409030698.

[95] Belyaev I. Nonthermal biological effects of microwaves: Current knowledge, further perspective, and urgent needs. Electromagn Biol Med. 2005;24(3):375-403. doi:10.1080/15368370500381844.

[96] Bise W. Low power radio-frequency and microwave effects on human electroencephalogram and behavior. Physiol

Chem Phys. 1978;10(5):387-398.

[97] Brauer I. Experimentelle Untersuchungen über die Wirkung von Meterwellen verschiedener Feldstärke auf das Teilungswachstum der Pflanzen. Chromosoma. 1950;3(1):483-509. doi:10.1007/BF00319492.

[98] Kondra P, Smith W, Hodgson G, Bragg D, Gavora J, Hamid M. Growth and reproduction of chickens subjected to microwave radiation. Can J Anim Sci. 1970;50(3):639-644. doi:10.4141/cjas70-087.

[99] Frey AH, Seifert E. Pulse modulated UHF energy illumination of the heart associated with change in heart rate. Life Sciences. 1968;7(10 Part 2):505-512. doi: 10.1016/0024-3205(68)90068-4.

[100] Mann K, Röschke J. Effects of pulsed high-frequency electromagnetic fields on human sleep.Neuropsychobiology. 1996;33(1):41-47. doi: 10.1159/000119247.

[101] Tiagin NV. Clinical aspects of exposure to microwave radiation. Moscow: Meditsina; 1971 (Russian).

[102] Belpomme D, Campagnac C, Irigaray P. Reliable disease biomarkers characterizing and identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. Rev Environ Health 2015;30(4):251–271. https://www.jrseco.com/wp-content/uploads/Belpomme-Environmental-

health-2015.pdf. Accessed June 18, 2018.

[103] Hecht K. Health Implications of Long-term Exposure to Electrosmog. Competence Initiative for the Protection of Humanity, the Environment and Democracy. 2016: 16, 42-46. http://kompetenzinitiative.net/KIT/wp-content/uploads/2016/07/KI_Brochure-6_K_Hecht_web.pdf. Accessed June 20, 2018.

[104] Belyaev I, Dean A, Eger H, et al. EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses. Rev Environ Health. 2016;31(3):363-397. doi:10.1515/reveh-2016-0011.

[105] Schreier N, Huss A, Röösli M. The prevalence of symptoms attributed to electromagnetic field exposure: A cross-sectional representative survey in Switzerland. Soz Praventivmed. 2006;51(4):202-209. doi:10.1007/s00038-006-5061-2. Accessed July 16, 2018.

[106] Schroeder E. Stakeholder-Perspektiven zur Novellierung der 26. BImSchV: Ergebnisse der bundesweitenTelefonumfrage im Auftrag des Bundesamtes für Strahlenschutz (Report on stakeholder perspectives onamending the 26th Federal Emission Control Ordinance: Results of the nationwide telephone survey ordered by the Federal Office for Radiation Protection). Schr/bba 04.02.26536.020. Munich, Germany. 2002 (German). https://www.bfs.de/SharedDocs/Downloads/BfS/DE/berichte/emf/befuerchtunge__blob=publicationFile&v=3. Accessed July 19, 2018.

[107] Hallberg Ö, Oberfeld G. Letter to the

editor: Will we all become electrosensitive? Electromagn Biol Med.2006;25:189-191. https://www.criirem.org/wp-content/uploads/2006/03/ehs2006_hallbergoberfeld.pdf. Accessed June 22, 2018.

[108] Brussels International Scientific Declaration on Electromagnetic Hypersensitivity and Multiple Chemical Sensitivity. ECRI Institute. http://eceri-institute.org/fichiers/1441982765_Statement_EN_DEFINITIF.pdf. Published 2015. Accessed June 10, 2018.

[109] Removal of barriers to entry, 47 U.S.C. § 253. https://www.gpo.gov/fdsys/pkg/USCODE-2015-title47/pdf/USCODE-2015-title47-chap5-subchapII-partII-sec253.pdf; 5G For Europe: An Action Plan. European Commission; 2016. http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=17131. Accessed June 10, 2018.

[110] Federal Register - Rules and Regulations. 47 CFR Part 1 [WT Docket No 17-79; FCC 18-30] Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment. 2018;83(86). Accessed June 10, 2018.

[111] 5G For Europe: An Action Plan. European Commission; 2016. http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=17131. Accessed June 10, 2018.

[112] PCIA - The Wireless Infrastructure Association. Model wireless telecommunications facility siting ordinance.

2012. https://wia.org/wp-content/uploads/Advocacy_Docs/PCIA_Model_Zoning_Ordinance_June_2012.pdf Accessed June 29, 2018.

[113] Mobile services, 47 U.S.C. § 332(c)(7)(B)(iv). https://www.gpo.gov/fdsys/pkg/USCODE-2016-title47/pdf/USCODE-2016-title47-chap5-subchapIII-partI-sec332.pdf: "No state or local government or instrumentality thereof may regulate personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the [Federal Communications] Commission's regulations concerning such emissions." Courts have reversed regulatory decisions about cell tower placement simply because most of the public testimony was about health.

[114] Cellular Telephone Company v. Town of Oyster Bay, 166 F.3d 490, 495 (2nd Cir. 1999). https://openjurist.org/166/f3d/490/cellular-telephone-company-at-v-town-of-oyster-bay. Accessed June 10, 2018.; T-Mobile Northeast LLC v. Loudoun County Bd. of Sup'rs, 903 F.Supp.2d 385, 407 (E.D.Va. 2012). https://caselaw.findlaw.com/us-4th-circuit/1662394.html. Accessed June 10, 2018.

[115] Vogel G. A Coming Storm For Wireless? TalkMarkets. July 2017. http://talkmarkets.com/content/stocks--equities/a-coming-storm-for-wireless?post=143501&page=2. Accessed September 13, 2018.

[116] Swiss Re: SONAR - New emerging risk insights. July

2014:22. http://media.swissre.com/documents/SONAR_2014.pdf. Accessed June 10, 2018. "[A]n increasing level of interconnectivity and the growing prevalence of digital steering and feedback systems also give rise to new vulnerabilities. These could involve cascading effects with multiple damages as well as long-lasting interruptions if the problems turned out to be complex and/or difficult to repair. Interconnectivity and permanent data generation give rise to concerns about data privacy, and exposure to electromagnetic fields may also increase."

[117] Albert Einstein, letter to Max Born, Dec. 4, 1926.

[118] Active Denial Technology. Non-Lethal Weapons Program. https://jnlwp.defense.gov/Press-Room/Fact-Sheets/Article-View-Fact-sheets/Article/577989/active-denial-technology/. Published May 11, 2016. Accessed June 10, 2018.

[119] Conflicts of interest have frequently arisen in the past. For example, the EU Commission (2008/721/EC) appointed industry-supportive members for SCENIHR who submitted to the EU a misleading SCENIHR report on health risks, which gave the telecommunications industry carte blanche to irradiate EU citizens. The report is now quoted by radiation safety agencies in the EU. Another example is the US National Toxicology Program contracting with the IT'IS Foundation, which is funded by the entire telecommunications industry, to design, build and monitor the exposure facility for a two-year, 25-million-US-dollar study of cell

phones. It subsequently produced a misleading report that is now quoted by industry officials in the US.

[120] Ross M, Mills M, Toohey D. Potential climate impact of black carbon emitted by rockets. Geophys Res Lett. 2010;37:L24810. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2010GL044548. Accessed June 17, 2018.

[121] Ross MN, Schaeffer PM. Radiative forcing caused by rocket engine emissions. Earth's Future. 2014;2:177-196. https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2013EF000160. Accessed June 17, 2018.

[122] Callicott JB, Mumford K. Ecological sustainability as a conservation concept. Conservation Biology. 1997;11(1):32-40. https://www.sierraforestlegacy.org/Resources/Community/Sustainability/SY_CallicottMumford1997.pdf. Accessed June 20, 2018.

BACK TO THE TOP

From: **Maurya Kaarhus** siochain@pacinfo.com
Subject: Free Tech safety Event: Tonight March 26 6:30-8
Date: March 26, 2019 at 4:43 PM
To:

If you can't attend this event, please visit the **FAC website** for information, research, peer reviewed studies in pubmed, etc, under "Did you Know?"...

(as always, if you don't want to receive this type of forward, let me know and I'll remove your name. mk)

Like Tweet Share

Community Education Event

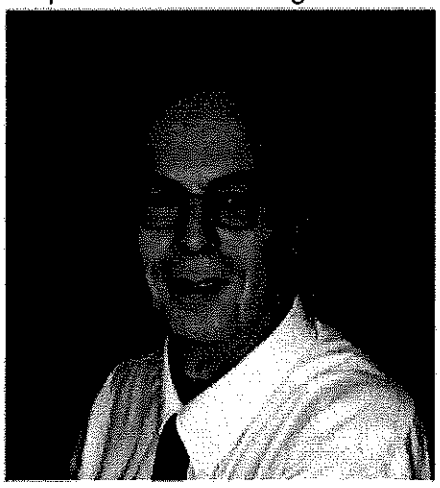
Wireless Technology and Our Children's Health:
What the Industry Isn't Telling Us

With
Paul Héroux, PhD
International expert in electrobiology and toxicology,
McGill University Faculty of Medicine

Paul Dart, MD, Discussant

Tuesday March 26, 2019, 6:30-8pm
Good Samaritan Center
3500 Hilyard Street, Eugene

Sponsored by Southeast Neighborhood Association



Paul Héroux, PhD is an internationally known expert on health impacts of electromagnetic radiation. This month he will be speaking at the Oregon State Legislature and the Portland Public School system concerning wireless radiation in schools. He is on the Faculty of Medicine at McGill University in Montreal, where he is Associate Professor, Director of the Occupational Health Program, Department of Epidemiology, Biostatistics and Occupational Health; and Medical Scientist, Department of Surgery, McGill University Health Center. He teaches Toxicology and Health Effects of Electromagnetic Radiation to Occupational Health and Engineering students. Since the beginning of his science career in 1976, he has followed the debate surrounding the biological effects of electromagnetism. He has studied electrical burns, electromagnetic field measurements, electrical measurements methods of edema, and effects of low frequency magnetic fields on cancer cells. His most recent work focuses on the utilization of magnetic fields against cancer in humans. He is author of the textbooks "Health Effects of Electromagnetism" and "Principles of Toxicology" available free in PDF at http://www.invitroplus.mcgill.ca/

Visit the **FAC website** for up to date info on happenings in Eugene.

Please circulate this message to friends and neighbors!

Bibliography of EMF/RF/MW Selected Resources 2/23/19

FamiliesForSafeMeters.org
Families for Safe Meters meets most Wednesdays from 5-6:30 PM at the
Good Samaritan Village 3500 Hilyard St. Eugene, OR
The FriendsofAmazonCreek.org website has updated following links:

1. Map of planned 5G sites in Eugene. Click to see potential new small cell locations in your neighborhood (see the key in the upper right header for interpretation). https://eugene-pwe.maps.arcgis.com/apps/webappviewer/index.html?id=cfb1e048f8964ed38a1d37cfb29a5e4e&fbclid=IwAR1gDoq2WOe_B8ns5zQaV-7OyPvUkKcFWrywe7hYD6--ZhvHYnyGa4rnanw
2. EWEB memo on small cell installations on EWEB facilities, January 23, 2019. This memo discusses EWEB's authority to regulate location of cellular equipment.
3. Eugeneans: PLEASE SIGN PETITION AT FAC. *

My Street My Choice-A Neighborhood Survival Guide -
Listen to Petaluma 38 min. radio show
http://mystreetmychoice.com/
http://scientists4wiredtech.com/2018/11/is-5g-a-technological-revolution-or-a-pandoras-box/
Is 5G a Technological Revolution or a Pandora's Box? Pima County, AZ 5G Awareness Coalition Public Forum: Is 5G a Technological Revolution or a Pandora's Box? 11/17/18

5G and the FCC: 10 Reasons Why You Should Care February 13, 2019 Sharon Buccino https://www.nrdc.org/experts/sharon-buccino/5g-and-fcc-10-reasons-why-you-should-care

Environmental Health Trust https://ehtrust.org/
http://www.electrosmogprevention.org/stop-5g-action-plan/10-actions-to-help-stop-5g/
From ElectroSmog Prevention site: actions and sample letters

> TEN ACTIONS TO STOP DANGEROUS 5G SMALL CELLS from being placed IN FRONT OF YOUR HOME and throughout your community:\LEARN about 5G concerns – NEW! SUMMARY of all issues concerning 5G for activists and the public

Physicians for Safe Technology https://mdsafetech.org/
Dr. Sharon Goldberg Testifies at Michigan's 5G Small Cell Tower ...
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwiNirG_5M_gAhWUFTQIHd3eD1wQwqsBMAJ6BAgGEAc&url=https://www.youtube.com/watch?v=CK0AliMe-KA&usg=AOvVaw1LerQPOLuJwUaG6HKcJxVw
WeAretheEvidence.org Attorney Dafna Tachover
https://www.youtube.com/watch?v=cQ5xKr68eFk&t=901s
Dr Martin Pall EMF Protection Health Presentation Eugene, OR 10/18/18 Dr. Pall starts 00:17:50

National Institute for Science, Law & Public Policy Washington, DC Re-Inventing Wires: The Future of Landlines and Networks
http://electromagnetichealth.org/wp-content/uploads/2018/05/Wires.pdf

Compliance Problems for 5G rollout detailed in new technical paper
https://www.emfacts.com/2018/12/compliance-problems-for-5g-rollout-detailed-in-new-technical-paper/ 08 DEC 18

