



Warning about Future 5G Roll-Out in Municipalities and Adverse Consequences to Humans, Flora and Fauna.

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EXHIBIT A: Curriculum Vitae Dr. Magda Havas (provided separately)

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I, Magda Havas, PhD, make the following declaration:

I. ACADEMIC CREDENTIALS

1. My name is Magda Havas and I am a recently retired (2018) professor at Trent School of the Environment, Trent University, 1600 West Bank Drive, Peterborough, ON, K9J 7B8, Canada.

2. I received my BSc in Biology and PhD in Environmental Toxicology at the University of Toronto and I did Postdoctoral research at Cornell University in New York. I spent the first 20 plus years of my research on the biological effects on humans and natural ecosystems of air and water pollution (with an emphasis on acid rain and metal pollution).

3. My research, along with the research of hundreds of colleagues around the world and the work of the Acid Rain Coalition, helped bring in clean air legislation in the 1990s in both Canada and the United States, including stricter standards for sulphur dioxide emissions. Shortly after this, lakes began to recover and this we also studied.

4. In 1989, I became an Associate Professor at Trent University. In the early 1990's, I changed my focus to the study of the biological effects of non-ionizing radiation (NIR) on humans, animals and plants. This included extremely low frequency electromagnetic fields (ELF EMF); intermediate frequencies (IF) that involve poor power quality or "dirty electricity" as it is commonly called; radio frequency (RF) and microwave (MW) radiation; as well as ground current pollution especially on farms. I work with people who have been injured by electromagnetic pollution from various sources and my research is focused on finding objective ways to diagnose such injuries. I also do research on the biological effects of pulsed electromagnetic field (PEMF) therapies. I spend considerable time educating health care providers on the harmful health effects of electrosmog so they can better diagnose and treat their patients.

5. I taught university courses and have trained graduate students at both the University of Toronto and Trent University. At Trent University the two courses that most closely relate to this case are *Pollution Ecology* and *Biological Effects of Electromagnetic Fields*. I also gave guest lectures in courses taught by my colleagues.

6. I review scientific publications for approximately 25 journals; provide scientific advice to organizations in Canada, U.S., Netherlands, Brussels, Italy, U.K., South Africa; provide expert testimony related to extremely low frequency EMFs and radio frequency radiation in Canada, U.S., Philippines and South Africa; and lecture around the world at scientific and medical conferences and to groups interested in the biological effects of electrosmog or the therapeutic effects of electrotherapy. I have given 366 lectures in 30 countries, 27 states in the U.S., and at 24 universities and almost all of these were by invitation. My CV is attached hereto as **Exhibit A**.

7. In this affidavit I provide evidence regarding the harmful effects of radio frequency radiation (RFR) on humans, animals and plants. A list of those references is provided in **Exhibit B**. RFR can consist of a continuous wave (as in a microwave oven used to heat food)

or it can be modulated, which is the form used for communication. The biological effects of continuous and modulated waves are quite different with modulated frequencies being more biologically active.

II. HUMAN STUDIES

8. RFR has been associated with cancers in people who use cell phones for more than 10 years. The tumors occur primarily on the same side of the head exposed to the cell phone (ipsilateral tumors) and they include gliomas, meningiomas, acoustic neuromas, and salivary gland tumors ([Hardell et al. 2013](#); [Cardis et al. 2012](#); [Sadetski et al. 2007](#)).

9. People who live near cell phone base stations, radio and TV broadcast antennas and radar installation have a greater risk of developing and dying from cancers than people who live further away ([Hocking et al 1996](#); [Goldsmith 1997](#); [Michelozzi et al. 2002](#); [Dode et al. 2011](#); [Yakymenko et al. 2011](#)). Many of these studies show an increase in leukemias especially among children. Furthermore, those who are occupationally exposed to RFR/MW radiation have a greater risk of developing different types of cancers ([Wirth et al. 2013](#)).

10. These are all epidemiological studies and such studies show an *association* between exposure (or a surrogate of exposure like distance) and an increased risk of cancer that increases with cumulative exposure.

11. We also have at least three large, multi-year well-controlled, animal studies documenting that MW radiation causes cancer ([Chou et al. 1992](#); [NTP 2018](#); [Falcioni et al. 2019](#)) and several studies showing that MW radiation damages DNA in rodents ([Phillips et al. 2009](#)). More information is provided below when I discuss effects of RFR on laboratory animals.

12. RF and MW radiation are classified as *non-ionizing radiation* (NIR). Considerable evidence exists that NIR increases free radicals by interfering with the neutralization of reactive oxygen species (ROS) ([Yakymenko et al. 2016](#)). ROS are known to cause cancer and other adverse biological effects. The mechanism by which non-ionizing radiation causes cancer is discussed by [Havas \(2017\)](#).

13. Considerable evidence shows that NIR damages sperm. At least twenty studies show abnormalities in sperm, which have clear implications for male infertility. At least five studies show DNA damage, which could be teratogenic (affecting the development of the embryo or fetus) and multi-generational.

14. [Agarwal et al. \(2008\)](#) document reduced sperm count, reduced sperm motility, reduced sperm viability and increased abnormal sperm morphology among men who use cell phones. The longer they use cell phones each day the greater the damage to sperm ([Figure 1](#)). This study shows a dose-response relationship and such results suggest *causation*.

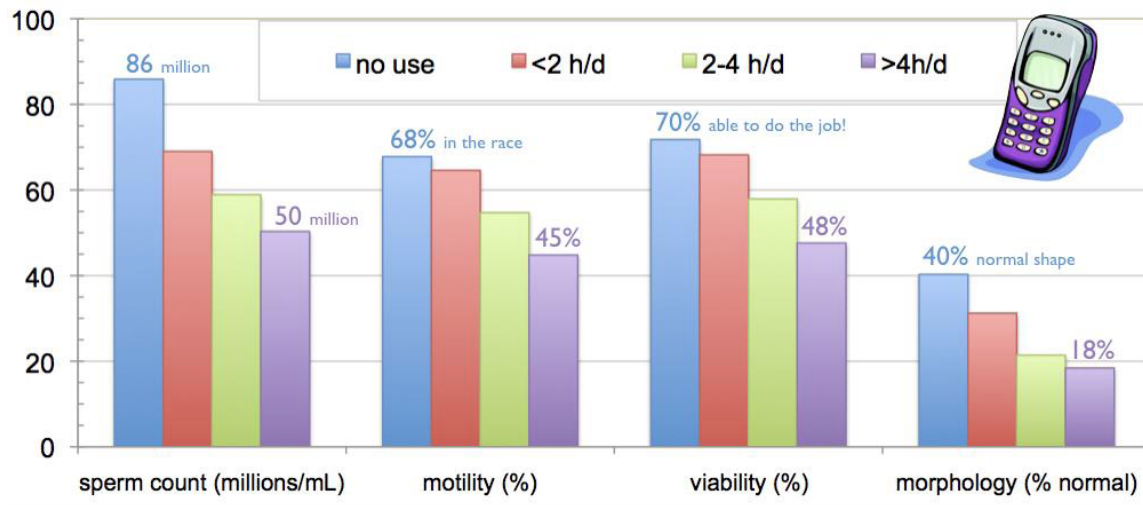


Figure 1. Cell phone use and sperm quality. The categories are based on the amount of cell phone use by men during a day ranging from no use (blue); less than 2 hours daily (red), 2 to 4 hours daily (green) and more than 4 hours daily (purple). Data based on Agarwall et al. 2006.

15. [Adams et al. \(2014\)](#) conducted a meta-analysis based on ten studies regarding the effects of mobile phones on sperm quality and presented the following conclusions in their abstract:

We conclude that pooled results from in vitro and in vivo studies suggest that mobile phone exposure negatively affects sperm quality. Further study is required to determine the full clinical implications for both sub-fertile men and the general population.

16. In one laboratory study ([Kesari et al. 2011](#)) reactive oxygen species (ROS) were shown to reduce testosterone in rats exposed to mobile phone radiation. Lower levels of testosterone are likely to adversely affect sperm production. Note testosterone levels were also lower for people who live within 500 m of cell phone antennas ([Eskander et al. 2012](#)).

17. We have scientific evidence from both human and animal studies documenting damage to sperm, impaired reproduction and altered hormonal levels. There is nothing more powerful in science as when studies, conducted in different ways, in different countries, with various organisms including humans, by many researchers point in the same direction and support the concept that RF and MW radiation harms sperm, reduces testosterone levels and adversely affects reproduction.

18. *Radio wave sickness* refers to a medical syndrome that includes poor sleep; chronic fatigue; cognitive dysfunction including brain fog, difficulty concentrating and poor short-term memory; mood disorders including depression and anxiety; chronic pain including headaches and/or migraines; dizziness; nausea; tinnitus; heart palpitations; abnormal blood sugar; skin problems; asthma; among others ([Bevington 2010](#)). This syndrome was originally called *neurasthenia* or *asthenic syndrome* and later *microwave syndrome* or *radio wave sickness*. More recently it has been referred to as electrohypersensitivity (EHS) or idiopathic environmental intolerance attributed to electromagnetic fields. The scientific community has

recognized these symptoms since the early to mid 1900s. [Dodge \(1969\)](#) states that electromagnetic radiation affects the central nervous system, autonomic nervous system, neurohumoral systems, endocrine glands and function, eye and ocular functions, blood and hemopoietic system and miscellaneous organs in humans-

19. [Santini et al. \(2003\)](#) reported the symptoms of people who live at different distances from cell phone antennas. This is called an epidemiological study. People who live closest to the antennas (within 10 m, red columns, [Figure 2](#)) have the highest incidence of symptoms and those furthest away (beyond 300 m, black columns) the lowest incidence. Similar results have been reported in other countries.