Top 20 Facts on 5G: What You Need To Know About 5G Wireless and "Small" Cells

https://ehtrust.org/key-issues/cell-phoneswireless/5g-internet-everything/20-quick-facts-what-you-need-to-know-about-5g-wireless-and-small-cells/

https://www.electrosmogprevention.org/stop-5g-action-plan/10-actions-to-help-stop-5g/
10 ACTIONS TO STOP DANGEROUS 5G SMALL CELLS from being placed IN FRONT OF YOUR HOME and throughout your community:

https://jackkruse.com/

http://sammilham.com/
Dirty Electricity tells the story of Dr. Samuel Milham, the scientist who first alerted the world about the frightening link between occupational exposure to electromagnetic fields, electromagnetic pollution, and human disease.
ElectricSense.com
Hear interview every Thurs. morning free play for one day.
https://emfhealthsummit.com/go-2-h2-a/ EMF Health Summit Oct. 2018, get DVDs+
Whatis5g.info
ElectronicSilentSpring.com
How Big Wireless Made Us Think That Cell Phones Are Safe: A Special Investigation The disinformation campaign—and massive radiation increase—behind the 5G rollout By Mark Hertsgaard, Mark Dowie 4/23/18
https://www.thenation.com/article/how-big-wireless-made-us-think-that-cell-phones-are-safe-a-special-investigation/

Find a building biologist: http://www.building-biology.org/?fbclid=IwAR2kD69c3RxB3_lUJx31d78sQKaMgTRMR06jvZPpdgJi8pihkswDeu22y6U

ELECTROMAGNETIC BIOLOGY AND MEDICINE
2016, VOL. 35, NO. 2, 186–202
http://dx.doi.org/10.3109/15368378.2015.1043557

Taylor & Francis
Taylor & Francis Group

REVIEW ARTICLE

Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation

Igor Yakymenko[a], Olexandr Tsybulin[b], Evgeniy Sidorik[a], Diane Henshel[c], Olga Kyrylenko[d], and Sergiy Kyrylenko[e]

[a]Institute of Experimental Pathology, Oncology and Radiobiology, National Academy of Sciences of Ukraine, Kyiv, Ukraine; [b]Department of Biophysics, Bila Tserkva National Agrarian University, Bila Tserkva, Ukraine; [c]School of Public and Environmental Affairs, Indiana University Bloomington, Bloomington, IN, USA; [d]A.I. Virtanen Institute, University of Eastern Finland, Kuopio, Finland; [e]Department of Structural and Functional Biology, University of Campinas, Campinas, Brazil

ABSTRACT

This review aims to cover experimental data on oxidative effects of low-intensity radiofrequency radiation (RFR) in living cells. Analysis of the currently available peer-reviewed scientific literature reveals molecular effects induced by low-intensity RFR in living cells; this includes significant activation of key pathways generating reactive oxygen species (ROS), activation of peroxidation, oxidative damage of DNA and changes in the activity of antioxidant enzymes. It indicates that among 100 currently available peer-reviewed studies dealing with oxidative effects of low-intensity RFR, in general, 93 confirmed that RFR induces oxidative effects in biological systems. A wide pathogenic potential of the induced ROS and their involvement in cell signaling pathways explains a range of biological/health effects of low-intensity RFR, which include both cancer and non-cancer pathologies. In conclusion, our analysis demonstrates that low-intensity RFR is an expressive oxidative agent for living cells with a high pathogenic potential and that the oxidative stress induced by RFR exposure should be recognized as one of the primary mechanisms of the biological activity of this kind of radiation.

ARTICLE HISTORY
Received 10 January 2015
Accepted 12 April 2015
Published online 7 July 2015

KEYWORDS
Cellular signaling; cancer; free radicals; oxidative stress; radiofrequency radiation; reactive oxygen species

Introduction

Intensive development of wireless technologies during the last decades led to a dramatic increase of background radiofrequency radiation (RFR) in the human environment. Thus, the level of indoor background RFR in industrialized countries increased 5,000-fold from 1985 to 2005 (Maes, 2005). Such significant environmental changes may have a serious impact on human biology and health. As a proof of such impact, a series of epidemiological studies on the increased risk of tumorigenesis in "heavy" users of wireless telephony exists (Hardell et al., 2007, 2011; Sadetzki et al., 2008; Sato et al., 2011). Some studies indicate that long-term RFR exposure in humans can cause various non-cancer disorders, e.g., headache, fatigue, depression, tinnitus, skin irritation, hormonal disorders and other conditions (Abdel-Rassoul et al., 2007; Buchner & Eger, 2011; Chu et al., 2011; Johansson, 2006; Santini et al., 2002; Yakymenko et al., 2011). In addition, convincing studies on hazardous effects of RFR in human germ cells have been published (Agarwal et al., 2009; De Iuliis et al., 2009).

All abovementioned studies dealt with the effects of low-intensity RFR. This means that the intensity of radiation was far below observable thermal effects in biological tissues, and far below safety limits of the International Commissions on Non-Ionizing Radiation Protection (ICNIRP) (ICNIRP, 1998). To date, molecular mechanisms of non-thermal effects of RFR are still a bottleneck in the research on the biological/health effects of low-intensity RFR, although recently many studies have been carried out on metabolic changes in living cells under low-intensity RFR, and comprehensive reviews were published (Belyaev, 2010; Consales et al., 2012; Desai et al., 2009; Yakymenko et al., 2011). In the present work, we analyze the results of molecular effects of low-intensity RFR in living cells and model systems, with a special emphasis on oxidative effects and free radical mechanisms. It might seem paradoxical that, despite being non-ionizing, RFR can induce significant activation of free radical processes and overproduction of reactive oxygen species (ROS) in living cells. We believe that the analysis of recent findings will allow recognition of a

CONTACT Igor Yakymenko iyakymen@gmail.com Laboratory of Biophysics, Institute of Experimental Pathology, Oncology and Radiobiology of NAS of Ukraine, Vasylkivska str. 45, Kyiv, 03022 Ukraine.

general picture of the potential health effects of already ubiquitous and ever-increasing RFR.

Radiofrequency radiation

RFR is a part of electromagnetic spectrum with frequencies from 30 kHz to 300 GHz. RFR is classified as non-ionizing, which means that it does not carry sufficient energy for ionization of atoms and molecules. A part of RFR with the highest frequencies (300 MHz to 300 GHz) is referred to as microwaves (MWs). MW is RFR with the highest energy, which can potentially generate the highest thermal effects in the absorbing matter.

The main indexes of RFR are (i) frequency (Hz); (ii) intensity or power density (PD) of radiation (W/m^2 or $\mu W/cm^2$); (iii) its modulated or non-modulated nature; and (iv) continuous or discontinuous pattern of radiation. For the absorbed RFR energy, a parameter of specific absorption rate (SAR) is used (W/kg). The most common digital standard of RFR for mobile communication is still GSM (Global System for Mobile communication), which utilizes frequencies at about 850, 900, 1800 and 1900 MHz. This radiation is frequency modulated, with channel rotation frequency of 217 Hz, and belongs to the radiation of the pulsed mode (Hyland, 2000).

As to the international safety limits, the ICNIRP recommendations restrict intensity of RFR to 450–1000 $\mu W/cm^2$ (depending on the frequency of radiation) and the SAR value to 2 W/kg, as calculated for human heads and torsos (ICNIRP, 1998). These indexes were adopted by ICNIRP based on the behavioral response of laboratory rats, which were exposed to gradually increased intensities of RFR to determine the point at which the animals became thermally distressed (Gandhi et al., 2012).

Low-intensity RFR is referred to as radiation with intensities which do not induce significant thermal effects in biological tissues. Accordingly, any intensity of RFR under the ICNIRP limits can be referred to as low-intensity. In this paper we will analyze only the effects of low-intensity RFR.

Physical/biophysical effects of low-intensity RFR in living cells

RFR, especially MW, can produce thermal effects in matter due to interaction with charged particles, including free electrons, ions or polar molecules, inducing their oscillations in electromagnetic field. The thermal effect of MW can be seen when warming food in the microwave. The effect strongly depends on the intensity of radiation and is mostly negligible under low-intensity RFR conditions. On the other hand, energy of RFR/MW is insufficient not only for the ionization of molecules, but even for activation of orbital electrons. Hence, RFR was often assessed as a factor producing only thermal effects. Nevertheless, evident biological effects of low-intensity RFR promoted research on physical mechanisms of non-thermal biological effects of this kind of radiation.

A biophysical model of a forced-vibration of free ions on the surface of a cell membrane due to external oscillating electromagnetic field (EMF) was proposed (Panagopoulos et al., 2000, 2002). According to the authors, this vibration of electric charges can cause disruption of the cellular electrochemical balance and functions.

A "moving charge interaction" model was proposed for low-frequency EMF (Blank and Soo, 2001). The authors explained activation of genes and synthesis of stress proteins under EMF exposure due to interaction of the field with moving electrons in DNA (Blank and Soo, 2001; Goodman and Blank, 2002). They also demonstrated that EMF increased electron transfer rates in cytochrome oxidase and accelerated charges in the Na,K-ATPase reaction. Moreover, they demonstrated acceleration of the oscillating Belousov–Zhabotinski reaction in homogeneous solutions due to the application of low-frequency EMF (Blank and Soo, 2003).

An ability of low-strength magnetic fields to trigger onset- and offset-evoked potentials was demonstrated (Marino et al., 2009). Effectiveness of a rapid magnetic stimulus (0.2 ms) has led the authors to a conclusion on direct interaction between the field and ion channels in plasma membrane. A plausible mechanism of overproduction of free radicals in living cell due to electron spin flipping in confined free radical pairs in magnetic field of RFR was proposed (Georgiou, 2010).

A significant effect of low-intensity RFR on ferritin, an iron cage protein present in most living organisms from bacteria to humans, was revealed (Céspedes and Ueno, 2009). Exposure of ferritin solution to low-intensity RFR significantly, up to threefold, reduced iron chelation with ferrozine. The authors explained that magnetic field of RFR plays a principle role in the observed effect, and that this effect is strongly non-thermal. The non-thermal mechanism of the interaction of RFR magnetic fields with ferritin is supposedly mediated by an inner super-paramagnetic nanoparticle ($9H_2O \times 5Fe_2O_3$ with up to 4500 iron ions), which is a natural phenomenon intrinsic to the cells. It results in reduction of input of iron chelates into the ferritin cage. The authors underlined the potential role of ferritin

malfunction for oxidative processes in living cell due to the participation of Fe^{2+} ions in the Fenton reaction, which produces hydroxyl radicals. In this respect, it is interesting to point to the results of an *in vitro* study with RFR exposure of rat lymphocytes treated by iron ions (Zmyślony et al., 2004). Although RFR exposure (930 MHz) did not induce detectable intracellular ROS overproduction, the same exposure in the presence of $FeCl_2$ in the lymphocyte suspensions induced a significant overproduction of ROS.

Another set of studies indicates on a possibility of changes in protein conformation under RFR exposure. Thus, low-intensity 2.45 MHz RFR accelerated conformational changes in β-lactoglobulin through excitation of so-called collective intrinsic modes in the protein (Bohr and Bohr, 2000a, 2000b), which suggests a principal ability of RFR to modulate the non-random collective movements of entire protein domains. Similarly, a frequency-dependent effect on intrinsic flexibility in insulin structure due to applied oscillating electric field was demonstrated (Budi et al., 2007). Moreover, macromolecular structure of cytoskeleton was significantly altered in fibroblasts of Chinese hamster after the exposure to modulated RFR of the GSM standard (Pavicic and Trosic, 2010). Thus, a 3 h exposure of fibroblasts to modulated RFR (975 MHz) led to significant changes in the structure of microtubules and actin microfilaments, which have polar cytoskeleton structures, while non-polar vimentin filaments reportedly stayed unchanged. Taking into account an extensive regulatory potential of cytoskeleton on cell homeostasis, these data could obviously add to the nature of the biological effects of RFR.

It was shown that ornithine decarboxylase (ODC) can significantly change its activity under low-intensity RFR exposure (Byus et al., 1988; Hoyto et al., 2007; Litovitz et al., 1993, 1997; Paulraj et al., 1999).

In addition, so-called "calcium effects" under RFR exposure in living cells have been demonstrated (Dutta et al., 1989; Paulraj et al., 1999; Rao et al., 2008), which include a significant increase in intracellular Ca^{2+} spiking. Taking into account that calcium is a ubiquitous regulator of cellular metabolism, these data point to a possibility that non-thermal RFR can activate multiple Ca^{2+}-dependent signaling cascades.

Finally, an ability of low-intensity MW to dissociate water molecules was demonstrated in model experiments years ago (Vaks et al., 1994). In these experiments, MW of 10 GHz with radiated power 30 mW produced a significant level of H_2O_2 in deionized water (and also in $MgSO_4$ solution) under stable temperature conditions. According to the authors, a kinetic excitation of liquid water associates $C(H_2O)$ upon the absorption of MW leads to subsequent viscous losses due to friction between moving clusters of water molecules. It results in partial irreversible decomposition of water, including breaks of intramolecular bonds (H–OH) due to a mechanochemical reaction, and generation of $H^{\bullet}$; $OH^{\bullet}$; H^+ and OH^- groups. Among these, the hydroxyl radical ($OH^{\bullet}$) is the most aggressive form of ROS, which can break any chemical bond in surrounding molecules (Halliwell, 2007). The authors assessed that this type of mechanochemical transformation in water could be responsible for 10^{-4}–10^{-8} relative parts of the total MW energy absorbed. Given the fact that the water molecules are ubiquitous in living cells, even a subtle chance for dissociation of water molecules under low-intensity RFR exposure could have a profound effect on tissue homeostasis. It is of note here that one $OH^{\bullet}$ radical can initiate irreversible peroxidation of many hundreds of macromolecules, e.g. lipid molecules (Halliwell, 1991). Taken together, these data show that non-thermal RFR can be absorbed by particular charges, molecules and cellular structures, and in this way can potentially induce substantial modulatory effects in living cell.