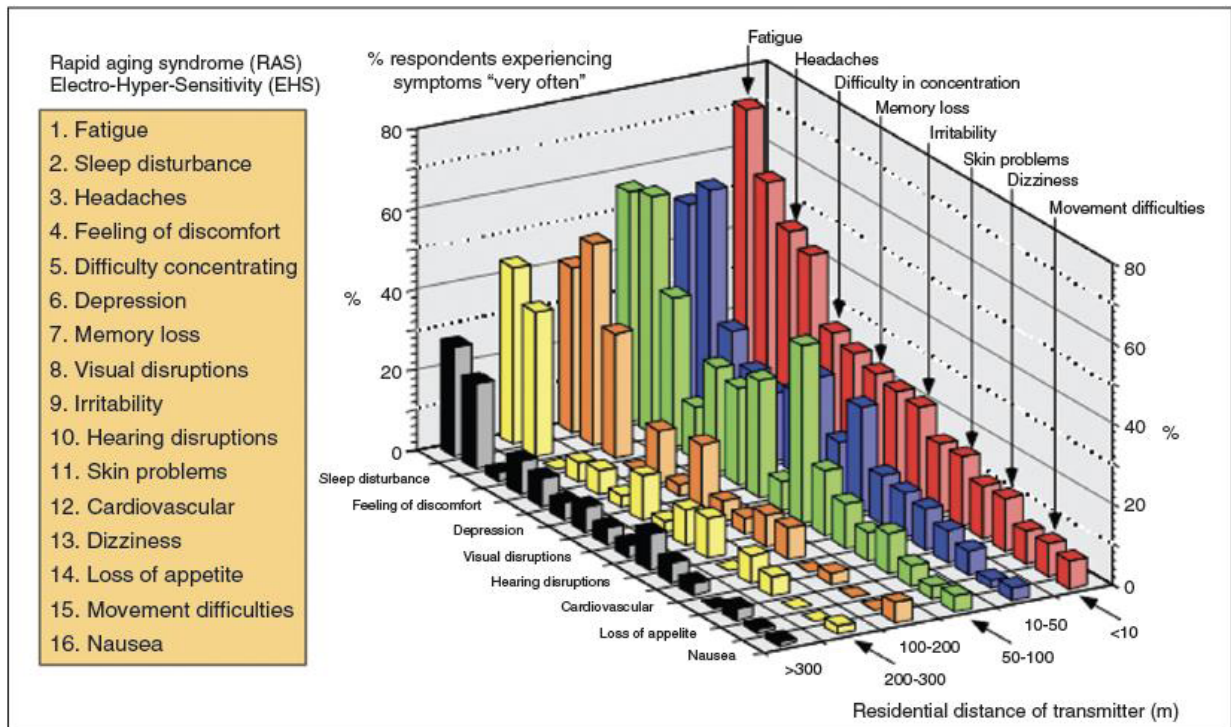


Figure 2. Symptoms experienced by people living near cellular phone base stations. Based on work by Santini et al. 2002, reproduced from Havas 2013.

20. As an example, we did one study testing the effect of MW radiation from a mobile phone base station on heart rate variability (HRV) ([Havas et al. 2010](#)). We did a double-blind, placebo-controlled study with 25 human volunteers in Colorado and found that some of them developed either tachycardia (rapid heart rate) or arrhythmia (irregular heart rate) when exposed to 2.4 GHz frequencies generated by a cordless phone base station placed near their head. For some, the body went into a “fight, flight or faint” response as indicated by their autonomic nervous system (ANS) with an up regulation of their sympathetic tone and a down regulation of their parasympathetic tone. When this happens, the person feels as though they are having either an anxiety attack or a heart attack. The former is a more accurate description of what is happening. When the cordless phone base station was disconnected from the electrical outlet, their heart rate and their autonomic nervous system returned to normal. Note that some of the early research also indicates that MWs affect the autonomic nervous system and the heart.

21. There is evidence that MWs affect the heart, the ANS, as well as the blood (Havas 2013). My own blood becomes more viscous when I am exposed to MW radiation for 10 minutes and this can be observed under a microscope (Plate 1). Symptoms of this can involve cold, numbness or tingling in fingers and toes; dizziness and nausea; with more severe symptoms leading to blood clots, strokes, or heart attacks.

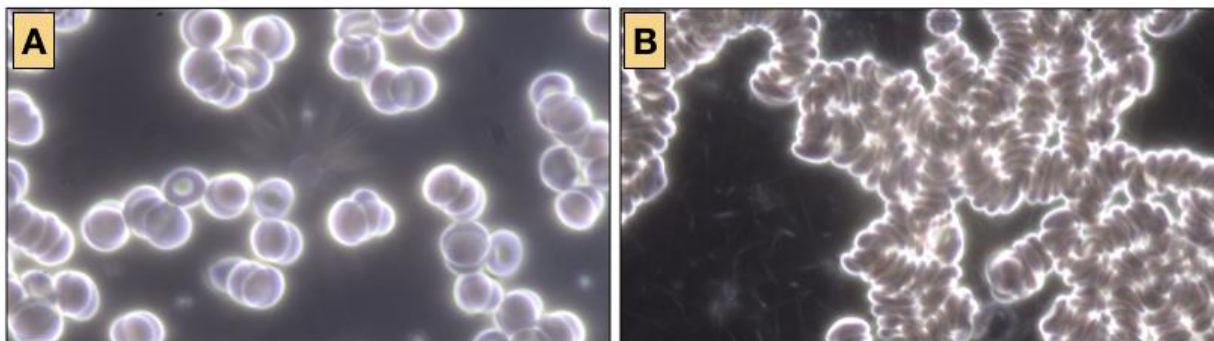


Plate I. Live blood under dark field microscopy. (A) is in an electromagnetically clean environment and (B) is after a 10-minute exposure of the body to microwave radiation generated by a home Wi-Fi router. The red blood cells on the right (B) are sticking together in what is known as rouleau formation. This interferes with exchange of gases and nutrients and can lead to serious health problems and is one of the responses of people who are hypersensitive to electromagnetic radiation.

22. There are now tens of thousands of peer-reviewed documents on these effects, and what few people realize is that the effects mentioned above have been known for decades. Dr. Zory R. Glaser, former U.S. Navy Researcher and the Navy’s key person responsible for microwave health, NIOSH Manager and Executive Secretary to the U.S. FDA, gave me his entire collection of declassified research articles, letters, and notes (more than 6000 documents) when he retired. Some of those articles are on my website: <http://magdahavas.com/category/from-zorys-archive/>.

23. As early as 1972, Dr. Glaser published a paper that listed more than 2000 references documenting the adverse effects of microwave radiation. The Glaser document counters the statements that “credible” research does not exist showing non-thermal effects. The research that I summarized is newer research and is just a small sample of what is available in the scientific literature. The statement that there are no thermal effects is a false statement promoted by those who are either unaware of the scientific literature or unwilling to admit this radiation—at levels to which we are currently exposed—can be harmful. Good science that most people would consider “credible” does exist and has been around for decades, although many have largely ignored this science as it contradicts their world view that this radiation is safe. The above-mentioned effects (cancers, reproductive problems and neurological disorders) are documented at levels well below current U.S. guidelines, which were designed to prevent only a heating effect in healthy adult males. These guidelines have not been updated despite the fact that our exposure to RF/MW radiation has increased considerably with the invention of wireless technology and that this exposure is no longer limited to the military or occupations but is found in homes, schools, hospitals, etc. and is difficult to avoid.

24. The intensity of RF radiation is measured as *power density* and the units are *Watts per meter squared* or *Watts per centimeter squared*. In the scientific literature values can range more than 12 or more orders of magnitude and so the units will vary from Watts (W) to milliW (1/1000th of a W) to microW (1/1000,000th of a W). In this document to minimize confusion I will convert all values to **microW/cm²**. The FCC guidelines have been significantly reduced in stages from 100,000 to 1,000 **microW/cm²** but are still 100 times higher than the current Russian guideline and those in many other countries (which is 10 **microW/cm²**).

25. Steneck et al. (1980) reviewed the origins of the U.S. safety standards for microwave radiation. The significance of this research is provided on my website [<http://magdahavas.com/pick-of-the-week-2-origins-of-1966-u-s-safety-standards-for-microwave-radiation/>] and is partly reproduced below. Based on published and unpublished literature as well as interviews and questionnaires, the authors of this report pieced together the process that led to the 1980 standard of 10 milliW/cm² (which is the same as 10,000 **microW/cm²**) designed to protect military and occupationally exposed personnel from microwave radiation. The original recommended standard, established in 1953, was 100 milliW/cm² (100,000 **microW/cm²**) and was based on a quick-and-dirty calculation that was grossly flawed and was almost immediately revised downward to 10 milliW/cm² (or 10,000 **microW/cm²**). This calculation was based on the ability of a 70-kg man to dissipate heat. The 100 milliW/cm² (100,000 **microW/cm²**) was obviously too high so a safety factor of 10 was introduced to reduce it to 10 milliW/cm² (10,000 **microW/cm²**). In the 1990s, this value was deemed too high and was further reduced to 1 milliW/cm² (1,000 **microW/cm²**), which is the current guideline.