Generation of reactive oxygen species under RFR exposure in living cells

NADH oxidase of cellular membrane was suggested as a primary mediator of RFR interaction with living cells (Friedman et al., 2007). Using purified membranes from HeLa cells, the authors experimentally proved that the exposure to RFR of 875 MHz, 200 $\mu W/cm^2$ for 5 or 10 min significantly, almost threefold, increased the activity of NADH oxidase. NADH oxidases are membrane-associated enzymes that catalyze one-electron reduction of oxygen into superoxide radical using NADH as a donor of electron, thus producing powerful ROS. This enzyme has been traditionally known due to its role in induction of oxidative burst in phagocytes as a part of immune response. Yet, later the existence of non-phagocytic NAD(P)H oxidases was revealed in various types of cells, including fibroblasts, vascular and cardiac cells (Griendling et al., 2000). Obviously, the presence of superoxide-generating enzyme in many types of non-phagocytic cells points to the considerable regulatory roles of ROS in living cells. On the other hand, an ability of low-intensity RFR to modulate the activity of the NADH oxidase automatically makes this factor a notable and potentially dangerous effector of cell metabolism. Notably, the authors pointed out that the acceptor of RFR is different from the peroxide-generating NADPH oxidases, which are also found in plasma membranes (Low et al., 2012).

The other powerful source of ROS in cells is mitochondrial electron transport chain (ETC), which can generate superoxide due to breakdowns in electron transport (Inoue et al., 2003). It was demonstrated that generation of ROS by mitochondrial pathway can be activated under RFR exposure in human spermatozoa (De Iuliis et al., 2009). The authors revealed a dose-dependent effect of 1.8 GHz RFR exposure on ROS production in spermatozoa, particularly in their mitochondria. The significantly increased level of total ROS in spermatozoa was detected under RFR with SAR = 1 W/kg, which is below the safety limits accepted in many countries. It was demonstrated recently in our laboratory that the exposure of quail embryos *in ovo* to extremely low-intensity RFR (GSM 900 MHz, 0.25 μW/cm^2) during the initial days of embryogenesis resulted in a robust overproduction of superoxide and nitrogen oxide radicals in mitochondria of embryonic cells (Burlaka et al., 2013). It is not clear yet which particular part of ETC is responsible for the interaction with RFR. To date, three possible sites of generation of superoxide in ETC have been shown: the ETC complex I (Inoue et al., 2003), complex II (Liu et al., 2002), and complex III (Guzy and Schumacker, 2006). A significant inverse correlation between mitochondrial membrane potential and ROS levels in living cell was found (Wang et al., 2003). As the authors underlined, such a relationship could be due to two mutually interconnected phenomena: ROS causing damage to the mitochondrial membrane, and the damaged mitochondrial membrane causing increased ROS production.

In addition to the well-established role of the mitochondria in energy metabolism, regulation of cell death is a second major function of these organelles. This, in turn, is linked to their role as the powerful intracellular source of ROS. Mitochondria-generated ROS play an important role in the release of cytochrome c and other pro-apoptotic proteins, which can trigger caspase activation and apoptosis (Ott et al., 2007). A few reports indicate on activation of apoptosis due to low-intensity RFR exposure. In human epidermoid cancer KB cells, 1950 MHz RFR induced time-dependent apoptosis (45% after 3 h) that is paralleled by 2.5-fold decrease of the expression of ras and Raf-1 and of the activity of ras and Erk-1/2 (Caraglia et al., 2005). Primary cultured neurons and astrocytes exposed to GSM 1900 MHz RFR for 2 h demonstrated up-regulation of caspase-2, caspase-6 and Asc (apoptosis associated speck-like protein containing a card) (Zhao et al., 2007). Up-regulation in neurons occurred in both "on" and "stand-by" modes, but in astrocytes only in the "on" mode. We should underline that, in that study an extremely high biological sensitivity to RFR was demonstrated, as a cell phone in the "stand-by" position emits negligibly low-intensity of radiation (up to hundredths μW/cm^2).

Based on the analysis of available literature data, we identified altogether 100 experimental studies in biological models which investigated oxidative stress due to low-intensity RFR exposures. From these 100 articles, 93 studies (93%) demonstrated significant oxidative effects induced by low-intensity RFR exposure (Table 1–3), while 7 studies (7%) demonstrated the absence of significant changes (Table 4). The total number includes 18 *in vitro* studies, 73 studies in animals, 3 studies in plants and 6 studies in humans. Majority of the research was done on laboratory rats (58 studies, with 54 positive results), while 4 studies out of 6 in humans were positive. From the *in vitro* studies, 17 were positive (94.4%), including 2 studies on human spermatozoa and 2 studies on human blood cells.

Most of the studies utilized RFR exposure in MW range, including a use of commercial or trial cell phones as sources of radiation. The power densities of RFR applied in positive studies varied from 0.1 μW/cm^2 (Oksay et al., 2014) to 680 μW/cm^2 (Jelodar et al., 2013) and SAR values varied from 3 μW/kg (Burlaka et al., 2013) to the ICNIRP recommended limit of 2 W/kg (Naziroglu et al., 2012a; Xu et al., 2010). Exposure times in positive studies varied from 5 min (Friedman et al., 2007) to 12.5 years, 29.6 h/month (Hamzany et al., 2013).

The most often used indexes of oxidative stress analyzed in the studies were ROS production, levels of lipid peroxidation (LPO)/malondialdehyde (MDA), protein oxidation (PO), nitric oxides (NO_x), glutathione (GSH), activity of antioxidant enzymes (superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH-Px)). It is important that some studies directly pointed to induction of free radicals (superoxide radical, NO) as a primary reaction of living cells to RFR exposure (Burlaka et al., 2013; Friedman et al., 2007). As we pointed out earlier, direct activation of NADH oxidase (Friedman et al., 2007) and the mitochondrial pathway of superoxide overproduction (Burlaka et al., 2013; De Iuliis et al., 2009) have been experimentally proven. Besides, a significant overproduction of nitrogen oxide was revealed in some studies (Avci et al., 2012; Bilgici et al., 2013; Burlaka et al., 2013), although it is unclear whether an induction of expression of NO-synthases or direct activation of the enzyme took place. It is however clear that significantly increased levels of these free radical species (superoxide and nitrogen oxide) in cells due to RFR exposure result in an activation of peroxidation and repression of activities of key antioxidant enzymes. It is indicative that many studies demonstrated effectiveness of different

Table 1. Publications which reported positive findings on oxidative stress caused by RFR exposure of cells *in vitro*.

Reference	Biological system exposed	RFR exposure	Statistically significant effects reported*
(Agarwal et al., 2009)	Human spermatozoa	Cell phone RFR, in talk mode, for 1 h	Increase in reactive oxygen species (ROS) level, decrease in sperm motility and viability.
(Campisi et al., 2010)	Rat astroglial cells	900 MHz (continuous or modulated), electric field 10 V/m, for5; 10; 20 min	Increase in ROS levels and DNA fragmentation after exposure to modulated RFR for 20 min.
(De Iuliis et al., 2009)	Human spermatozoa	1.8 GHz, SAR = 0.4–27.5 W/kg	Increased amounts of ROS.
(Friedman et al., 2007)	HeLa membranes	875 MHz, 200 μW/cm^2, for 5 and 10 min	Increased NADH oxidase activity.
(Hou et al., 2014)	Mouse embryonic fibroblasts (NIH/3T3)	1800-MHz GSM-talk mode RFR, SAR = 2 W/kg, intermittent exposure (5 min on/ 10 min off) for 0.5–8 h	Increased intracellular ROS levels.
(Kahya et al., 2014)	Cancer cell cultures	900 MHz RFR, SAR = 0.36 W/kg, for 1 h	Induced apoptosis effects through oxidative stress, selenium counteracted the effects of RFR exposure.
(Lantow et al., 2006a)	Human blood cells	Continuous wave or GSM signal,SAR = 2 W/kg, for 30 or 45 min of continuous or 5 min ON, 5 min OFF	After continuous or intermittent GSMsignal a different ROS production was detected in human monocytes compared to sham.
(Lantow et al., 2006b)	Human Mono Mac 6 and K562 cells	Continuous wave, GSM speaking only, GSM hearing only, GSM talk, SARs of 0.5, 1.0, 1.5 and 2.0 W/kg.	The GSM-DTX signal at 2 W/kg produced difference in free radical production compared to sham.
(Liu et al., 2013b)	GC-2 cells	1800 MHz, SAR = 1; 2 W/kg,5 min ON, 10 min OFF for 24 h	In the 2 W/kg exposed cultures, the level of ROS was increased.
(Lu et al., 2012)	Human blood mononuclear cells	900 MHz, SAR = 0.4 W/kg, for 1–8 h	The increased level of apoptosis induced through the mitochondrial pathway and mediated by activating ROS and caspase-3.
(Marjanovic et al., 2014)	V79 cells	1800 MHz, SAR = 1.6 W/kg, for 10, 30 and 60 min	ROS level increased after 10 min of exposure. Decrease in ROS level after 30-min treatment indicating antioxidant defense mechanism activation.
(Naziroglu et al., 2012b)	HL-60 cells	2450 MHz, pulsed, SAR = 0.1–2.5 W/kg, for 1; 2; 12 or 24 h	Lipid peroxide (LPO) levels were increased at all exposure times.
(Ni et al., 2013)	Human lens epithelial cells	1800 MHz, SAR = 2; 3; 4 W/kg	The ROS and malondialdehyde (MDA) levels were increased.
(Pilla, 2012)	Neuronal cells and human fibroblasts	27.12 MHz, pulsed, electric field 41 V/m, 2 min prior to lipopolysaccharide administration or for 15 min	Increased level of nitric oxide (NO).
(Sefidbakht et al., 2014)	HEK293T cells	940 MHz, SAR = 0.09 W/kg, for 15, 30, 45, 60 and 90 min	ROS generation increased in the 30 min exposed cells. A sharp rise in catalase (CAT) and superoxide dismutase (SOD) activity and elevation of glutathione (GSH) during the 45 min exposure.
(Xu et al., 2010)	Primary cultured neurons	1800 MHz, pulsed, SAR = 2 W/kg, for 24 h	An increase in the levels of8-hydroxy-2'-deoxyguanosine (8-OH-dG).
(Zmyślony et al., 2004)	Rat lymphocytes	930 MHz, PD of 500 μW/cm^2, SAR = 1.5 W/kg, for 5 and 15 min	Intracellular ROS level increased in exposed $FeCl_2$ treated cells compared with unexposed $FeCl_2$ treated cells.

*All effects were statistically significant (at least $p < 0.05$) as compared to control or sham exposed groups.

antioxidants to override oxidative stress caused by RFR exposure. Such effects have been reported for melatonin (Ayata et al., 2004; Lai and Singh, 1997; Oktem et al., 2005; Ozguner et al., 2006; Sokolovic et al., 2008), vitamin E and C (Jelodar et al., 2013; Oral et al., 2006), caffeic acid phenethyl ester (Ozguner et al., 2006), selenium, L-carnitine (Turker et al., 2011) and garlic (Avci et al., 2012; Bilgici et al., 2013).

It is worthwhile to emphasize a strict non-thermal character of ROS overproduction under RFR exposure described in the cited reports. As low as 0.1 μW/cm^2 intensity of RFR and absorbed energy (specific absorption rate, SAR) of 0.3 μW/kg were demonstrated to be effective in inducing significant oxidative stress in living cells (Burlaka et al., 2013; Oksay et al., 2014). This observation is particularly important as the modern international safety limits on RFR exposure are based solely on the thermal effects of radiation and only restrict RFR intensity to 450–1000 μW/cm^2 and SAR to 2 W/kg (ICNIRP, 1998). Moreover, studies where high (thermal) intensities of RFR have been used could not reveal oxidative effects (Hong et al., 2012; Kang et al., 2013; Luukkonen et al., 2009), which might point to the variety of molecular mechanisms for different radiation intensities.

Taken together, the analysis of the contemporary scientific literature on the biological effects of RFR persuasively proves that the exposure to low-intensity RFR in living cells leads to generation of significant levels of ROS and results in a significant oxidative stress.

Oxidative damage of DNA under RFR exposure

To date more than hundred papers have been published on mutagenic effects of RFR and most of them revealed significant effects (Ruediger, 2009). There is a substantial number of studies which demonstrated the formation of micronuclei (Garaj-Vrhovac et al., 1992; Tice et al., 2002; Zotti-Martelli et al., 2005) or structural anomalies of metaphase chromosomes (Garson et al., 1991; Kerbacher et al., 1990; Maes et al., 2000) in living

Table 2. Publications which reported positive findings on oxidative stress caused by RFR exposure of animals and plants.