26. If a particular level of exposure is deemed harmful, then often a “safety factor” is introduced to provide a margin of safety. Initially the disagreement about the appropriate safety factor ranged from a safety factor of 10 recommended by the US military to 100 suggested by General Electric to 1,000 suggested by Bell Telephone Laboratories. The military prevailed. Evidence for non-thermal effects was discounted. Had the Bell Laboratories’ guideline prevailed current guideline would be 100 times lower and closer to those in Russia.

27. What few people realize is that emphasis at the time was to protect military operations and secondarily to protect military personnel. Protection of the general public was barely discussed, and no public standards were set because microwaves were viewed as radar and radar was limited to military and industrial exposure.

28. Both *microwaves* and *intermediate frequencies* (IF) are classified as radio frequencies although they are at different parts of the RF spectrum. MWs range from 300 MHz to 300 GHz and IFs are primarily in the kHz range. When RFR is used for telecommunication, it is modulated at frequencies ranging from extremely low to thousands of cycles per second (kHz). Indeed, it is these frequencies that provide the information. Consequently, exposure consists of the carrier wave and the modulated frequencies, both of which can elicit a biological response.

29. While MWs travel through the air and can penetrate buildings, IFs flow along electrical wires in the home and can radiate from these wires. Another term for these IFs is “dirty electricity,” which contributes to poor power quality. Dirty electricity consists of high frequency voltage transients (HFVT) that can be measured using an oscilloscope. HFVTs contribute to

electromagnetic interferences (EMI) that can damage sensitive electronic equipment. Similarly, these frequencies can interfere with the electrical circuitry in the body. [Ontario Hydro \(1996\)](#) has a 130-page reference guide, entitled *Power Quality*, dealing with remediating poor power quality as it is the utility's responsibility to bring clean, safe power to its clients.

30. We have worked with pre-diabetics and diabetics (type 1 and type 2) and found that some of these individuals have great difficulty regulating their blood sugar in an environment where they are exposed to poor power quality or RF radiation ([Havas 2008](#)). When levels of dirty electricity are high their blood sugar increases rapidly (within a matter of 20 minutes) and when they move to an electromagnetically clean environment their blood sugar drops just as rapidly. Often these individuals require more medication in an environment with EMF pollution. Being unable to control blood sugar can be life threatening and can contribute to chronic illness including but not limited to organ damage, poor circulation, blindness, neuropathy and—in some cases— the eventual need for amputation of limbs.

31. According to the Center for Disease Control (CDC), 30 million people in the U.S. (9.4% of the American population) had diabetes in 2015. With so many diabetics and pre-diabetics in the U.S. it is unwise to increase their exposure to electromagnetic radiation if this can be avoided. Exacerbating symptoms of diabetes, for those diabetics and pre-diabetics who are sensitive to this radiation, is likely to be quite costly from a human health perspective and will place greater pressure on the health care system in this country.

32. We have done studies with people who have Multiple Sclerosis (MS) and found that their symptoms improve when the dirty electricity in their home is reduced ([Havas 2006](#)). We have video evidence of tremors and ability to walk before and after remediation (see <http://magdahavas.com/multiple-sclerosis-and-dirty-electricity/>).

33. We also have evidence that living in a home for seven years with reduced levels of dirty electricity reduces sclerosis in the brain as measured by MRI scans and hence this cannot be considered a placebo effect. In addition to improved physical symptoms like balance and tremors, we also noticed an improvement in cognitive activity.

34. When we reduced the levels of dirty electricity in schools, we found that teacher health and student behavior improved during remediation ([Havas and Olstad 2008](#)). The teacher symptoms that recovered are similar to those of radio wave sickness. The student behavior that improved resembles symptoms of attention deficit hyperactivity disorder (ADHD).

35. If *reducing* dirty electricity in a home or school improves the health and wellness of some individuals, one may expect that *increasing* the levels of dirty electricity or modulated RFR may have the opposite effect. Many people have told me that their health problems began shortly after a smart meter was installed on the side of their home or a cell tower was erected nearby. Smart meters produce both MWs and dirty electricity.

36. Since 1997, EMF and RF experts have submitted more than 60 appeals stating that levels below existing guidelines are making people ill and that governments need to develop non-thermal guidelines that truly protect the health of the public and especially of children and pregnant women. <http://magdahavas.com/international-experts-perspective-on-the-health-effects->

[of-electromagnetic-fields-emf-and-electromagnetic-radiation-emr/](http://www.cellphonetaskforce.org/governments-and-organizations-that-ban-or-warn-against-wireless-technology/) and <http://www.cellphonetaskforce.org/governments-and-organizations-that-ban-or-warn-against-wireless-technology/>.

37. Of particular note is the International EMF Scientist Appeal, which was signed by more than 200 scientists and doctors who publish in this field from more than 40 countries (Blank et al. 2015). Collectively we requested that:

- i. *children and pregnant women be protected;*
- ii. *guidelines and regulatory standards be strengthened;*
- iii. *manufacturers be encouraged to develop safer technology;*
- iv. *utilities responsible for the generation, transmission, distribution, and monitoring of electricity maintain adequate power quality and ensure proper electrical wiring to minimize harmful ground current;*
- v. *the public be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies;*
- vi. *medical professionals be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity;*
- vii. *governments fund training and research on electromagnetic fields and health that is independent of industry and mandate industry cooperation with researchers;*
- viii. *media disclose experts' financial relationships with industry when citing their opinions regarding health and safety aspects of EMF-emitting technologies; and*
- ix. *white-zones (radiation-free areas) be established.*

38. A non-expert may conclude that the scientific community is conflicted when it comes to determining whether or not existing guidelines are safe. However, an examination of the source of funding and the results of studies indicates that research funded by industry has a preponderance of “no effects”, while those independently funded are showing a preponderance of significant adverse effects (Figure 3) (Huss et al. 2007).

39. In Figure 3, only 8% of the studies funded by industry reported a statistically significant adverse effect of mobile phone use, whereas 45% to 64% of the studies with mixed funding or non-industry funding showed adverse effects of cell phone use. Conversely, 84% of the authors funded by industry reported “no effects” of cell phone use, whereas 23% to 46% in the studies otherwise funded reported “no effects”. These results are statistically significant and suggest an inherent bias attributed to the industry-funded studies.

40. This potential bias in scientific publications is becoming so extreme that journals are requiring information on funding sources and disclaimers of conflict of interest.

Source of Funding and Authors' Interpretation of Results

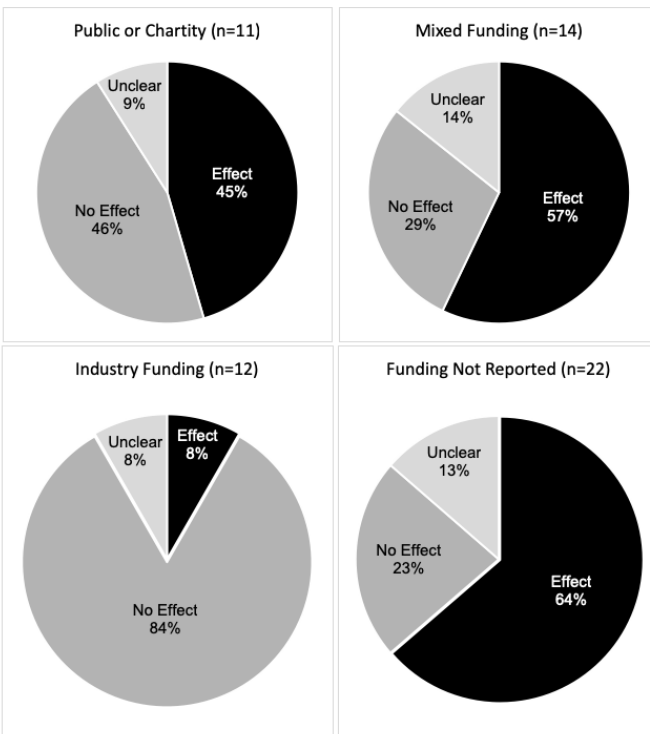


Figure 3. Relationship between funding source and outcome of research. Data from Huss et al. 2007 (Table 2).

41. Some people use the term “credible evidence” to mislead those not experts in this field. *Credible* according to what criteria and according to whom? The term “credible” is not a scientific term but one used by agencies and individuals attempting to downplay adverse effects. *Credible* is a value-laden term and one that most scientists would avoid using. Either the science is good or bad. If it is “bad” and does not follow the scientific method or has some inherent flaws it is not considered science.

42. The evidence that RF radiation is harmful to human health is overwhelming. In addition to cancer, RF radiation damages human sperm (at levels well below FCC guidelines) and reduces testosterone levels in laboratory rats. There is an association with people living near (within 500 m from) cellular antennas and a decrease in hormones (testosterone, plasma ACTH, serum cortisol, T3, T4 and progesterone), which gets worse with duration of exposure from 1 to 3 to 5 years (Eskander et al. 2012).

43. We have recent reviews with thousands of additional documents referenced for a variety of health effects available at www.bioinitiative.com. These documents cannot all be ignored. What must be kept in mind is that a study that reports “no effect” does not negate a study that finds an effect. If all of the studies reporting adverse effects were due entirely to chance, then we should have an equal number of studies showing beneficial effects of this radiation (also due to chance). Very few of these studies exist.

III. EFFECTS ON BIOTA

44. An increasing number of publications have appeared during the past few years on the effects of non-ionizing radiation (NIR) on plants and animals. These studies include effects

on biota living under natural conditions and recently exposed to NIR; as well as effects on various species exposed to NIR in controlled laboratory experiments. There are now hundreds of such studies available ([Balmori 2005, 2006](#); [Warnke 2009](#); [Expert Group 2010](#); [Hillman et al. 2013](#); [Halgamuge 2015](#); [Manville 2016](#)). Part of this affidavit is intended to provide an *overview* that highlights some key research in this area.

45. The effects of electrosmog on biota include the following:

1. *Bee Populations*: aggressive behavior, reduced productivity, swarming, abandonment of hive (colony collapse disorder);
2. *Bird Populations – Wild and Domestic*: impaired reproduction, aggressive behavior, interference with migratory behavior, bird deaths;
3. *Migratory Populations*;
4. *Mammals – Laboratory, livestock, pets*
 - a. dairy cows: reduced milk yield, altered milk quality, reduced fertility and impaired reproduction, miscarriages and deformities in offspring, infections that won't heal with antibiotics, behavioral changes, sudden death;
 - b. rodents: impaired reproduction, cancers, neurological disturbances
 - c. cats and dogs: impaired reproduction and possibly an increase in cancers.
5. *Amphibians*: deformities, population decline;
6. *Plants*: reduced growth, stunted roots, reduced yield, increased infections.

46. ***Bee Populations***: Considerable concern has been raised worldwide regarding the sudden disappearance of bees from their hives, referred to as colony collapse disorder (CCD). Bees provide not only honey, wax, and pollen but are responsible also for the pollination of approximately 85% of all flowering plants that result in fruit and seed production. Without bees, production of fruits (cherry, apple, pear and plum); vegetables (tomato, cucumber, pumpkin) and agricultural crops (rap, sunflower, red clover, horse bean) would be severely reduced ([Warnke 2009](#)).

47. CCD has been reported in the U.S., Canada, Germany Switzerland, Austria, Italy, Spain, Poland and New Zealand. Losses of bee colonies range from less than 10% to greater than 90% depending on location. Beekeepers agree that the bees are not developing properly, and while they may survive the winter, in spring they disappear leaving the colony empty. Only the brood remains in the hives and they are unable to survive without the care of the older bees (cited in [Warnke 2009](#)).

48. Several hypotheses have been put forward as to why bees are disappearing that include natural parasites and predators, extreme weather conditions and manmade stressors such as pesticides, genetically modified food crops, monocultures and electrosmog. While it is likely that all of these are adversely affecting bee colonies, this affidavit will focus on studies documenting only the effects of electrosmog.

49. Ferdinand Ruzicka, scientist and beekeeper reports (Ruzicka, 2003 as cited in Warnke 2009):

"I observed a pronounced restlessness in my bee colonies (initially about 40) and a greatly increased urge to swarm. As a frame-hive beekeeper, I use a so-called high floor, the bees did not build their combs in this space in the manner prescribed by the frames, but in random fashion. In the summer, bee colonies collapsed without obvious cause. In the winter, I observed that the bees went foraging despite snow and temperatures below zero and died of cold next to the hive. Colonies that exhibited this behavior collapsed, even though they were strong, healthy colonies with active queens before winter. They were provided with adequate additional food and the available pollen was more than adequate in autumn. The problems only materialised from the time that several transmitters were erected in the immediate vicinity of my beehives."

50. A survey through the magazine *Der Bienenvater* (2003/9) provided the following response from beekeepers:

Questions asked of Beekeepers (n=20)	% "yes"
1 Is there a mobile radio antenna within 30 m of your bee hives?	100%
2 Are you observing increased aggressiveness of the bees compared to the time before the transmitters were in operation?	37.5%
3 Is there a greater tendency to swarm?	25%
4 Are colonies inexplicably collapsing?	65%

51. Several experiments have been performed to determine how microwave radiation affects bees in their hives. In one study, Harst et al. (2006) placed a mobile phone near bee colonies and documented how quickly the bees returned to their hives. Twenty-five bees from control colonies (not exposed to mobile phone radiation) and 25 bees from exposed colonies were marked and taken 800 meters away from their hives. The return of the bees during a 45-minute period was assessed. Sixty-five percent of bees from the control colonies and less than 25% of the bees from the exposed colonies returned during the 45-minute period. At the end of the season, the exposed hives were 20% lighter with less honey and pollen than control hives. Apparently, bees do not want to live in a hive exposed to electromog in the form of microwave radiation.

52. Favre (2011) exposed his hives to the handset of a mobile phone. The sound made by the bees was recorded and analyzed. The presence of actively communicating mobile phone handsets near honeybees within 25 to 40 minutes induced worker piping (a special sound which indicates distress and the signal to swarm and leave the hive). Repeated testing under different environmental conditions produced the same result. The experiment was terminated after 20 hours before any swarming could occur. Honeybees are reacting in a stressful way to pulsed electromagnetic fields generated by mobile telephones. While such phones are unlikely to be

near beehives on a permanent basis, the radiation coming from nearby cellular phone base stations is similar and is likely to elicit the same response.

53. In a similar study with a mobile phone placed near a beehive with much longer exposure (5 to 10 days), the colony collapsed. Worker bees left the hives with queen, eggs and immature bees, and failed to return home after foraging (Pattazhy 2009).

54. This study has been repeated with slightly different exposure conditions. Sahib (2011) exposed 3 colonies of honeybees to test conditions that consisted of a mobile phone in working conditions for 10 minutes a day at 900 MHz frequency for ten days and had three control colonies, not exposed to this radiation. The results are shown in Table 1.

55. The results in Table 1 are dramatic and indicate that the worker bees left the colony after the 10-day experiment, which is what happens in CCD. Prior to leaving, the activity of the workers decreased significantly as did the number of eggs laid by the queen. Under such conditions a colony is unable to survive.

Table 1: Change in colony status of honeybees exposed to mobile phones. The results are shown as the mean plus/minus the standard deviation (Sahib, 2011).

Parameters	Exposure	Control	Treated (10 min daily for 10 days)
Number of workers bees leaving the hive entrance/minute	before	40.7 ± 15	38.2 ± 12
	during	41.5 ± 14	18.5 ± 13
	after	42.4 ± 14	0
Returning ability (number/minute)	before	42.5 ± 15	39.5 ± 14
	during	43.6 ± 14	15.6 ± 13
	after	44.6 ± 13	0
Bee Productivity	before	9 frames	9 frames
	during	9 frames	5 frames
	after	9 frames	1 frame
Egg laying rate of queen/day	before	365	355
	during	362	199
	after	350	100

56. Kumar et al. (2011) exposed adult worker bees (*Apis mellifera*) to cell phone radiation. The bees displayed two types of behaviour. The initial response, during which time bees were much less active and had increase concentrations of biomolecules (proteins, carbohydrates and lipids), was followed by an on-mass migration reminiscent of the *fight or flight* stress response.

57. Collectively these studies indicate that bees are able to sense and react to MW radiation generated by cell phones (and cell phone base station antennas). The exposure elicits an aggressive bee reaction and, if sufficiently prolonged (several days), workers bees leave the hive and the remaining brood and queen remain defenseless with no ability to survive. This could very

well be contributing to colony collapse disorder globally since MW exposure from wireless telecommunication antennas is now widespread.

58. ***Bird Populations–Wild and Domesticated:*** Research on the effects of electromagnetic fields on bird populations includes studies of behavioral changes and nesting success in the field and experimental exposure of eggs (mostly chicken eggs) under controlled laboratory conditions.

59. [Balmori \(2004\)](#) studied white stork populations nesting within 200 meters of phone masts compared to those nesting more than 300 meters away. He documented failures in breeding in nests near the antennas. Pairs of white storks near the masts were aggressive and had difficulty building their nests.

60. House sparrow populations have been decreasing during recent decades in the U.S., U.K, and several European countries ([Balmori and Hallberg, 2007](#)). Between October 2002 and May 2006, house sparrow populations were monitored and electric fields (in the frequency range of 1 MHz to 3GHz) were measured along a transect in Valladolid, Spain. Significant declines ($p=0.0037$) were observed in bird density over time, and lowest bird densities were observed in areas with high electric fields. The authors concluded that electromagnetic pollution may be responsible, either by itself or in combination with other factors, for the recently observed decline of this species in European cities.

61. [Everaert and Bauwens \(2007\)](#) made similar observations in Belgium. Fewer house sparrow males were observed in areas with elevated electric fields from cell phone base stations supporting the concept that long-term exposure to higher levels of RFR reduces the abundance and alters the behavior of house sparrows in the wild.

62. [Ferne et al. \(2000\)](#) tested whether EMFs affect reproductive success of captive American kestrels. Birds were bred for two years under either controlled (i.e. unexposed) or EMF exposure that was equivalent to that experienced by wild kestrels. In both years, fertility was higher but hatching success was lower in EMF pairs than control pairs. EMF eggs were larger, with more yolk, albumen, and water, but had thinner eggshells than control eggs. EMF exposure affected reproductive success of kestrels, increasing fertility, egg size, embryonic development, and fledging success but reducing hatching success. Reduced hatching success could put the population at risk.

63. In a follow-up study, EMF exposure altered melatonin, behavior, growth, and reproduction of captive American kestrels, particularly of males, and male kestrels exposed to EMFs experienced higher levels of oxidative stress ([Ferne et al. 2001](#)).

64. [Tanner and Romero-Sierra \(1982\)](#) exposed chickens (white leghorns) to very low intensity continuous wave MW radiation at 7.06 GHz for 248 days. Field intensity in each cage (without birds) ranged from 0.19 $\mu\text{W}/\text{cm}^2$ in the outer cages to 360 $\mu\text{W}/\text{cm}^2$. Egg production of the irradiated colony was greater (13.7%) than that of the control colony but was accompanied by twice the mortality rate. The irradiated birds that survived showed a profound deterioration in health when autopsied.