Reference	Biological system exposed	RFR exposure	Statistically significant effects reported*
(Akbari et al., 2014)	Rat whole body	RFR from base transceiver station	Glutathione peroxidase (GSH-Px), SOD, and CAT activity decreased and level of MDA increased. Vitamin C reduced the effect.
(Al-Damegh, 2012)	Rat whole body	Cell phone RFR, 15, 30, or 60 min/day for 2 weeks	Levels of conjugated dienes, LPO and CAT activities in serum and testicular tissue increased, the total serum and testicular tissue GSH and GSH-Px levels decreased.
(Avci et al., 2012)	Rat whole body	1800 MHz, SAR = 0.4 W/kg, 1 h/day for 3 weeks	An increased level of protein oxidation (PO) in brain tissue and an increase in serum NO. Garlic administration reduced protein oxidation in brain tissue.
(Ayata et al., 2004)	Rat whole body	900 MHz, 30 min/day for 10 days	MDA and hydroxyproline levels and activities of CAT and GSH-Px were increased, andsuperoxide dismutase (SOD) activity was decreased in skin. Melatonin treatment reversed effect.
(Aynali et al., 2013)	Rat whole body	2450 MHz, pulsed, SAR = 0.143 W/kg,60 min/day for 30 days	LPO was increased, an administration of melatonin prevented this effect.
(Balci et al., 2007)	Rat whole body	"Standardized daily dose" of cell phoneRFR for 4 weeks	In corneal tissue, MDA level and CAT activity increased, whereas SOD activity was decreased. In the lens tissues, the MDA level was increased.
(Bilgici et al., 2013)	Rat whole body	850–950 MHz,SAR = 1.08 W/kg,1 h/day for 3 weeks	The serum NO levels and levels of MDA and the PO in brain were increased. An administration of garlic extract diminished these effects.
(Bodera et al., 2013)	Rat whole body	1800 MHz, GSM, for 15 min	Reduced antioxidant capacity both in healthy animals and in those with paw inflammation.
(Burlaka et al., 2013)	Quail embryo *in ovo*	GSM 900 MHz, power density (PD) of 0.25 μW/cm^2, SAR = 3 μW/kg, 48 sec ON - 12 sec OFF, for 158–360 h	Overproduction of superoxide and NO, increased levels of thiobarbituric acid reactive substances (TBARS) and 8-OH-dG, decreased SOD and CAT activities.
(Burlaka et al., 2014)	Male rat whole body	Pulsed and continuous MWin the doses equivalent to the maximal permitted energy load for the staffs of the radar stations	Increased rates of superoxide production, formation of the iron-nitrosyl complexes and decreased activity of NADH-ubiquinone oxidoreductase complex in liver, cardiac and aorta tissues 28 days after the exposure.
(Cenesiz et al., 2011)	Guinea pig whole body	900; 1800 MHz RFR from base station antennas, 4 h/day for 20 days	Difference in guinea pigs subjected to 900 and 1800 MHz for plasma oxidant status levels. NO level changed in 900 MHz subjected guinea pigs, as compared to the control.
(Cetin et al., 2014)	Pregnant rats and offspring	900; 1800 MHz RFR, 1 h/day during pregnancy and neonatal development	Brain and liver GSH-Px activities, selenium concentrations in the brain and liver vitamin A and β-carotene concentrations decreased in offspring.
(Dasdag et al., 2009)	Head of rats	900 MHz, 2 h/day for 10 months	The total antioxidant capacity and CATactivity in brains were higher than that in the sham group.
(Dasdag et al., 2012)	Head of rats	900 MHz, cell-phones-like, 2 h/day for 10 months	Protein carbonyl level was higher in the brain of exposedrats.
(Dasdag et al., 2008)	Rat whole body	900 MHz, PD of 78 μW/cm^2, 2 h/days for10 months.	Increased levels of MDA and total oxidative status in liver tissue.
(Deshmukh et al., 2013)	Rat whole body	900 MHz, 2 h/day, 5 days a week for 30 days	The levels of LPO and PO were increased.
(Esmekaya et al., 2011)	Rat whole body	900 MHz, pulsed, modulated, SAR = 1.2 W/kg, 20 min/day for 3 weeks	The increased level of MDA and NOx, and decreased levels of GSH in liver, lung, testis and heart tissues.
(Furtado-Filho et al., 2014)	Rat whole body	950 MHz, SAR = 0.01–0.88 W/kg,30 min/day for 21 days during pregnancy (or additionally 6 or 15 days of postnatal period)	Neonatal rats exposed in utero had decreased levels of CAT and lower LPO, and genotoxic effect.
(Guler et al., 2012)	Rabbit infant whole body	GSM 1800 MHz, 15 min/day for 7 days (females) or 14 days (males)	LPO levels in the liver tissues of females and males increased,liver 8-OH-dG levels of females were increased.
(Guney et al., 2007)	Rat whole body	900 MHz, 30 min/day for 30 days	Endometrial levels of NO and MDA increased, endometrial SOD, CAT and GSH-Px activities were decreased.Vitamin E and C treatment prevented these effects.
(Gürler et al., 2014)	Rat whole body	2450 MHz, 3.68 V/m, 1 h/day for 30 days	Increased 8-OH-dG level in both plasma and brain tissue whereas it increased PO level only in plasma. Garlic prevented the increase of 8-OH-dG level in brain tissue and plasma PO levels.
(Ilhan et al., 2004)	Rat whole body	900 MHz, from cell phone,1 h/day for 7 days	Increase in MDA, NO levels, andxanthine oxidase (XO) activity, decrease in SOD and GSH-Px activities in brain. These effects were prevented by Ginkgo bilobaextract treatment.
(Jelodar, et al., 2013)	Rat whole body	900 MHz, PD of 680 μW/cm^2, 4 h/day for 45 days,	The concentration of MDA was increased and activities of SOD, GSH-Px and CAT were decreased in rat eyes. An administration of vitamin C prevented these effects.
(Jelodar et al., 2013)	Rat whole body	900 MHz, daily for 45 days	Increased level of MDA and decreased antioxidant enzymes activity in rat testis.
(Jing et al., 2012)	Rat whole body	Cell phone RFR, SAR = 0.9 W/kg,3 x 10; 30 or 60 min for 20 days during gestation	After 30 and 60 min the level of MDA was increased, the activities of SOD and GSH-Pxwere decreased.

(*Continued*)

Table 2. (Continued).

Reference	Biological system exposed	RFR exposure	Statistically significant effects reported*
(Kerman & Senol, 2012)	Rat whole body	900 MHz, 30 min/day for 10 days	Tissue MDA levels were increased, SOD, CAT and GSH-Pxactivities were reduced. Melatonin treatment reversed these effects.
(Kesari et al., 2010)	Male rat whole body	Cell phone RFR, SAR = 0.9 W/kg,2 h/day for 35 days	Reduction in protein kinase activity, decrease in sperm count and increase in apoptosis.
(Kesari et al., 2011)	Rat whole body	900 MHz, pulsed, SAR = 0.9 W/kg,2 h/day for 45 days	Increase in the level of ROS, decrease in the activities of SOD and GSH-Px,and in the level of pineal melatonin.
(Kesari et al., 2013)	Rat whole body	2115 MHz, SAR = 0.26 W/kg,2 h/day for 60 days	The level of ROS, DNA damage and theapoptosis rate were increased.
(Khalil et al., 2012)	Rat whole body	1800 MHz, electric field 15–20 V/m, for2 h	Elevations in the levels of 8-OH-dG in urine.
(Kismali et al., 2012)	Rabbit whole body (non-pregnant and pregnant)	1800 MHz, GSM modulation, 15 min/day for 7 days	Creatine kinases levels' changes.
(Koc et al., 2013)	Male rat whole body	Cell phone RFR at calling or stand-by	Oxidative stress detected at both calling and stand-by exposures.
(Koylu et al., 2006)	Rat whole body	900 MHz	The levels of LPO in the brain cortex and hippocampus increased.These levels in the hippocampus were decreased by melatonin administration.
(Koyu et al., 2009)	Rat whole body	900 MHz	The activities of XO, CAT and level of LPO increased in liver.XO, CAT activities and LPO levels were decreased by caffeic acid phenethyl ester (CAPE) administration.
(Kumar et al., 2014)	Rat whole body	Cell phone 1910.5 MHz RFR, 2 h/day for 60 days day (6 days a week).	Increase in LPO, damage in sperm cells and DNA damage.
(Lai & Singh, 1997)	Rat whole body	2450 MHz, pulsed, PD = 2 mW/cm^2, SAR = 1.2 W/kg	Melatonin or spin-trap compound blocked DNA strand breaks induced by RFR exposure in rat brain cells.
(Luo et al., 2014)	Rat whole body	900 MHz imitated cell phone RFR, 4 h/day for 12 days	Contents of liver MDA and Nrf2 protein increased, contents of liver SOD and GSH decreased.
(Mailankot et al., 2009)	Rat whole body	900/1800 MHz,GSM,1 h/day for 28 days	Increase in LPO and decreased GSH content in the testis and epididymis.
(Manta et al., 2013)	Drosophila whole body	1880–1900 MHz, DECT modulation, SAR = 0.009 W/kg, for 0.5–96 h	Increase in ROS levels in male and female bodies, a quick response in ROS increase in ovaries.
(Marzook et al., 2014)	Rat whole body	900 MHz from cellular tower, 24 h/day for 8 weeks	SOD and CAT activities were reduced in blood, sesame oil reversed the effect
(Meena et al., 2013)	Rat whole body	2450 MHz, PDof 210 μW/cm^2, SAR = 0.14 W/kg, 2 h/day for 45 days	Increased level of MDA and ROS in testis. Melatonin prevented oxidative stress.
(Megha et al., 2012)	Rat whole body	900; 1800 MHz, PD of 170 μW/cm^2, SAR = 0.6 mW/kg, 2 h/day, 5 days/week for 30 days	The levels of the LPO and PO were increased; the level of GSH was decreased.
(Meral et al., 2007)	Guinea pig whole body	890–915 MHz,from cell phone, SAR = 0.95 w/kg, 12 h/day for 30 days (11 h 45 min stand-by and 15 min spiking mode)	MDA level increased, GSH level and CAT activity weredecreased in the brain. MDA, vitamins A, D_3 and E levels and CAT enzyme activity increased, and GSH level was decreased in the blood.
(Motawi et al., 2014)	Rat whole body	Test cellphone RFR, SAR = 1.13 W/kg, 2 h/day for 60 days	Increments in conjugated dienes, protein carbonyls, total oxidant status and oxidative stress index along with a reduction of total antioxidant capacity levels.
(Naziroglu & Gumral, 2009)	Rat whole body	2450 MHz,60 min/day for 28 days	Decrease of the cortex brain vitamin A, vitamin C and vitamin E levels.
(Naziroglu et al., 2012a)	Rat whole body	2450 MHz, 60 min/day for 30 days	LPO, cell viability and cytosolic Ca^{2+} values in dorsal root ganglion neurons were increased.
(Oksay et al., 2014)	Rat whole body	2450 MHz, pulsed, PD of0.1 μW/cm^2, SAR = 0.1 W/kg, 1 h/day for 30 days	LPO was higher in exposed animals. Melatonin treatment reversed the effect.
(Oktem et al., 2005)	Rat whole body	900 MHz, 30 min/day for 10 days	Renal tissue MDA level increased, SOD, CAT and GSH-Px activities were reduced. Melatonin treatment reversed these effects.
(Oral et al., 2006)	Rat whole body	900 MHz, 30 min/day for 30 days	Increased MDA levels and apoptosis in endometrial tissue.Treatment with vitamins E and C diminished these changes.
(Ozguner et al., 2005a)	Rat whole body	900 MHz, 30 min/day for 10 days	Heart tissue MDA and NO levels increased, SOD, CAT and GSH-Px activities were reduced. CAPE treatment reversed these effects.
(Ozguner et al., 2006)	Rat whole body	900 MHz, from cell phone	Retinal levels of NO and MDA increased, SOD, GSH-Px and CAT activities were decreased.Melatonin and CAPE treatment prevented effects.
(Ozguner et al., 2005b)	Rat whole body	900 MHz	Renal tissue MDA and NO levels increased, the activities of SOD, CAT and GSH-Px were reduced. CAPE treatment reversed these effects.
(Ozgur et al., 2010)	Guinea pig whole body	1800 MHz,GSM, SAR = 0.38 W/kg, 10 or 20 min/day for 7 days	Increases in MDA and total NO(x) levels and decreases in activities of SOD, myeloperoxidase and GSH-Px in liver. Extent of oxidative damage was proportional to the duration of exposure.
(Ozgur et al., 2013)	Rabbit whole body	1800 MHz, pulsed, 15 min/day for 7 days in pregnant animals, for 7 or 15 days in infants	The amount of LPO was increased in the prenatal exposure group.

(*Continued*)

Table 2. (Continued).

Reference	Biological system exposed	RFR exposure	Statistically significant effects reported*
(Özorak et al., 2013)	Rat whole body	900; 1800; 2450 MHz, pulsed, PD of 12 μW/cm^2. SAR = 0.18; 1.2 W/kg, 60 min/day during gestation and 6 weeks following delivery	At the age of six weeks, an increased LPO in the kidney and testis, and decreased level of GSH and total antioxidant status.
(Qin et al., 2014)	Male mouse whole body	1800 MHz, 208 μW/cm^2, 30 or 120 min/d for 30 days	Decreased activities of CAT and GSH-Px and increasedlevel of MDA in cerebrum. Nano-selenium decreased MDA level, and increased GSH-Px and CAT activities.
(Ragy, 2014)	Rat whole body	Cell phone 900 MHz RFR, 1 h/d for 60 days	Increase in MDA levels and decrease total antioxidant capacity levels in brain, liver and kidneys tissues. These alterations were corrected by withdrawal of RFR exposure during 30 days.
(Saikhedkar et al., 2014)	Rat whole body	Cell phone 900 MHz RFR, 4 h/d for 15 days	A significant change in level of antioxidant enzymes and non-enzymatic antioxidants, and an increase in LPO.
(Shahin et al., 2013)	Mouse whole body	2450 MHz, PD of 33.5 μW/cm^2, SAR = 23 mW/kg, 2 h/day for 45 days	An increase in ROS, decrease in NO and antioxidant enzymes activities.
(Sharma et al., 2009)	Plant(mung bean) whole body	900 MHz, from cell phone, PD of 8.55 μW/cm^2; for 0.5; 1; 2, and 4 h	Increased level of MDA,H_2O_2 accumulation and root oxidizability, upregulation in the activities of SOD, CAT, ascorbate peroxidases, guaiacol peroxidases and GSHreductases in roots.
(Singh et al., 2012)	Plant (mung bean) whole body	900 MHz,from cell phone	The increased level of MDA, hydrogen peroxide and proline content in hypocotyls.
(Sokolovic et al., 2008)	Rat whole body	RFR from cell phone, SAR = 0.043–0.135 W/kg, for 20, 40 and 60 days	An increase in the brain tissue MDA and carbonyl group concentration. Decreased activity of CAT and increased activity of xanthine oxidase (XO). Melatonin treatment prevented the effects.
(Sokolovic et al., 2013)	Rat whole body	900 MHz, SAR = 0,043–0.135 W/kg,4 h/day for 29; 40 or 60 days,	The level of LPO and PO, activities of CAT, XO, number of apoptotic cells were increased in thymus tissue. An administration of melatonin prevented these effects.
(Suleyman et al., 2004)	Rat whole body	Cell phoneRFR,SAR = 0.52 W/kg,20 min/day for 1 month	MDA concentration was increased in brains.
(Tkalec et al., 2007)	Plant Lemna minor (duckweed)	400 and 900 MHz, 10, 23, 41 and 120 V/m, for 2 or 4 h	LPO and H_2O_2 content increased: CAT activity increased, pyrogallol peroxidase decreased.
(Tkalec et al., 2013)	Earthworm whole body	900 MHz, PD of 30–3800 μW/cm^2, SAR = 0.13–9.33 mW/kg, for 2 h	The protein carbonyl content was increased in all exposures above 30 μWc/m^2. The level of MDA was increased at 140μW/cm^2.
(Tök et al., 2014)	Rat whole body	2450 MHz, Wi-Fi RFR, 60 min/day for 30 days	Decreased GSH-Px activity. GSH-Px activity and GSH values increased after melatonin treatment.
(Tomruk et al., 2010)	Rabbit whole body	1800 MHz, GSM-like signal, 15 min/day for a week	Increase of MDA and ferrous oxidation in xylenol orange levels.
(Tsybulin et al., 2012)	Quail embryo *in ovo*	900 MHz, fromcell phone, GSM, PD of 0.024–0.21 μW/cm^2, intermittent for 14 days	Increased level of TBARS in brains and livers of hatchlings.
(Turker et al., 2011)	Rat partial body	2450 MHz, pulsed, SAR = 0.1 W/kg,1 h/day for 28 days	The increased level of LPO, the decreased concentrations of vitamin A, vitamin C and vitamin E. There was a protective effect of selenium and L-carnitine.
(Türedi et al., 2014)	Pregnant rat whole body	900 MHz, 13.7 V/m, 50 μW/cm^2, 1 h/day for 13–21 days of pregnancy	MDA, SOD and CAT values increased, GSH values decreased in exposed pups.
(Yurekli et al., 2006)	Rat whole body	945 MHz, GSM, PD of 367 μW/cm^2, SAR = 11.3 mW/kg	MDA level and SOD activity increased, GSH concentration was decreased.

*All effects were statistically significant (at least $p < 0.05$) as compared to control or sham exposed groups.

Table 3. Publications which reported positive findings on oxidative stress caused by RFR exposure of humans.

Reference	Biological system exposed	RFR exposure	Statistically significant effects reported*
(Abu Khadra et al., 2014)	Human male head	GSM 1800 MHz from cell phone, SAR = 1.09 W/kg, for 15 and 30 min	SOD activity in saliva increased.
(Garaj-Vrhovac et al., 2011)	Human whole body	3; 5.5; 9.4 GHz, pulsed, from radars	Increased level of MDA, decreased level of GSH.
(Hamzany et al., 2013)	Human head/ whole body	RFR from cell phone a mean time of 29.6 h/ month for 12.5 years	Increase in all salivary oxidative stress indices.
(Moustafa et al., 2001)	Human male body	Cell phone in a pocket in standby position, for 1; 2 or 4 h	Plasma level of LPO was increased, activities of SOD and GSH-Px in erythrocytes decreased.

*All effects were statistically significant (at least $p < 0.05$) as compared to control or sham-exposed groups.

cells due to low-intensity RFR exposure. However, majority of the studies on the mutagenic effects of RFR successfully used a comet assay approach (Baohong et al., 2005; Belyaev et al., 2006; Diem et al., 2005; Kim et al., 2008; Lai and Singh, 1996; Liu et al., 2013a). Particular studies identified specific marker of oxidative damage of DNA, 8-hydroxy-2'-deoxyguanosine (8-OH-dG) (Burlaka et al., 2013; De Iuliis et al.,

Table 4. Publications which reported no significant oxidative effects after RFR exposure.

Reference	Biological system exposed	RFR exposure	Effects reported
(Hook et al., 2004)	Mammalian cells *in vitro*	835.62 MHz (frequency-modulated continuous-wave, FMCW) and 847.74 MHz (code division multiple access, CDMA), SAR = 0.8 W/kg, for 20–22 h	FMCW- and CDMA-modulated RFR did not alter parameters indicative of oxidative stress.
(Ferreira et al., 2006a)	Rat whole body	800–1800 MHz, from cell phone	No changes in lipid and protein damage, and in non-enzymatic antioxidant defense in frontal cortex or hippocampus.
(Ferreira et al., 2006b)	Pregnant rat whole body	RFR from cell phone	No differences in oxidative parameter of offspring blood and liver, but increase in erythrocytes micronuclei incidence in offspring.
(Dasdag et al., 2003)	Rat whole body	Cell phone RFR, SAR = 0.52 W/kg, 20 min/day for 1 month	No alteration in MDA concentration.
(Demirel et al., 2012)	Rat whole body	3G cell phone RFR, "standardized daily dose" for 20 days	No difference in GSH-Px and CAT activity in eye tissues, in MDA and GSH levels in blood.
(Khalil et al., 2014)	Human head/whole body	Cell phone RFR (talking mode) for 15 or 30 min	No relationship between exposure and changes in the salivary oxidant/antioxidant profile.
(de Souza et al., 2014)	Human head/whole body	Cell phone RFR	No difference in the saliva from the parotid gland exposed to cell phone RFR to the saliva from the opposite gland of each individual.

2009; Guler et al., 2012; Khalil et al., 2012; Xu et al., 2010). Thus, the level of 8-OH-dG in human spermatozoa was shown to be significantly increased after *in vitro* exposure to low-intensity RFR (De Iuliis et al., 2009). Likewise, we demonstrated that the exposure of quail embryos *in ovo* to GSM 900 MHz of 0.25 $\mu W/cm^2$ during a few days was sufficient for a significant, two-threefold, increase of 8-OH-dG level in embryonic cells (Burlaka et al., 2013).

It would be logical to assume that most mutagenic effects due to the RFR exposure are caused by oxidative damage to DNA, as the overproduction of ROS in living cells due to RFR exposure was reliably documented. It is known that superoxide itself does not affect DNA. The most aggressive form of ROS, which is able to affect the DNA molecule directly, is hydroxyl radical (Halliwell, 2007). The hydroxyl radicals are generated in cell in the Fenton reaction ($Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + OH^{\bullet} + OH^-$) and in the Haber–Weiss reaction ($O_2^{\bullet-} + H_2O_2 \rightarrow O_2 + OH^{\bullet} + OH^-$) (Valko et al., 2006). On the other hand, increased concentration of NO in addition to superoxide in the RFR-exposed cells can lead to the formation of other aggressive form of ROS, peroxynitrite ($ONOO^-$), which can also cause DNA damage (Valko et al., 2006).

Free radicals induced under the RFR exposure can perturb cellular signaling

Taking into account the abovementioned data, we can state that the exposure to RFR leads to overproduction of free radicals/ROS in living cell. Certainly, free radicals can induce harmful effects via direct damage due to oxidation of biological macromolecules. To that, it becomes clear nowadays that free radicals/ROS are an intrinsic part of the cellular signaling cascades (Forman et al., 2014). Thus, hydrogen peroxide appears as a second messenger both in insulin signaling and in growth factor-induced signalling cascades (Sies, 2014). These species are also implicated in biochemical mechanism of oxidation of ethanol and in other metabolic processes (Oshino et al., 1975) and is also required for initiation of wound repair (Enyedi and Niethammer, 2013). In addition, ROS at relatively low concentrations can modulate inflammation via activation of NF-kB pathway (Hayden and Ghosh, 2011). Therefore, even subtle exposures to RFR with generation of hardly detectable quantities of free radicals can have their meaningful biological consequences.

We could ascertain the signaling effects of moderate levels of free radicals from our experiments in quail embryos irradiated with the commercial cell phone. Thus, we were able to show that the prolonged exposures of embryos *in ovo* led to robust repression of their development (Tsybulin et al., 2013), which was concomitant with significant overproduction of superoxide radical and NO radical, increased rates of lipid peroxidation and oxidative damage of DNA (Burlaka et al., 2013; Tsybulin et al., 2012). Notably, shorter exposures instead led to enhancement in embryonic development (Tsybulin et al., 2012, 2013). We demonstrated the favorable effects of shorter exposures also on the molecular level. Thus, after the short-time RFR exposure the DNA comets in embryonic cells were significantly shorter than in the control non-irradiated embryos, pointing to activation of mechanisms maintaining the integrity of DNA. The "beneficial" consequences of the irradiation could be explained by hormesis effect (Calabrese, 2008). However, one could hypothesize that the "beneficial" effects of the irradiation could be explained by the signaling action of free radicals induced at levels below the damaging concentrations.

Obviously, any seemingly beneficial effect of external environmental impact should be treated with caution and possibly minimized before careful evaluation of the long-term consequences. Altogether, this gives a clear warning of the adverse health effects of low-intensity RFR, which could be evoked both by the direct oxidative damage and by disturbed cellular signaling.

Oxidative effects and non-cancer health effects of RFR

A new medical condition, so-called electrohypersensitivity (EHS), in which people suffer due to RFR exposure, has been described (Johansson, 2006). Typically, these persons suffer from skin- and mucosa-related symptoms (itching, smarting, pain, heat sensation), or heart and nervous system disorders after exposure to computer monitors, cell phones and other electromagnetic devices. This disorder is growing continuously: starting from 0.06% of the total population in 1985, this category now includes as much as 9–11% of the European population (Hallberg and Oberfeld, 2006). In Sweden, for example, EHS has become an officially recognized health impairment.

To that, a high percentage, up to 18–43% of young people, has recently been described to be suffering from headache/earache during or after cell phone conversations (Chu et al., 2011; Yakymenko et al., 2011). Likewise, a number of psychophysical and preclinical disorders including fatigue, irritation, headache, sleep disorders, hormonal imbalances were detected in high percent of people living nearby cell phone base transceiver stations (Buchner and Eger, 2011; Santini et al., 2002).

An allergy reaction to RFR in humans has been confirmed by a significant increase in the level of mast cells in skin of persons under exposure to electromagnetic devices (Johansson et al., 2001). Likewise, higher level of degranulated mast cells in dermis of EHS persons has been detected (Johansson, 2006). In turn, the activated mast cells can release histamine and other mediators of such reactions which include allergic hypersensitivity, itching, dermatoses, etc. Importantly, an implication of ROS in allergic reactions is rather clear nowadays. For example, in case of airway allergic inflammation, the lung cells generate superoxide in nanomolar concentrations following antigen challenges (Nagata, 2005). Then, mast cells generate ROS following aggregation of FcεRI, a high-affinity IgE receptor (Okayama, 2005). In addition, pollen NADPH oxidases rapidly increase the level of ROS in lung epithelium (Boldogh et al., 2005); and removal of pollen NADPH oxidases from the challenge material reduced antigen-induced allergic airway inflammation. Thus, it seems plausible that EHS-like conditions can be attributed at least partially to ROS overproduction in cells due to RFR exposures.

Oxidative effects and potential carcinogenicity of RFR

During recent years, a number of epidemiological studies indicated a significant increase in incidence of various types of tumors among long-term or "heavy" users of cellular phones (Yakymenko et al., 2011). Briefly, reports pointed to the increased risk in brain tumors (Cardis et al., 2010; Hardell and Carlberg, 2009; Hardell et al., 2007), acoustic neuroma (Hardell et al., 2005; Sato et al., 2011), tumors of parotid glands (Sadetzki et al., 2008), seminomas (Hardell et al., 2007), melanomas (Hardell et al., 2011) and lymphomas (Hardell et al., 2005) in these cohorts of people. To that, a significant increase in tumor incidence among people living nearby cellular base transceiver stations was also reported (Eger et al., 2004; Wolf and Wolf, 2007). Similarly, experimental evidences of cancer expansion in rodents caused by long-term low-intensity RFR exposure were published (Chou et al., 1992; Repacholi et al., 1997; Szmigielski et al., 1982; Toler et al., 1997). To that, activation of ODC was detected in RFR-exposed cells (Hoyto et al., 2007). ODC is involved in processes of cell growth and differentiation, and its activity is increased in tumor cells. Although overexpression of ODC is not sufficient for tumorigenic transformation, an increased activity of this enzyme was shown to promote the development of tumors from pre-tumor cells (Clifford et al., 1995).

Significant overproduction of ROS leads to oxidative stress in living cells, induces oxidative damage of DNA and can cause malignant transformation (Halliwell and Whiteman, 2004; Valko et al., 2007). It is known that in addition to mutagenic effects, ROS play a role as a second messenger for intracellular signaling cascades which can also induce oncogenic transformation (Valko et al., 2006). Earlier we hypothesized (Burlaka et al., 2013) that low-intensity RFR exposure leads to dysfunctions of mitochondria, which result in overproduction of superoxide and NO, and subsequently to ROS-mediated mutagenesis. To that, it is well established that oxidative stress is associated with carcinogenesis; for instance, the oxidative stress elicited by Membrane-Type 1 Matrix Metalloproteinase is implicated in both the pathogenesis and progression of prostate cancer (Nguyen et al., 2011). Similarly, a progressive elevation in mitochondrial ROS production (chronic ROS) under both hypoxia and/or low glucose,

which leads to stabilization of cells via increased HIF-2alpha expression, can eventually result in malignant transformation (Ralph et al., 2010). These data, together with the strong experimental evidences on activation of NADH oxidase under RFR exposure (Friedman et al., 2007) suggest that low-intensity RFR is a multifactorial stress factor for living cell, significant feature of which is oxidative effects and potential carcinogenicity as a result.

Conclusions

The analysis of modern data on biological effects of low-intensity RFR leads to a firm conclusion that this physical agent is a powerful oxidative stressor for living cell. The oxidative efficiency of RFR can be mediated via changes in activities of key ROS-generating systems, including mitochondria and non-phagocytic NADH oxidases, via direct effects on water molecules, and via induction of conformation changes in biologically important macromolecules. In turn, a broad biological potential of ROS and other free radicals, including both their mutagenic effects and their signaling regulatory potential, makes RFR a potentially hazardous factor for human health. We suggest minimizing the intensity and time of RFR exposures, and taking a precautionary approach towards wireless technologies in everyday human life.

Acknowledgments

The authors are grateful to the unknown referees for the valuable comments on the first version of the manuscript.