65. [Grigoriev \(2003\)](#) exposed chicken embryos to EMF from a cell phone for 21 days during embryonic development. He reported an increase in embryo mortality in exposed chicks (75%) compared with the controls (16%). Similar results were obtained for chick eggs exposed to 900 MHz frequencies ([Ingol and Ghosh, 2006](#)). Developmental abnormalities were observed in chick eggs exposed to 100 Hz, 2.1 microsecond pulse, 1 microT magnetic field ([Ubeda et al. 1994](#)).

66. Collectively these studies show that birds are sensitive to RFR and that this radiation affects behavior and reproductive success.

67. ***Migratory Population:*** Birds that migrate great distances navigate with several redundant systems that include visible clues of landscape, location of the sun, and the earth's geomagnetic field for which they have magneto-receptors in their skull. Power lines, antennas for radar, broadcast antennas, and cell phone communication can interfere with their magnetic compass and put them off course permanently or temporarily until other cues are able to correct their course. Factors that increase energy consumption of migratory birds, decrease their ability to survival. Another concern is collisions with towers or power lines.

68. [Wiltschko et al. \(2015\)](#) noted that radio frequency fields in the MHz range disrupted birds' orientation. In one experiment birds were unable to navigate as long as the RFR was present. Two different exposures were used: 7 MHz at 480 nanoT and 1.315 MHz at 15 nanoT. Once the field was turned off, birds were able to orient to the local geomagnetic field.

69. [Engels et al. \(2015\)](#) demonstrated in a double-blind experiment with European robins that migratory birds were unable to use their magnetic compass in the presence of urban electromagnetic pollution that ranged from 50 kHz to 5 MHz.

70. Birds use a magnetic compass (magneto-receptors) in their skull or beak, depending on species, that provides information about their relative position to the earth's geomagnetic field. This field does not oscillate but does decrease in strength from the poles to the equator. Alternating current from power line frequencies to microwave radiation appears to interfere with their internal magnetic compass throwing them off course during migration. The more energy they extend to correct their course the less they have to complete their flight plan.

71. Bird feathers are piezoelectric and act like antennas receiving MW radiation. [Bigu-del-Blanco and Romero-Sierra \(1975\)](#) showed that bird feathers "received" or absorbed MW radiation in the 10 to 16 GHz region. So, in addition to magneto-reception, feathers may also play a role in birds being able to detect and react to MW radiation. These higher frequencies are of particular concern with 5th generation (5G) technology.

72. ***Mammals: Dairy Cows, Ground Current and Radio frequency Radiation:*** By far the most information on the effects of electrosmog on livestock comes from studies with dairy cows. [Hillman et al. \(2013\)](#) provide a concise literature review as well as a field study based on thirteen farms with serious ground current pollution in Wisconsin and Michigan. They show that dirty electricity flowing along the ground as ground current has serious effects on cow health and productivity. Levels at which this happens are well below existing guidelines.

73. RFR also seems to adversely affect cows. On a dairy farm in Germany, after a mobile phone base station was erected nearby, calves born on this farm had a higher incidence of

cataracts compared with the Swiss average (Hassig et al. 2012). Neither chemical poisons nor infection could explain these findings. Microwave radiation is known to cause cataracts in humans and laboratory animals (Glaser 1972).

74. Loscher and Kas (1998) studied a herd of dairy cows on a farm near a TV and cell phone transmitting antenna over a two-year period and reported reduced milk yield, increasing health problems and behavioral abnormalities. Radiation from the antennas was monitored and ranged in frequency from 2.2 to 734 MHz. The highest power density reading in and around the stable was 4.5 milliW/m² (0.45 microW/cm²) at 512 MHz (well below international and FCC guidelines).

The following symptoms were observed:

1. Most animals in the herd showed conjunctivitis with strong tear flow (constant wet cheeks) and eye itching (some animals were constantly scratching their eyes on reachable stable arrangements or neighboring animals).
2. Many animals squeezed with their heads the breast area of their neighboring animal; thus, all animals ended up positioning their heads in the same direction.
3. One animal showed remarkable head motions, periodically moving the head back and forth; periods of calmness were superseded by the above described behavior which could last for as long as 30 minutes.
4. Calves and cows let out on the meadow grazed only for a few minutes, then they “took shelter” from the transmission tower behind the stable building.
5. Cows, mostly after the third or fourth calving, fell into decay. When they were getting up after having lain down, their legs started trembling, and this condition became worse very quickly. The decay happened within a few weeks, and then the animals died.

75. In this study, various tests were performed to determine what was affecting the cattle.

1. To rule out metabolic disturbances the feed was analyzed. Feed quality was high and the amounts given to the animals corresponded to their needs.
2. Autopsy of a four-year old cow indicated that death was caused by acute heart circulatory problems with internal bleedings in several organs. No signs of acute or chronic organ changes.
3. Analysis of miscarriage material provided no microscopic or serological evidence of germs that could have caused the miscarriages.
4. One animal with behavioral disturbances was relocated to a similar stable some 20 kilometers away from the transmission tower, together with another cow of the herd. After five days in the new stable the observed behavioral disturbances disappeared completely. The animals were brought home to the

stable near the transmission station after two weeks. Already after a few days the symptoms could be observed in the animal again.

5. The symptoms experienced by these cows could not be explained by poor farm management and resemble effects documented for cows near high voltage power lines and cows exposed to ground current (Burchard et al. 2006; Hillman et al. 2013), which are two other forms of electrosmog.

76. The following effects are summarized in Balmori's review. Note that U.S. guidelines for RF radiation are 1000 microW/cm²:

1. Radiation of frogs at 30–60 microW/cm² altered heart rhythm;
2. Radiation of toad hearts with 1425 MHz at 0.6 microW/cm² increased heart rate and produced arrhythmia;
3. Experimental frog tadpole development was delayed compared to control tadpoles;
4. Electromagnetic fields (EMF) caused allergies and changes in blood counts;
5. Amphibians are particularly sensitive to weak electrical fields and respond to frequencies from 0.1 Hz to 2 kHz;
6. EMFs increase tadpole mortality;
7. Electromagnetic radiation (EMR) alters the immune, nervous, and endocrine systems;
8. EMR produces stress on the immune system that interferes with DNA;
9. Heat shock proteins may play a role in protecting animals exposed to EMR;
10. Susceptibility to EMR varies among species and among populations.

77. **Laboratory Rodents & Reproduction:** Mice and rats are used in controlled experiments as a surrogate for experiments with humans. Magras and Xenos, (1997) placed twelve pairs of mice, divided into two groups, in locations around an "antenna park" where the RF power densities ranged from 168 nanoW/cm² to 1053 nanoW/cm² (0.168 to 1.053 microW/cm²). The pairs were mated five times. A progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility. In other words, if we use *drops of a substance* as an analogy for *microwave radiation*, the guidelines state that more than 1000 drops are required for any adverse effect, but this study shows that adverse effects (i.e. irreversible infertility) occurred at 1 drop.

78. **Laboratory Rodents & Cancer:** The U.S. National Toxicology Program (NTP 2018) conducted one of the largest and most expensive rodent studies to date and released their peer-reviewed report in November 2018. Rats were exposed to RFR similar to modulations currently used in U.S. wireless cellular networks starting *in utero* and continuing throughout their lifetime. An increased incidence of malignant brain gliomas and heart schwannomas as well as potentially pre-cancerous lesions were observed in male rats exposed to RFR. The tumors observed were similar to tumors observed in some epidemiology studies of cell phone use

(gliomas, schwannomas). These findings support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR.

79. This is not the first large rodent study documenting an increase in cancers following RFR exposure. [Chou et al. \(1992\)](#) exposed rats to 2.45 GHz frequencies for 25 months (the same frequencies used for microwave ovens and Wi-Fi routers). At the end of the experiment, metastatic tumors increased 100% and primary tumors increased 260% (both statistically significant).

80. [Repacholi et al. \(1997\)](#) exposed mice to 900 MHz microwave radiation pulsed at 217 Hz, specific absorption rate 0.007 to 4.3 W/kg for 30 minutes daily for up to 18 months. RF-exposed mice developed twice as many lymphomas as the unexposed mice. The FCC specific absorption rate guideline for public exposure is 1.6 W/kg.

81. More recently, the Ramazzini Institute released their rodent study, which was similar to but used lower intensities than the NTP study ([Falcioni et al. 2019](#)). Their results were similar to the NTP study as they also reported an increase in gliomas in the brain and schwannomas of the heart for the RF-exposed animals compared with the unexposed controls.

82. These four *in vivo* studies under controlled conditions and the antenna study indicate causation so these studies show that MW radiation at both cell phone frequencies and Wi-Fi frequencies and at levels below guidelines causes cancer and infertility in rats.

83. **Amphibians:** Amphibians are considered bio-indicators of environmental quality. Changes in their populations bode poorly for other species. [Balmori \(2006\)](#) reviewed the literature on amphibian declines and found that 32% of the 5743 populations studied, were in threat of extinction. Amphibians with deformities (i.e. absent or extra limbs) are also found in the environment. Both these deformities and declines are due to complex ecosystem interactions. One factor that is receiving increasing attention is the increase in microwave and radio frequency radiation in the environment from mobile phone antennas base stations.