Declaration of interest

The authors declare no conflicts of interest. This study was supported by National Academy of Sciences of Ukraine (I.Y., E.S.) and by University of Campinas via PPVE (Programa Professor Visitante do Exterior), Brazil (S.K.).

References

Abdel-Rassoul, G., El-Fateh, O. A., Salem, M. A., et al. (2007). Neurobehavioral effects among inhabitants around mobile phone base stations. *Neurotoxicology* 28:434–440.

Abu Khadra, K. M., Khalil, A. M., Abu Samak, M., et al. (2014). Evaluation of selected biochemical parameters in the saliva of young males using mobile phones. *Electromagn. Biol. Med.* 32:72–76.

Agarwal, A., Desai, N. R., Makker, K., et al. (2009). Effects of radiofrequency electromagnetic waves (RF-EMW) from cellular phones on human ejaculated semen: An in vitro pilot study. *Fertil. Steril.* 92:1318–1325.

Akbari, A., Jelodar, G., Nazifi, S. (2014). Vitamin C protects rat cerebellum and encephalon from oxidative stress following exposure to radiofrequency wave generated by BTS antenna mobile. *Toxicol. Mechanisms Methods* 24:347–352.

Al-Damegh, M. A. (2012). Rat testicular impairment induced by electromagnetic radiation from a conventional cellular telephone and the protective effects of the antioxidants vitamins C and E. *Clinics* 67:785–792.

Avci, B., Akar, A., Bilgici, B., et al. (2012). Oxidative stress induced by 1.8 GHz radio frequency electromagnetic radiation and effects of garlic extract in rats. *Int. J. Radiat. Biol.* 88:799–805.

Ayata, A., Mollaoglu, H., Yilmaz, H. R., et al. (2004). Oxidative stress-mediated skin damage in an experimental mobile phone model can be prevented by melatonin. *J. Dermatol.* 31:878–883.

Aynali, G., Naziroglu, M., Celik, O., et al. (2013). Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin. *Eur. Arch. Oto-Rhino-Laryngol.* 270:1695–1700.

Balci, M., Devrim, E., Durak, I. (2007). Effects of mobile phones on oxidant/antioxidant balance in cornea and lens of rats. *Curr. Eye Res.* 32:21–25.

Baohong, W., Jiliang, H., Lifen, J., et al. (2005). Studying the synergistic damage effects induced by 1.8 GHz radiofrequency field radiation (RFR) with four chemical mutagens on human lymphocyte DNA using comet assay in vitro. *Mutat. Res.* 578:149–157.

Belyaev, I. (2010). Dependence of non-thermal biological effects of microwaves on physical and biological variables: Implications for reproducibility and safety standards. *Eur. J. Oncol. Library* 5:187–217.

Belyaev, I. Y., Koch, C. B., Terenius, O., et al. (2006). Exposure of rat brain to 915 MHz GSM microwaves induces changes in gene expression but not double stranded DNA breaks or effects on chromatin conformation. *Bioelectromagnetics* 27:295–306.

Bilgici, B., Akar, A., Avci, B., et al. (2013). Effect of 900 MHz radiofrequency radiation on oxidative stress in rat brain and serum. *Electromagn. Biol. Med.* 32:20–29.

Blank, M., Soo, L. (2001). Electromagnetic acceleration of electron transfer reactions. *J. Cell Biochem.* 81:278–283.

Blank, M., Soo, L. (2003). Electromagnetic acceleration of the Belousov–Zhabotinski reaction. *Bioelectrochemistry* 61:93–97.

Bodera, P., Stankiewicz, W., Zawada, K., et al. (2013). Changes in antioxidant capacity of blood due to mutual action of electromagnetic field (1800 MHz) and opioid drug (tramadol) in animal model of persistent inflammatory state. *Pharmacol. Rep.* 65:421–428.

Bohr, H., Bohr, J. (2000a). Microwave-enhanced folding and denaturation of globular proteins. *Phys. Rev. E* 61:4310–4314.

Bohr, H., Bohr, J. (2000b). Microwave enhanced kinetics observed in ORD studies of a protein. *Bioelectromagnetics* 21:68–72.

Boldogh, I., Bacsi, A., Choudhury, B. K., et al. (2005). ROS generated by pollen NADPH oxidase provide a signal that augments antigen-induced allergic airway inflammation. *J. Clin. Investig.* 115:2169–2179.

Buchner, K., Eger, H. (2011). [Changes of clinically important neurotransmitters under the influence of modulated RF fields—A long-term study under real-life conditions]. *Umwelt -Medizin-Gesellschaft* 24:44–57.

Budi, A., Legge, F. S., Treutlein, H., et al. (2007). Effect of frequency on insulin response to electric field stress. J. Phys. Chem. B. 111:5748–5756.

Burlaka, A., Selyuk, M., Gafurov, M., et al. (2014). Changes in mitochondrial functioning with electromagnetic radiation of ultra high frequency as revealed by electron paramagnetic resonance methods. Int. J. Radiat. Biol. 90:357–362.

Burlaka, A., Tsybulin, O., Sidorik, E., et al. (2013). Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation. Exp. Oncol. 35:219–225.

Byus, C. V., Kartun, K., Pieper, S., et al. (1988). Increased ornithine decarboxylase activity in cultured cells exposed to low energy modulated microwave fields and phorbol ester tumor promoters. *Cancer Res.* 48:4222–4226.

Calabrese, E. J. (2008). Hormesis: Why it is important to toxicology and toxicologists. *Environ. Toxicol. Chem.* 27:1451–1474.

Campisi, A., Gulino, M., Acquaviva, R., et al. (2010). Reactive oxygen species levels and DNA fragmentation on astrocytes in primary culture after acute exposure to low intensity microwave electromagnetic field. *Neurosci. Lett.* 473:52–55.

Caraglia, M., Marra, M., Mancinelli, F., et al. (2005). Electromagnetic fields at mobile phone frequency induce apoptosis and inactivation of the multi-chaperone complex in human epidermoid cancer cells. *J. Cell. Physiol.* 204:539–548.

Cardis, E., Deltour, I., Vrijheid, M., et al. (2010). Brain tumour risk in relation to mobile telephone use: Results of the INTERPHONE international case-control study. *Int. J. Epidemiol.* 39:675–694.

Cenesis, M., Atakisi, O., Akar, A., et al. (2011). Effects of 900 and 1800 MHz electromagnetic field application on electrocardiogram, nitric oxide, total antioxidant capacity, total oxidant capacity, total protein, albumin and globulin levels in guinea pigs. Kafkas Üniv. Vet. Fakültesi Dergisi 17:357–362.

Céspedes, O., Ueno, S. (2009). Effects of radio frequency magnetic fields on iron release from cage proteins. *Bioelectromagnetics* 30:336–342.

Cetin, H., Naziroglu, M., Celik, Ö., et al. (2014). Liver antioxidant stores protect the brain from electromagnetic radiation (900 and 1800 MHz)-induced oxidative stress in rats during pregnancy and the development of offspring. J. Matern.-Fetal Neonat. Med. 72:1915–1921.

Chou, C. K., Guy, A. W., Kunz, L. L., et al. (1992). Long-term, low-level microwave irradiation of rats. *Bioelectromagnetics* 13:469–496.

Chu, M. K., Song, H. G., Kim, C., et al. (2011). Clinical features of headache associated with mobile phone use: A cross-sectional study in university students. *BMC Neurol.* 11:115.

Clifford, A., Morgan, D., Yuspa, S. H., et al. (1995). Role of ornithine decarboxylase in epidermal tumorigenesis. Cancer Res. 55:1680–1686.

Consales, C., Merla, C., Marino, C., et al. (2012). Electromagnetic fields, oxidative stress, and neurodegeneration. *Int. J. Cell Biol.* 2012:683897.

Dasdag, S., Akdag, M. Z., Kizil, G., et al. (2012). Effect of 900 MHz radio frequency radiation on beta amyloid protein, protein carbonyl, and malondialdehyde in the brain. *Electromagn. Biol. Med.* 31:67–74.

Dasdag, S., Akdag, M. Z., Ulukaya, E., et al. (2009). Effect of mobile phone exposure on apoptotic glial cells and status of oxidative stress in rat brain. Electromagn. Biol. Med. 28:342–354.

Dasdag, S., Bilgin, H., Akdag, M. Z., et al. (2008). Effect of long term mobile phone exposure on oxidative-antioxidative processes and nitric oxide in rats. Biotechnol. Biotechnol. Equip. 22:992–997.

Dasdag, S., Zulkuf Akdag, M., Aksen, F., et al. (2003). Whole body exposure of rats to microwaves emitted from a cell phone does not affect the testes. *Bioelectromagnetics* 24:182–188.

De Iuliis, G. N., Newey, R. J., King, B. V., et al. (2009). Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro. *PLoS One* 4:e6446.

de Souza, F. T., Silva, J. F., Ferreira, E. F., et al. (2014). Cell phone use and parotid salivary gland alterations: No molecular evidence. *Cancer Epidemiol. Biomarkers Prevent.* 23:1428–1431.

Demirel, S., Doganay, S., Turkoz, Y., et al. (2012). Effects of third generation mobile phone-emitted electromagnetic radiation on oxidative stress parameters in eye tissue and blood of rats. *Cutan. Ocul. Toxicol.* 31:89–94.

Desai, N. R., Kesari, K. K., Agarwal, A. (2009). Pathophysiology of cell phone radiation: Oxidative stress and carcinogenesis with focus on male reproductive system. *Reprod. Biol. Endocrinol.* 7:114.

Deshmukh, P. S., Banerjee, B. D., Abegaonkar, M. P., et al. (2013). Effect of low level microwave radiation exposure on cognitive function and oxidative stress in rats. *Indian J. Biochem. Biophys.* 50:114–119.

Diem, E., Schwarz, C., Adlkofer, F., et al. (2005). Non-thermal DNA breakage by mobile-phone radiation (1800 MHz) in human fibroblasts and in transformed GFSH-R17 rat granulosa cells in vitro. *Mutat. Res.* 583:178–183.

Dutta, S. K., Ghosh, B., Blackman, C. F. (1989). Radiofrequency radiation-induced calcium ion efflux enhancement from human and other neuroblastoma cells in culture. *Bioelectromagnetics* 10:197–202.

Eger, H., Hagen, K., Lucas, B., et al. (2004). [Influence of the proximity of mobile phone base stations on the incidence of cancer]. Environ. Med. Soc. 17:273–356.

Enyedi, B., Niethammer, P. (2013). H_2O_2: A chemoattractant? *Methods Enzymol.* 528:237–255.

Esmekaya, M. A., Ozer, C., Seyhan, N. (2011). 900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues. Gen. Physiol. Biophys. 30:84–89.

Ferreira, A. R., Bonatto, F., de Bittencourt Pasquali, M. A., et al. (2006a). Oxidative stress effects on the central nervous system of rats after acute exposure to ultra high frequency electromagnetic fields. *Bioelectromagnetics* 27:487–493.

Ferreira, A. R., Knakievicz, T., Pasquali, M. A., et al. (2006b). Ultra high frequency-electromagnetic field irradiation during pregnancy leads to an increase in erythrocytes micronuclei incidence in rat offspring. *Life Sci.* 80:43–50.

Forman, H. J., Ursini, F., Maiorino, M. (2014). An overview of mechanisms of redox signaling. J. Mol. Cell Cardiol. 73:2–9.

Friedman, J., Kraus, S., Hauptman, Y., et al. (2007). Mechanism of short-term ERK activation by electromagnetic fields at mobile phone frequencies. Biochem. J. 405:559–568.

Furtado-Filho, O. V., Borba, J. B., Dallegrave, A., et al. (2014). Effect of 950 MHz UHF electromagnetic radiation on biomarkers of oxidative damage, metabolism of UFA and antioxidants in the livers of young rats of different ages. *Int. J. Radiat. Biol.* 90:159–168.

Gandhi, O. P., Morgan, L. L., de Salles, A. A., et al. (2012). Exposure limits: The underestimation of absorbed cell phone radiation, especially in children. Electromagn. Biol. Med. 31:34–51.

Garaj-Vrhovac, V., Fucic, A., Horvat, D. (1992). The correlation between the frequency of micronuclei and specific chromosome aberrations in human lymphocytes exposed to microwave radiation in vitro. *Mutat. Res.* 281:181–186.

Garaj-Vrhovac, V., Gajski, G., Pažanin, S., et al. (2011). Assessment of cytogenetic damage and oxidative stress in personnel occupationally exposed to the pulsed microwave radiation of marine radar equipment. *Int. J. Hyg. Environ. Health.* 214:59–65.

Garson, O. M., McRobert, T. L., Campbell, L. J., et al. (1991). A chromosomal study of workers with long-term exposure to radio-frequency radiation. *Med. J. Austral.* 155:289–292.

Georgiou, C. D. (2010). Oxidative stress-induced biological damage by low-level EMFs: Mechanism of free radical pair electron spin-polarization and biochemical amplification. Eur. J. Oncol. 5:63–113.

Goodman, R., Blank, M. (2002). Insights into electromagnetic interaction mechanisms. J. Cell Physiol. 192:16–22.

Griendling, K. K., Sorescu, D., Ushio-Fukai, M. (2000). NAD (P)H oxidase: Role in cardiovascular biology and disease. Circ. Res. 86:494–501.

Guler, G., Tomruk, A., Ozgur, E., et al. (2012). The effect of radiofrequency radiation on DNA and lipid damage in female and male infant rabbits. *Int. J. Radiat. Biol.* 88:367–373.

Guney, M., Ozguner, F., Oral, B., et al. (2007). 900 MHz radiofrequency-induced histopathologic changes and oxidative stress in rat endometrium: Protection by vitamins E and C. *Toxicol. Ind. Health* 23:411–420.

Gürler, H. Ş., Bilgici, B., Akar, A. K., et al. (2014). Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic. *Int. J. Radiat. Biol.* 90:892–896.

Guzy, R. D., Schumacker, P. T. (2006). Oxygen sensing by mitochondria at complex III: The paradox of increased reactive oxygen species during hypoxia. *Exp. Physiol.* 91:807–819.