84. **Plants:** Plants are also sensitive to electrosmog in various forms, but especially radio frequency and microwave radiation. [Halgamuge \(2016\)](#) reviewed 45 scientific publications describing 169 experimental observations to detect changes in plants exposed to weak radio frequency radiation. Almost 90% of the studies documented physiological and/or morphological effects. Maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbeans were particularly sensitive to RF-EMFs. Frequencies with the greatest effect were from 0.8 to 1.5 GHz; 1.5 to 2.4 GHz; and 3.5 to 8 GHz. Biological effects relied on field strength and amplitude modulation of the applied field. The effects were more pronounced in short-term (up to 13 weeks) rather than long-term (3 months to 6 six years) exposure studies implying there may be some adaption to this exposure.

85. In 1990, permanent plots were established near the Skrunda Radio Station in Latvia, which had been operating for the previous 20 years, and a nearby control area to test the growth of pine trees using tree ring data and examining annual growth rate ([Balodis et al. 1996](#)). The annual growth rate can be determined by tree ring radius. There was a significant negative relationship ($p < 0.01$) between the annual increment in tree growth and the intensity of the

electric field that was traced back to 1970 when the station began operation. No other environmental factor could account for this response except the radiation from the radio station.

86. In 2015, the intensity of RFR was mapped in two Germany cities (Bamberg and Hallstadt). A total of 120 trees were selected for detailed analysis of damage. Sixty of these were damaged trees, 30 were from low RF environments and 30 were selected at random (Waldmann-Selsam et al. 2016). Significant differences were observed between the damaged side facing a phone mast and the opposite side of trees. Damage was associated with power flux density and damage afflicted on trees by mobile phone towers usually started on one side and extended to the whole tree over time. The trees selected from low radiation areas (no phone mast visible and at power density less than $0.005 \text{ microW/cm}^2$) showed no damage. This study demonstrates that electromagnetic radiation from mobile phone masts is harmful to trees.

87. Tree decline is one indicator of environmental stress as the declines are often associated with infestations (insects, fungi, etc.), air pollution or altered climatic/weather conditions. Since 2004, rapid declines in aspen clones have been documented in Colorado, and the hypothesis that this decline was associated with RFR from nearby broadcast and cellular antennas was investigated (Haggerty 2010).

88. Seedlings were grown in shielded (aluminum screen) faraday cages and with mock-shielding (fiberglass screen). A portable radio was used to test the effectiveness of the shielding and indicated that there was no reception within the aluminum cages as compared with the mock shielding and unshielded controls. Conditions in the shielded and mock-shielded enclosures were similar except for the difference in RF background intensities.

89. Plants in the shielded and mock-shielded enclosures looked different at the end of the study. The RF background appeared to be adversely affecting leaf and shoot growth and inhibiting fall colors associated with leaf senescence in trembling aspen seedlings. The mock-shielded plants had many more necrotic spots on the leaves than the shielded plants (see Plate 2). According to the author, these effects suggest that exposure to the RF background may be an underlying factor in the recent rapid decline of aspen populations in Colorado.

91. Another experiment was conducted under controlled conditions testing the effect of radiation from a Wi-Fi router on the germination and growth of edible and fast germinating seedlings (garden cress, broccoli, red clover and pea) (Havas and Symington 2016). Radiation levels were $0.00001 \text{ microW/cm}^2$ for the controls. The mean and maximum exposure levels for the RF-exposed seedlings were $2\text{--}4 \text{ microW/cm}^2$ and 9.6 microW/cm^2 respectively. These levels are well below international and FCC guidelines for RF exposure (1000 microW/cm^2).

92. There were no effects on germination of the seedlings. However, dry weight of the broccoli and peas (Plate 3) exposed to Wi-Fi radiation was much lower than controls at the end of the experiment ($p < 0.01$). Wi-Fi exposure inhibited root growth of several species. It also caused root tips to turn brown and reduced root hairs of cress compared with the reference treatment. Broccoli seedlings closest to the Wi-Fi router grew away from the router; cress seedlings had larger leaves and were chlorotic compared with controls; and several of the Wi-Fi replicates had obvious growth of mold in Petri plates with unhealthy seedlings. Radiation generated by Wi-Fi routers can adversely affect plant growth and may interfere with a plant's

ability to protect itself from opportunistic mold. In addition to adverse effects on human populations, RFR also appears to adversely affect biota including plants, insects, birds, mammals, and amphibians.

Plate 2. More necrosis visible on mock-shielded (A) than shielded (B) aspen seedlings. Also leaf veins of mock-shielded plants are yellow or green and petioles are light red to pink and less healthy than leaf veins and petioles of shielded plants (Oct 6, 2007). [Source: [Haggerty 2010](#)]

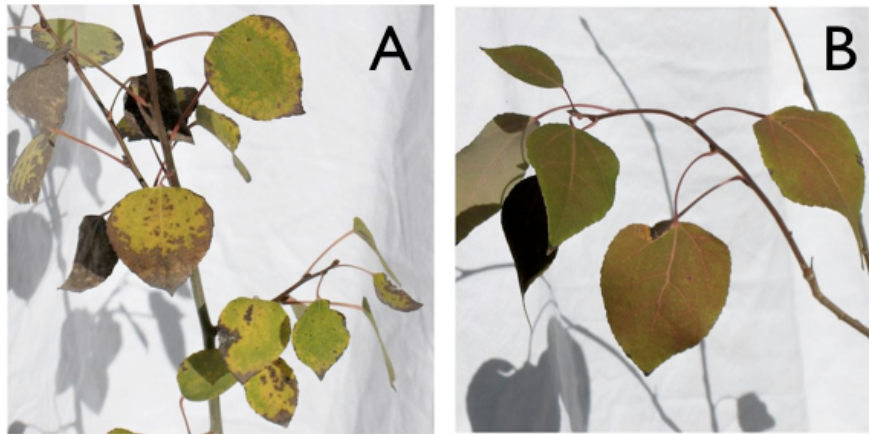
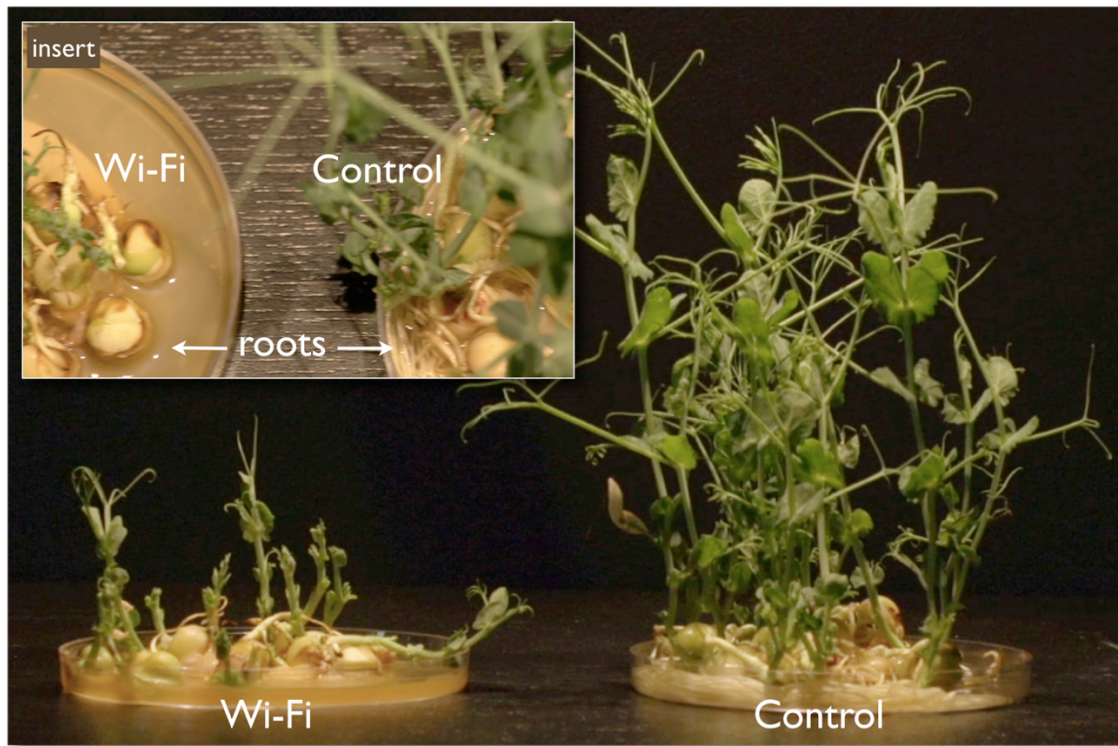


Plate 3. Growth of pea seedlings exposed to Wi-Fi radiation for one month compared with controls that were not exposed to RFR. Wi-Fi radiation reduced root growth (insert) and reduced above ground biomass. [Source: [Havas and Symington \(2016\)](#)]



IV. SCIENCE, GUIDELINES, AND MECHANISMS

93. One major disagreement among scientists is whether the effects of RFR are thermal (based on heating the body) or non-thermal. Consequently, guidelines in various countries are based on a thermal effect, a non-thermal effect, or the precautionary principle resulting in guidelines that differ by several orders of magnitude.

94. In a letter dated July 16, 2002 and addressed to Janet Newton (President, The EMR Network, Marshfield, Vermont), [Norbert Hankin](#) (Center for Science and Risk Assessment, Radiation Protection Division of the U.S. EPA) stated the following:

- a) *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.*
- b) *They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn. The hazard level (for frequencies generally at or greater than 3 MHz) is based on a specific absorption dose-rate, SAR, associated with an effect that results from an increase in body temperature. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified.*

95. Note that in the above letter, Hankin clearly states that the FCC guidelines, “do not apply to chronic, nonthermal exposure situations.”