Hallberg, O., Oberfeld, G. (2006). Letter to the editor: Will we all become electrosensitive? *Electromagn. Biol. Med.* 25:189–191.

Halliwell, B. (1991). Reactive oxygen species in living systems: Source, biochemistry, and role in human disease. *Am. J. Med.* 91:14S–22S.

Halliwell, B. (2007). Biochemistry of oxidative stress. *Biochem. Soc. Trans.* 35:1147–1150.

Halliwell, B., Whiteman, M. (2004). Measuring reactive species and oxidative damage in vivo and in cell culture: How should you do it and what do the results mean? *Br. J. Pharmacol.* 142:231–255.

Hamzany, Y., Feinmesser, R., Shpitzer, T., et al. (2013). Is human saliva an indicator of the adverse health effects of using mobile phones? *Antioxid .Redox. Signal.* 18:622–627.

Hardell, L., Carlberg, M. (2009). Mobile phones, cordless phones and the risk for brain tumours. *Int. J. Oncol.* 35:5–17.

Hardell, L., Carlberg, M., Hansson Mild, K. (2005). Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000–2003. *Neuroepidemiology* 25:120–128.

Hardell, L., Carlberg, M., Hansson Mild, K., et al. (2011). Case-control study on the use of mobile and cordless phones and the risk for malignant melanoma in the head and neck region. *Pathophysiology* 18:325–333.

Hardell, L., Carlberg, M., Ohlson, C. G., et al. (2007). Use of cellular and cordless telephones and risk of testicular cancer. *Int. J. Androl.* 30:115–122.

Hardell, L., Carlberg, M., Soderqvist, F., et al. (2007). Long-term use of cellular phones and brain tumours: Increased risk associated with use for > or = 0 years. Occup. Environ. Med. 64:626–632.

Hardell, L., Eriksson, M., Carlberg, M., et al. (2005). Use of cellular or cordless telephones and the risk for non-Hodgkin's lymphoma. *Int. Arch. Occup. Environ. Health* 78:625–632.

Hayden, M. S., Ghosh, S. (2011). NF-kappa B in immunobiology. Cell Res. 21:223–244.

Hong, M. N., Kim, B. C., Ko, Y. G., et al. (2012). Effects of 837 and 1950 MHz radiofrequency radiation exposure alone or combined on oxidative stress in MCF10A cells. *Bioelectromagnetics* 33:604–611.

Hook, G. J., Spitz, D. R., Sim, J. E., et al. (2004). Evaluation of parameters of oxidative stress after in vitro exposure to FMCW- and CDMA-modulated radiofrequency radiation fields. *Radiat. Res.* 162:497–504.

Hou, Q., Wang, M., Wu, S., et al. (2014). Oxidative changes and apoptosis induced by 1800-MHz electromagnetic radiation in NIH/3T3 cells. Electromagn. Biol. Med. 34:85–92.

Hoyto, A., Juutilainen, J., Naarala, J. (2007). Ornithine decarboxylase activity is affected in primary astrocytes but not in secondary cell lines exposed to 872 MHz RF radiation. *Int. J. Radiat. Biol.* 83:367–374.

Hyland, G. J. (2000). Physics and biology of mobile telephony. *Lancet* 356:1833–1836.

ICNIRP. (1998). Guidelines for limiting exposure to time-varying elecrtic, magnetic and electromagnetic fields (up to 300 GHz). *Health Phys.* 74:494–522.

Ilhan, A., Gurel, A., Armutcu, F., et al. (2004). Ginkgo biloba prevents mobile phone-induced oxidative stress in rat brain. *Clin. Chim. Acta.* 340:153–162.

Inoue, M., Sato, E. F., Nishikawa, M., et al. (2003). Mitochondrial generation of reactive oxygen species and its role in aerobic life. *Curr. Med. Chem.* 10:2495–2505.

Jelodar, G., Akbari, A., Nazifi, S. (2013). The prophylactic effect of vitamin C on oxidative stress indexes in rat eyes

following exposure to radiofrequency wave generated by a BTS antenna model. *Int. J. Radiat. Biol.* 89:128–131.

Jelodar, G., Nazifi, S., Akbari, A. (2013). The prophylactic effect of vitamin C on induced oxidative stress in rat testis following exposure to 900 MHz radio frequency wave generated by a BTS antenna model. *Electromagn. Biol. Med.* 32:409–416.

Jing, J., Yuhua, Z., Xiao-qian, Y., et al. (2012). The influence of microwave radiation from cellular phone on fetal rat brain. *Electromagn. Biol. Med.* 31:57–66.

Johansson, O. (2006). Electrohypersensitivity: State-of-the-art of a functional impairment. *Electromagn. Biol. Med.* 25:245–258.

Johansson, O., Gangi, S., Liang, Y., et al. (2001). Cutaneous mast cells are altered in normal healthy volunteers sitting in front of ordinary TVs/PCs – results from open-field provocation experiments. *J. Cutan. Pathol.* 28:513–519.

Kahya, M. C., Nazıroğlu, M., Çiğ, B. (2014). Selenium reduces mobile phone (900 MHz)-induced oxidative stress, mitochondrial function, and apoptosis in breast cancer cells. *Biol. Trace Elem. Res.* 160:285–293.

Kang, K. A., Lee, H. C., Lee, J. J., et al. (2013). Effects of combined radiofrequency radiation exposure on levels of reactive oxygen species in neuronal cells. *J. Radiat. Res. (Published online)*:rrt116.

Kerbacher, J. J., Meltz, M. L., Erwin, D. N. (1990). Influence of radiofrequency radiation on chromosome aberrations in CHO cells and its interaction with DNA-damaging agents. *Radiat. Res.* 123:311–319.

Kerman, M., Senol, N. (2012). Oxidative stress in hippocampus induced by 900 MHz electromagnetic field emitting mobile phone: Protection by melatonin. *Biomed. Res.*. 23:147–151.

Kesari, K. K., Kumar, S., Behari, J. (2010). Mobile phone usage and male infertility in Wistar rats. *Indian J. Exp. Biol.* 48:987–992.

Kesari, K. K., Kumar, S., Behari, J. (2011). 900-MHz microwave radiation promotes oxidation in rat brain. [Research Support, Non-U.S. Gov't]. *Electromagn. Biol. Med.* 30:219–234.

Kesari, K. K., Meena, R., Nirala, J., et al. (2013). Effect of 3G cell phone exposure with computer controlled 2-D stepper motor on non-thermal activation of the hsp27/p38MAPK stress pathway in rat brain. *Cell Biochem. Biophys.* 68:347–358.

Khalil, A. M., Abu Khadra, K. M., Aljaberi, A. M., et al. (2014). Assessment of oxidant/antioxidant status in saliva of cell phone users. Electromagn. Biol. Med. 32:92–97.

Khalil, A. M., Gagaa, M. H., Alshamali, A. M. (2012). 8-Oxo-7, 8-dihydro-2'-deoxyguanosine as a biomarker of DNA damage by mobile phone radiation. *Hum. Exp. Toxicol.* 31:734–740.

Kim, J. Y., Hong, S. Y., Lee, Y. M., et al. (2008). In vitro assessment of clastogenicity of mobile-phone radiation (835 MHz) using the alkaline comet assay and chromosomal aberration test. [Research Support, Non-U.S. Gov't]. *Environ. Toxicol.*. 23:319–327.

Kismali, G., Ozgur, E., Guler, G., et al. (2012). The influence of 1800 MHz GSM-like signals on blood chemistry and oxidative stress in non-pregnant and pregnant rabbits. *Int. J. Radiat. Biol.* 88:414–419.

Koc, A., Unal, D., Cimentepe, E. (2013). The effects of antioxidants on testicular apoptosis and oxidative stress produced by cell phones. *Turk. J. Med. Sci.* 43:131–137.

Koylu, H., Mollaoglu, H., Ozguner, F., et al. (2006). Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain. *Toxicol. Ind. Health* 22:211–216.

Koyu, A., Ozguner, F., Yilmaz, H., et al. (2009). The protective effect of caffeic acid phenethyl ester (CAPE) on oxidative stress in rat liver exposed to the 900 MHz electromagnetic field. *Toxicol. Ind. Health* 25:429–434.

Kumar, S., Nirala, J. P., Behari, J., et al. (2014). Effect of electromagnetic irradiation produced by 3G mobile phone on male rat reproductive system in a simulated scenario. *Indian J. Exp. Biol.* 52:890–897.

Lai, H., Singh, N. P. (1996). Single- and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation. *Int. J. Radiat. Biol.* 69:513–521.

Lai, H., Singh, N. P. (1997). Melatonin and a spin-trap compound block radiofrequency electromagnetic radiation-induced DNA strand breaks in rat brain cells. *Bioelectromagnetics* 18:446–454.

Lantow, M., Lupke, M., Frahm, J., et al. (2006a). ROS release and Hsp70 expression after exposure to 1,800 MHz radiofrequency electromagnetic fields in primary human monocytes and lymphocytes. *Radiat. Environ. Biophys.* 45:55–62.

Lantow, M., Schuderer, J., Hartwig, C., et al. (2006b). Free radical release and HSP70 expression in two human immune-relevant cell lines after exposure to 1800 MHz radiofrequency radiation. *Radiat. Res.* 165:88–94.

Litovitz, T. A., Krause, D., Penafiel, M., et al. (1993). The role of coherence time in the effect of microwaves on ornithine decarboxylase activity. *Bioelectromagnetics* 14:395–403.

Litovitz, T. A., Penafiel, L. M., Farrel, J. M., et al. (1997). Bioeffects induced by exposure to microwaves are mitigated by superposition of ELF noise. *Bioelectromagnetics* 18:422–430.

Liu, C., Duan, W., Xu, S., et al. (2013a). Exposure to 1800 MHz radiofrequency electromagnetic radiation induces oxidative DNA base damage in a mouse spermatocyte-derived cell line. *Toxicol. Lett.* 218:2–9.

Liu, C., Gao, P., Xu, S.-C., et al. (2013b). Mobile phone radiation induces mode-dependent DNA damage in a mouse spermatocyte-derived cell line: A protective role of melatonin. *Int J Radiat Biol.* 89:993–1001.

Liu, Y., Fiskum, G., Schubert, D. (2002). Generation of reactive oxygen species by the mitochondrial electron transport chain. *J. Neurochem.* 80:780–787.

Low, H., Crane, F. L., Morre, D. J. (2012). Putting together a plasma membrane NADH oxidase: a tale of three laboratories. *Int. J. Biochem. Cell Biol.* 44:1834–1838.

Lu, Y. S., Huang, B. T., Huang, Y. X. (2012). Reactive oxygen species formation and apoptosis in human peripheral blood mononuclear cell induced by 900 MHz mobile phone radiation. *Oxid. Med. Cell Longev.* 2012:740280.

Luo, Y.-p., Ma, H.-R., Chen, J.-W., et al. (2014). [Effect of American Ginseng Capsule on the liver oxidative injury and the Nrf2 protein expression in rats exposed by electromagnetic radiation of frequency of cell phone]. Zhongguo Zhong xi yi jie he za zhi Zhongguo Zhongxiyi

jiehe zazhi = Chin. J. Integr. Tradit. Western Med. 34:575–580.

Luukkonen, J., Hakulinen, P., Maki-Paakkanen, J., et al. (2009). Enhancement of chemically induced reactive oxygen species production and DNA damage in human SH-SY5Y neuroblastoma cells by 872 MHz radiofrequency radiation. *Mutat. Res.* 662:54–58.

Maes, A., Collier, M., Verschaeve, L. (2000). Cytogenetic investigations on microwaves emitted by a 455.7 MHz car phone. *Folia Biol.* 46:175–180.

Maes, W. (2005). *[*Stress Caused by Electromagnetic Fields and Radiation*]*. Neubeuern, Germany: IBN.

Mailankot, M., Kunnath, A. P., Jayalekshmi, H., et al. (2009). Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats. *Clinics* 64:561–565.

Manta, A. K., Stravopodis, D. J., Papassideri, I. S., et al. (2013). Reactive oxygen species elevation and recovery in Drosophila bodies and ovaries following short-term and long-term exposure to DECT base EMF. Electromagn. Biol. Med. 33:118–131.

Marino, A. A., Carrubba, S., Frilot, C., et al. (2009). Evidence that transduction of electromagnetic field is mediated by a force receptor. *Neurosci. Lett.* 452:119–123.

Marjanovic, A. M., Pavicic, I., Trosic, I. (2014). Cell oxidation–reduction imbalance after modulated radiofrequency radiation. Electromagn. Biol. Med. (Published online). 13:1–6.

Marzook, E. A., Abd El Moneim, A. E., Elhadary, A. A. (2014). Protective role of sesame oil against mobile base station-induced oxidative stress. *J. Radiat. Res. Appl. Sci.* 7:1–6.

Meena, R., Kumari, K., Kumar, J., et al. (2013). Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress-mediated toxicity on male fertility pattern of Wistar rats. Electromagn. Biol. Med. 33:81–91.

Megha, K., Deshmukh, P. S., Banerjee, B. D., et al. (2012). Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats. *Indian J. Exp. Biol.* 50:889–896.

Meral, I., Mert, H., Mert, N., et al. (2007). Effects of 900-MHz electromagnetic field emitted from cellular phone on brain oxidative stress and some vitamin levels of guinea pigs. *Brain Res.* 1169:120–124.

Motawi, T., Darwish, H., Moustafa, Y., et al. (2014). Biochemical modifications and neuronal damage in brain of young and adult rats after long-term exposure to mobile phone radiations. *Cell Biochem. Biophys.* 70:845–855.

Moustafa, Y. M., Moustafa, R. M., Belacy, A., et al. (2001). Effects of acute exposure to the radiofrequency fields of cellular phones on plasma lipid peroxide and antioxidase activities in human erythrocytes. *J. Pharm. Biomed. Anal.* 26:605–608.

Nagata, M. (2005). Inflammatory cells and oxygen radicals. *Curr. Drug Targets* 4:503–504.