96. [Yakymenko et al. \(2011\)](#) reviewed 95 publications and, according to the authors, this research clearly shows that long-term exposure to microwave radiation provokes cancer growth based on evidence from radar and mobile phone communication systems. Chronic exposure is generally used to mean long-term low level (or non-thermal) exposure.

97. In environmental toxicology we base our conclusions on three different types of studies. These include *epidemiological* studies that document an *association* between an agent and an outcome (RFR exposure and cancer, for example) under normal exposures of the human population. *In vivo* studies (meaning using living organisms, often laboratory animals) demonstrate a *cause-effect relationship* between an agent and an outcome under carefully controlled conditions (cancers in rats exposed to microwave radiation, for example). *In vitro* studies (meaning in glassware) are carefully controlled laboratory studies using tissue cultures or cells to determine *mechanisms* involved. The more these different types of studies align the more confidence scientists have in making statements that a particular agent has a particular effect.

98. For RFR we have all three types of evidence that document an increased risk of cancer with RF exposure in human and animal populations. We also have *in vitro* studies indicating oxidative damage due to impaired repair mechanisms that can contribute to cancer.

We have similar evidence for reproductive problems and other illnesses. I want to note here that many different mechanisms have been disrupted by exposure to RFR and these include altered calcium flow (calcium controls many different processes within the body), increased permeability of the blood-brain-barrier, increase in certain enzymes like ornithine carboxylase (ODC), for example, that is an enzyme activated during carcinogenesis, DNA breaks, increased cell proliferation, etc. ([Pall 2013](#), [Phillips et al. 2009](#); [Royal Society of Canada 1999](#)).

99. In science, evidence from well-constructed laboratory experiments and clinical trials needs to be compared with evidence from epidemiological (human population) studies. Each of these studies provides different types of information and their power comes when they all point in the same direction. Science requires a high level of evidence that the outcome (i.e. cancer with RFR exposure) is not due to chance with a statistical confidence at or above 95%. This means that there is only a 5% probability that the result is due to chance or error. This level of confidence is much higher than “beyond a reasonable doubt” required in legal cases. We have this high level of scientific evidence for the harmful biological effects of radio frequency radiation.

100. Based on the large body of research that I have reviewed and my own studies, it is my expert opinion that RF-emitting antennas should not be located on the sidewalk in front of homes, businesses, and schools where people spend a lot of time. Nor should constantly transmitting antennas be placed inside homes as the effect is cumulative and exposure to even low levels over time can have adverse biological effects on those exposed. While children, pregnant women, the elderly and those who have an impaired immune system or are chronically ill are likely to be most at risk, this radiation is likely to affect all living organisms to some extent with long-term cumulative exposure.

101. Based on peer-reviewed scientific papers and numerous medical/science appeals, it is my understanding that RFR at levels to which we are currently exposed is adversely affecting the health and wellbeing of people, plants and animals.

V. 5G TECHNOLOGY

102. The telecommunication industry with the support of the Canadian government is currently testing and installing 5G technology, which refers to 5th generation telecommunication technology. This new technology will not replace 4G. It will be in addition to current exposures meaning more exposure of the population to microwave radiation. 5G will use multiple frequency bands including low bands—600, 800 & 900 MHz; mid bands—2.5, 3.5, 3.7-4.2 GHz; and high bands (millimeter waves)—24, 28, 37, 39, 47 GHz (in U.S. and these will vary slightly between different countries. NOTE: 600 MHz to 47 GHz are all microwave frequencies. 5G will also involve densification of “small cell” antennas that will be on lamp posts and powerlines near many homes.

103. Concern about 5G technology is the increased levels of microwave exposure; proximity of “small cell” antennas near homes and other buildings; the absence of any long-term testing of the biological and health effects of mmwaves; and the large number of satellites deployed to blanket the earth with this radiation.

104. The few studies that are available for short-term exposure suggest that this radiation is going to have significant effects on people and other species, especially insects, since the size of the wave is similar to the size of insects leading to a resonance effect, meaning that more of the radiation is absorbed. The rush to have faster download speeds seems to be more important than the potential and probable effects on human health and wellbeing. Ignoring the science is not going to make this problem go away. Should the concerns of scientists and medical doctors be realized (namely that this millimeter radiation will adversely affect human health and the health of biota) we are going to pay a large price for the added convenience of rapidly communicating wireless technology in terms of health care and ecosystem dysfunction in addition to the billions of dollars for 5G infrastructure.

105. In addition to health considerations there are also issues of privacy, surveillance (facial recognition), addiction to the technology (already documented in the scientific literature), social development of young people, safety, security (hacking accounts and viruses), energy consumption leading to accelerated climate change. Insects are likely to be more severely affected due to their body size as compared to the size of the mmwaves.

106. Finally, mmwave technology is currently being deployed as a weapon called the “active denial system” for crowd control. Short bursts of this radiation causes pain as it heats the surface of the body. It has been tested and used by the U.S. government for several years.

107. Another use of mmwaves is at airports as passengers are screened before they board the airplane. A growing number of the personnel who work at these stations are reporting illnesses that include cancers.

108. Since microwave frequencies are known to weaken the immune system, the current covid-19 pandemic may be more lethal due to such a large population being exposed to 4G and 5G radiation.

109. [Russell \(2018\)](#), reviewed what limited research is available and came up with the following conclusion.

- sweat glands will be the target as they act like miniature antennas to mmwaves.
- systemic signaling in the skin can result in physiological effects on the nervous system, heart, and immune system mediated through neuroendocrine mechanisms;
- some frequencies had no effect (61 and 75 GHz) while other frequencies (55 and 73 GHz) caused pronounced arrhythmia. For this very reason, testing is essential to identify the frequencies that are least likely to be harmful should we move ahead with 5G technology.
- there is likely to be an epidemic of ocular pathology with long-term exposure and an increase in cataracts in both young and old;
- evidence that the immune system is impaired after a single dose resulting in 50% suppression of phagocytic activity in healthy mice;

- teratogenic effects (birth defects) were detected in drosophila (fruit flies that are used in the lab for studies involving several generations).
- evidence that bacterial growth may increase or decrease depending on the species tested and on frequency and intensity of the mmwaves; and
- evidence of antibiotic resistance caused by mmwaves.

110. Clearly, we need to be very carefully to avoid harmful biological and health effects to humans and other species if we are to expose virtually the entire population of Canada (and the world) to mmwaves.

111. Professor [Martin Pall \(2018\)](#) predicts four types of blindness associated with 5G technology: cataracts, detached retinas, glaucoma and macular degeneration. He goes on to state, “Putting in tens of millions of 5G antennae without a single biological test of safety has got to be about the stupidest idea anyone has had in the history of the world.”

112. Many scientists agree that 5G needs to be placed on hold until proper scientific testing of the biological effects is complete. Scientists and doctors have signed a 5G appeal <http://www.5gappeal.eu/scientists-and-doctors-warn-of-potential-serious-health-effects-of-5g/> and warn of potential serious health effects of 5G. They recommend a moratorium on the roll-out of 5G for telecommunication until potential hazards for human health and the environment have been fully investigated by scientists independent from industry. 5G will substantially increase exposure to radio frequency electromagnetic fields (RF-EMF) on top of the 2G, 3G, 4G, Wi-Fi, etc. RF-EMF has been proven to be harmful for humans and the environment at current levels. Increasing exposure is likely to make things that much worse.

113. This 5G Appeal, has been signed by more than 231 scientists in 40 nations as of April 30, 2019.

114. I am deeply concerned that once the 5G infrastructure is in place it will too late to protect people and the planet. [All the addressed negative impacts could easily be avoided by applying far safer/faster/more secured alternatives like wired communication networks as mentioned in Timothy Schoechle’s paper <https://electromagnetichealth.org/wp-content/uploads/2018/02/ReInventing-Wires-1-25-18.pdf>.](#)

VI. HEALTH CANADA’S SAFETY CODE 6 – CRITICAL ASSESSMENT

115. Health Canada (HC) is responsible for establishing guidelines and standards to protect the Canadian public against electromagnetic pollution. When it comes to NIR, HC is failing to fulfill its mandate. Very briefly I have some concerns about Health Canada’s Safety Code 6 (SC6), the document that provides guidelines for electromagnetic pollution. Those concerns are as follows:

116. HC does not have guidelines for electromagnetic frequencies below 3 kHz. Consequently, we have no guidelines for ELF electric or ELF magnetic fields associated with our use of electricity despite the fact that studies are documenting,

- a) an increase in various types of cancers with occupational exposure to ELF EMFs;

- b) an increase in childhood leukemia for residential exposure to ELF EMFs; and
- c) reduced oncostatic effect of melatonin and tamoxifen on breast cancer in the presence of a magnetic field of 12 mG (Havas 2000). Consequently people who live near high voltage power lines or are exposed occupationally to ELF EMFs are not protected due to absence of guidelines. This is unacceptable. Canada needs guidelines for ELF EMFs and those guidelines should differ for children and adults as we know that children exposed to magnetic fields at or above 3 mG have a greater risk of developing leukemia whereas adults appear to develop cancers at higher magnetic field exposures in the range of 10 to 12 mG. Indeed IARC recognized this in 2002 when they classified ELF EMFs as possibly carcinogenic to humans.

117. HC's guidelines for frequencies between 3 kHz and 300 GHz are out of date and are based on the false assumption that only shock (at lower frequencies) and thermal effects (at higher frequencies) are important from a biological/health perspectives. In other words, if you don't get a shock and if your body temperature does not increase you are safe. Once again, thousands of studies at levels well below thermal effects document adverse health effects that are being ignored by HC.