Naziroglu, M., Celik, O., Ozgul, C., et al. (2012a). Melatonin modulates wireless (2.45 GHz)-induced oxidative injury through TRPM2 and voltage gated Ca(2+) channels in brain and dorsal root ganglion in rat. *Physiol. Behav.* 105:683–692.

Naziroglu, M., Cig, B., Dogan, S., et al. (2012b). 2.45-Gz wireless devices induce oxidative stress and proliferation through cytosolic Ca(2)(+) influx in human leukemia cancer cells. *Int. J. Radiat. Biol.* 88:449–456.

Naziroglu, M., Gumral, N. (2009). Modulator effects of L-carnitine and selenium on wireless devices (2.45 GHz)-induced oxidative stress and electroencephalography records in brain of rat. Int. J. Radiat. Biol. 85:680–689.

Nguyen, H. L., Zucker, S., Zarrabi, K., et al. (2011). Oxidative stress and prostate cancer progression are elicited by membrane-type 1 matrix metalloproteinase. Mol. Cancer Res. 9:1305–1318.

Ni, S., Yu, Y., Zhang, Y., et al. (2013). Study of oxidative stress in human lens epithelial cells exposed to 1.8 GHz radiofrequency fields. *PLoS One.* 8:e72370.

Okayama, Y. (2005). Oxidative stress in allergic and inflammatory skin diseases. *Curr. Drug Targets* 4:517–519.

Oksay, T., Naziroğlu, M., Doğan, S., et al. (2014). Protective effects of melatonin against oxidative injury in rat testis induced by wireless (2.45 GHz) devices. *Andrologia* 46:65–72.

Oktem, F., Ozguner, F., Mollaoglu, H., et al. (2005). Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: Protection by melatonin. *Arch. Med. Res.* 36:350–355.

Oral, B., Guney, M., Ozguner, F., et al. (2006). Endometrial apoptosis induced by a 900-MHz mobile phone: Preventive effects of vitamins E and C. *Adv. Ther.* 23:957–973.

Oshino, N., Jamieson, D., Sugano, T., et al. (1975). Optical measurement of catalase-hydrogen peroxide intermediate (compound-i) in liver of anesthetized rats and its implication to hydrogen-peroxide production in situ. *Biochem. J.* 146:67–77.

Ott, M., Gogvadze, V., Orrenius, S., et al. (2007). Mitochondria, oxidative stress and cell death. *Apoptosis* 12:913–922.

Ozguner, F., Altinbas, A., Ozaydin, M., et al. (2005a). Mobile phone-induced myocardial oxidative stress: Protection by a novel antioxidant agent caffeic acid phenethyl ester. *Toxicol. Ind. Health.* 21:223–230.

Ozguner, F., Bardak, Y., Comlekci, S. (2006). Protective effects of melatonin and caffeic acid phenethyl ester against retinal oxidative stress in long-term use of mobile phone: A comparative study. Mol. Cell Biochem. 282:83–88.

Ozguner, F., Oktem, F., Ayata, A., et al. (2005b). A novel antioxidant agent caffeic acid phenethyl ester prevents long-term mobile phone exposure-induced renal impairment in rat. Prognostic value of malondialdehyde, N-acetyl-beta-D-glucosaminidase and nitric oxide determination. *Mol. Cell Biochem.* 277:73–80.

Ozgur, E., Guler, G., Seyhan, N. (2010). Mobile phone radiation-induced free radical damage in the liver is inhibited by the antioxidants N-acetyl cysteine and epigallocatechin-gallate. *Int. J. Radiat. Biol.* 86:935–945.

Ozgur, E., Kismali, G., Guler, G., et al. (2013). Effects of prenatal and postnatal exposure to gsm-like radiofrequency on blood chemistry and oxidative stress in infant rabbits, an experimental study. *Cell Biochem. Biophys.* 67:743–751.

Özorak, A., Nazıroğlu, M., Çelik, Ö., et al. (2013). Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-

induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring. *Biol. Trace Elem. Res.* 156:221–229.

Panagopoulos, D. J., Karabarbounis, A., Margaritis, L. H. (2002). Mechanism for action of electromagnetic fields on cells. *Biochem. Biophys. Res. Commun.* 298:95–102.

Panagopoulos, D. J., Messini, N., Karabarbounis, A., et al. (2000). A mechanism for action of oscillating electric fields on cells. *Biochem. Biophys. Res. Commun.* 272: 634–640.

Paulraj, R., Behari, J., Rao, A. R. (1999). Effect of amplitude modulated RF radiation on calcium ion efflux and ODC activity in chronically exposed rat brain. Indian J. Biochem. Biophys. 36:337–340.

Pavicic, I., Trosic, I. (2010). Interaction of GSM modulated RF radiation and macromolecular cytoskeleton structures. *Paper presented at the 6th International Workshop on Biological Effects of Electromagnetic Fields.*

Pilla, A. A. (2012). Electromagnetic fields instantaneously modulate nitric oxide signaling in challenged biological systems. *Biochem. Biophys. Res. Commun.* 426:330–333.

Qin, F., Yuan, H., Nie, J., et al. (2014). [Effects of nano-selenium on cognition performance of mice exposed in 1800 MHz radiofrequency fields]. Wei sheng yan jiu = J. Hygiene Res. 43:16–21.

Ragy, M. M. (2014). Effect of exposure and withdrawal of 900-MHz-electromagnetic waves on brain, kidney and liver oxidative stress and some biochemical parameters in male rats. *Electromagn. Biol. Med. (Published online).*:1–6.

Ralph, S. J., Rodríguez-Enríquez, S., Neuzil, J., et al. (2010). The causes of cancer revisited: "Mitochondrial malignancy" and ROS-induced oncogenic transformation – Why mitochondria are targets for cancer therapy. *Mol. Aspects Med.* 31:145–170.

Rao, V. S., Titushkin, I. A., Moros, E. G., et al. (2008). Nonthermal effects of radiofrequency-field exposure on calcium dynamics in stem cell-derived neuronal cells: Elucidation of calcium pathways. *Radiat. Res.* 169:319–329.

Repacholi, M. H., Basten, A., Gebski, V., et al. (1997). Lymphomas in E mu-Pim1 transgenic mice exposed to pulsed 900 MHZ electromagnetic fields. *Radiat. Res.* 147:631–640.

Ruediger, H. W. (2009). Genotoxic effects of radiofrequency electromagnetic fields. *Pathophysiology* 16:89–102.

Sadetzki, S., Chetrit, A., Jarus-Hakak, A., et al. (2008). Cellular phone use and risk of benign and malignant parotid gland tumors – A nationwide case-control study. *Am. J. Epidemiol.* 167:457–467.

Saikhedkar, N., Bhatnagar, M., Jain, A., et al. (2014). Effects of mobile phone radiation (900 MHz radiofrequency) on structure and functions of rat brain. *Neurol. Res.* 36:1072–1079.

Santini, R., Santini, P., Danze, J. M., et al. (2002). Study of the health of people living in the vicinity of mobile phone base stations: I. Influences of distance and sex. *Pathol. Biol.* 50:369–373.

Sato, Y., Akiba, S., Kubo, O., et al. (2011). A case-case study of mobile phone use and acoustic neuroma risk in Japan. *Bioelectromagnetics* 32:85–93.

Sefidbakht, Y., Moosavi-Movahedi, A. A., Hosseinkhani, S., et al. (2014). Effects of 940 MHz EMF on bioluminescence and oxidative response of stable luciferase producing HEK cells. *Photochem. Photobiol. Sci.* 13:1082–1092.

Shahin, S., Singh, V. P., Shukla, R. K., et al. (2013). 2.45 GHz microwave irradiation-induced oxidative stress affects implantation or pregnancy in mice, Mus musculus. *Appl. Biochem. Biotechnol.* 169:1727–1751.

Sharma, V. P., Singh, H. P., Kohli, R. K., et al. (2009). Mobile phone radiation inhibits *Vigna radiata* (mung bean) root growth by inducing oxidative stress. *Sci. Total Environ.* 407:5543–5547.

Sies, H. (2014). Role of metabolic H_2O_2 generation: Redox signalling and oxidative stress. *J. Biol. Chem.* 289:8735–8741.

Singh, H. P., Sharma, V. P., Batish, D. R., et al. (2012). Cell phone electromagnetic field radiations affect rhizogenesis through impairment of biochemical processes. *Environ. Monitor. Assess.* 184:1813–1821.

Sokolovic, D., Djindjic, B., Nikolic, J., et al. (2008). Melatonin reduces oxidative stress induced by chronic exposure of microwave radiation from mobile phones in rat brain. *J. Radiat. Res. (Tokyo).* 49:579–586.

Sokolovic, D., Djordjevic, B., Kocic, G., et al. (2013). Melatonin protects rat thymus against oxidative stress caused by exposure to microwaves and modulates proliferation/apoptosis of thymocytes. *Gen. Physiol. Biophys.* 32:79–90.

Suleyman, D., M. Zulkuf, A., Feyzan, A., et al. (2004). Does 900 MHZ GSM mobile phone exposure affect rat brain? *Electromagn. Biol. Med.*. 23:201–214.

Szmigielski, S., Szudzinski, A., Pietraszek, A., et al. (1982). Accelerated development of spontaneous and benzopyrene-induced skin cancer in mice exposed to 2450-MHz microwave radiation. *Bioelectromagnetics* 3:179–191.

Tice, R. R., Hook, G. G., Donner, M., et al. (2002). Genotoxicity of radiofrequency signals. I. Investigation of DNA damage and micronuclei induction in cultured human blood cells. *Bioelectromagnetics* 23:113–126.

Tkalec, M., Malaric, K., Pevalek-Kozlina, B. (2007). Exposure to radiofrequency radiation induces oxidative stress in duckweed Lemna minor L. *Sci. Total. Environ.* 388:78–89.

Tkalec, M., Stambuk, A., Srut, M., et al. (2013). Oxidative and genotoxic effects of 900 MHz electromagnetic fields in the earthworm Eisenia fetida. *Ecotoxicol. Environ. Saf.* 90:7–12.

Tök, L., Nazıroğlu, M., Doğan, S., et al. (2014). Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats. Indian J. Ophthalmol. 62:12–15.

Toler, J. C., Shelton, W. W., Frei, M. R., et al. (1997). Long-term, low-level exposure of mice prone to mammary tumors to 435 MHz radiofrequency radiation. *Radiat. Res.* 148:227–234.

Tomruk, A., Guler, G., Dincel, A. S. (2010). The influence of 1800 MHz GSM-like signals on hepatic oxidative DNA and lipid damage in nonpregnant, pregnant, and newly born rabbits. *Cell. Biochem. Biophys.* 56:39–47.

Tsybulin, O., Sidorik, E., Brieieva, O., et al. (2013). GSM 900 MHz cellular phone radiation can either stimulate or depress early embryogenesis in Japanese quails depending on the duration of exposure. *Int. J. Radiat. Biol.* 89:756–763.

Tsybulin, O., Sidorik, E., Kyrylenko, S., et al. (2012). GSM 900 MHz microwave radiation affects embryo development of Japanese quails. Electromagn. Biol. Med. 31:75–86.

Türedi, S., Hancı, H., Topal, Z., et al. (2014). The effects of prenatal exposure to a 900-MHz electromagnetic field on

the 21-day-old male rat heart. *Electromagn. Biol. Med. (Published online).*1–8.

Turker, Y., Naziroglu, M., Gumral, N., et al. (2011). Selenium and L-carnitine reduce oxidative stress in the heart of rat induced by 2.45-GHz radiation from wireless devices. *Biol. Trace Elem. Res.* 143:1640–1650.

Vaks, V. L., Domrachev, G. A., Rodygin, Y. L., et al. (1994). Dissociation of water by microwave radiation. *Radiophys. Quant. Electron.* 37:85–88.

Valko, M., Leibfritz, D., Moncol, J., et al. (2007). Free radicals and antioxidants in normal physiological functions and human disease. *Int. J. Biochem. Cell Biol.* 39:44–84.

Valko, M., Rhodes, C. J., Moncol, J., et al. (2006). Free radicals, metals and antioxidants in oxidative stress-induced cancer. *Chem. Biol. Interact.* 160:1–40.

Wang, X., Sharma, R. K., Gupta, A., et al. (2003). Alterations in mitochondria membrane potential and oxidative stress in infertile men: A prospective observational study. *Fertil. Steril.* 80:844–850.

Wolf, R., Wolf, D. (2007). Increased incidence of cancer near a cell-phone transmitted station. In F. Columbus (Ed.), *Trends in Cancer Prevention* New York: Nova Science Publishers, Inc. pp. 1–8.

Xu, S., Zhou, Z., Zhang, L., et al. (2010). Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons. *Brain. Res.* 1311:189–196.

Yakymenko, I., Sidorik, E., Kyrylenko, S., et al. (2011). Long-term exposure to microwave radiation provokes cancer growth: Evidences from radars and mobile communication systems. *Exp. Oncol.* 33:62–70.

Yakymenko, I., Sidorik, E., Tsybulin, O., et al. (2011). Potential risks of microwaves from mobile phones for youth health. *Environ. Health* 56:48–51.

Yurekli, A. I., Ozkan, M., Kalkan, T., et al. (2006). GSM base station electromagnetic radiation and oxidative stress in rats. *Electromagn. Biol. Med.* 25:177–188.

Zhao, T. Y., Zou, S. P., Knapp, P. E. (2007). Exposure to cell phone radiation up-regulates apoptosis genes in primary cultures of neurons and astrocytes. *Neurosci. Lett.* 412:34–38.

Zmyślony, M., Politanski, P., Rajkowska, E., et al. (2004). Acute exposure to 930 MHz CW electromagnetic radiation in vitro affects reactive oxygen species level in rat lymphocytes treated by iron ions. *Bioelectromagnetics* 25:324–328.

Zotti-Martelli, L., Peccatori, M., Maggini, V., et al. (2005). Individual responsiveness to induction of micronuclei in human lymphocytes after exposure in vitro to 1800-MHz microwave radiation. *Mutat. Res.* 582:42–52.