118. Guidelines are for a small subset of the population and not for all Canadians. In HC's "Understanding Safety Code 6" <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/understanding-safety-code-6.html> they state: "The safety limits in this code apply to all individuals working at, or visiting, federally regulated sites." There are no guidelines for schools, hospitals, or occupational settings. This is unacceptable.

119. To establish if guidelines are exceeded, HC relies on the average readings based on a 6-minute period of monitoring. There are two concerns related to this. Averages are used by engineers but living organisms respond to extremes and not averages. Consequently someone can scald their hand within a matter of seconds with boiling water even if they then place their hand in a cool water bath giving a lower average temperature. The second concern is effects of short-term exposure differ considerably from long-term exposure and we have no guidelines for long-term, continuous exposure irrespective of what Health Canada states.

120. In an earlier version of SC6 (1999) the following statement appeared on page 11, "Certain members of the general public may be more susceptible to harm from RF and microwave exposure." This statement was removed from more recent versions with no explanation provided for that removal.

121. It is unclear which scientific documents HC relied on for their guidelines and which ones they ignored as no monograph has been produced and no references are provided. This is in sharp contrast to the two excellent monographs produced by IARC for ELF (2002) and RF (2012) exposure. What is missing is transparency.

122. Perhaps what I find most disturbing is HC's Fact Sheet entitled, "Busting Myths on Safety Code 6." These are "myths" and "facts" according to HC.

123. Health Canada provides the following myths/facts that I challenge below:
<https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/fact-sheet-what-safety-code-6.html>

124. **Myth #1:** Safety Code 6 limits only provide protection based on limited exposure for healthy adults. The guideline does not account for vulnerable populations such as children or people with electro hypersensitivity disorder.

HC Fact: Even a small child, following continuous exposure from multiple sources of RF energy, would not experience adverse health effects provided that the exposure limits set in Safety Code 6 are respected.

My Comments: Where is the scientific evidence supporting this statement? I know of no study that deliberately exposed a small child to continuous RF radiation and documented the health effects. Indeed this type of research would be ethically unacceptable. What does seem to be happening is that students in schools with Wi-Fi are complaining of ill health (see 16 by 9 the bigger picture Wi-Fi in Schools dangerous, <http://www.emf-safety.com/169-wifi-in-schools-dangerous.html>).

HC goes on to state: While the symptoms attributed to electrohypersensitivity conditions are real, scientific evidence has failed to demonstrate that they are caused by exposure to electromagnetic fields.

My Comments: A double blind, placebo controlled study showed that exposure to 2.4 GHz microwave radiation at levels below 5 microW/cm² (i.e. less than 1% of SC6 guidelines) affects the heart and the autonomic nervous system of those who are electrically sensitive (Havas et al. 2010).

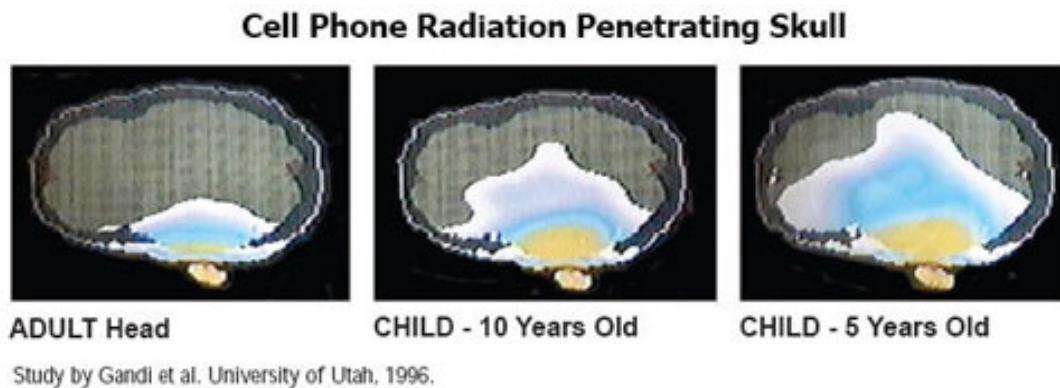
Dr. William Rea and colleagues (1991) tested the response of 100 patients to different electromagnetic frequencies from 0.1 Hz to 5 MHz and found that 16 regularly responded only to EM exposure and not to blank exposures. Most of the reactions were neurological (such as tingling, sleepiness, headache, dizziness, and in severe cases unconsciousness) although a variety of other symptoms were also observed including pain of various sorts, muscle tightness particularly in the chest, spasm, palpitation, flushing, tachycardia, edema, nausea, belching, pressure in ears, burning and itching of eyes and skin.

In addition to the clinical symptoms, instrument recordings of pupil dilation, respiration, and heart activity were also included in the study using a double-blind approach. Results indicate a 20% decrease in pulmonary function and a 40% increase in heart rate. Patients sometimes had delayed or prolonged responses. These objective instrumental recordings, in combination with the clinical symptoms, demonstrate that EMF sensitive individuals respond physiologically to certain EMF frequencies.

125. **Myth #2:** Frequent users of cell phones, such as children and teenagers, are at an increased risk of adverse health effects caused by exposure to RF energy.

HC Fact: There is no evidence that children and teenagers are at increased risk when Safety Code 6 exposure limits are respected.

My Comments: [Hardell et al \(2009\)](#) showed that young people who used a cell phone before the age of 20 had a greater risk of developing a brain tumor than did adults. [Gandhi et al \(2012\)](#) showed that radiation from a cell phone penetrates much more deeply into the brain of a child than that of an adult ([Figure 4](#)).



1. Children **absorb** more **energy** than adults from the same phone.
2. Tumors in **mid brain** are more deadly than those in **temporal lobe**.
3. Children's **cells** are **reproducing** more quickly than adults.
4. Children's **immune system** is not as well developed as adults.
5. Longer potential for **life-time exposure** for children than adults.

Figure 4. Cell phone radiation penetrating into the brain of a 5-year old, 10-year old and adult.

Depth of absorption of cell phone radiation in a 5-year old child, a 10-year old child, and in an adult from GSM cell phone radiation at 900 MHz. Color scale on right shows the SAR in Watts per kilogram. Source: [Gandhi et al., \(2012\)](#).

To their credit, HC provides information on how to reduce your risk in their fact sheet on *Cell Phones and Cell Phone Towers* <https://www.canada.ca/en/health-canada/services/consumer-radiation/safety-cell-phones-cell-phone-towers.html>. They state the following:

Health Canada reminds cell phone users that they can take practical measures to reduce their RF exposure by:

- limiting the length of cell phone calls
- using "hands-free" devices
- replacing cell phone calls with text messages
- Health Canada also encourages parents to take these measures to reduce their children's RF exposure from cell phones since children are typically more sensitive to a variety of environmental agents.

My comments: So HC does recognize that children are more sensitive than adults to a variety of environmental agents, but they don't apply this concept to their RF guidelines.

126. **Myth #3:** Many countries have limits 100 times lower than Safety Code 6. This must mean Safety Code 6 doesn't protect my health.

HC Fact: Canada's limits are consistent with the science-based standards used in other parts of the world, including the United States, the European Union, Japan, Australia and New Zealand.

My Comments: Countries that rely on the science-based evidence recognize non-thermal effects and hence have much lower guidelines than does Canada. Guidelines globally fall into one of three categories: thermal, non-thermal and precautionary principle. Canada's guidelines are thermal and are the least protective.

127. **Myth #4:** Health Canada ignores certain studies, especially those that show adverse health effects resulting from exposure to RF energy.

HC Fact: When developing the exposure limits in Safety Code 6, Health Canada scientists consider all peer-reviewed scientific studies and employ a weight-of-evidence approach.

HC goes on to state: The weight-of-evidence approach takes into account both the quantity of studies on a particular endpoint (whether adverse or no effect), and, more importantly, the quality of those studies.

My Comments: First it is not possible to consider "all" peer-reviewed scientific studies as there are hundreds of thousands of them. Second, HC does not provide any of the studies upon which they relied so it is not possible to determine which studies were omitted or ignored. And finally, HC conducts weight-of-evidence improperly and comes to the wrong conclusion from a scientific basis. As they state above, they consider whether a study documents adverse or no effects. What about studies that document a beneficial effect? How does HC deal with those studies? When conducting weight-of-evidence analysis studies showing adverse effects are compared to studies showing beneficial effects. Studies showing no effect are ignored. The appropriate way to conduct research and to establish guidelines is demonstrated by [IARC](#) in their two monographs on ELF (2002) and RFR (2012) both of which are longer than 400 pages. These monographs provide the studies considered and the rationale for the conclusions drawn. This is the appropriate way to conduct and communicate research in a transparent manner that allows for further dialogue among experts.

128. **Myth #5:** Safety Code 6 is based only on preventing thermal (heating) effects and doesn't consider other harmful non-thermal/biological effects.

HC Fact: Health Canada scientists consider all peer-reviewed scientific studies and consider many different potential health effects including thermal, non-thermal and biological effects.

HC goes on to state: The exposure limits in Safety Code 6 for frequencies above 10 MHz are therefore set below the level at which heating (thermal effects) could occur. Harmful non-thermal/biological effects at levels below the limits in Safety Code 6 have not been scientifically established.

My comments: If HC believes that non-thermal effects have not been scientifically established then they must have ignored all the scientific literature documenting non-thermal effects. Many of these studies are available in the [BioInitiative Report \(Carpenter and Sage 2007\)](#).

129. **Myth #6:** I live and work in a major city, so I am constantly exposed to RF energy, all the time. Safety Code 6 does not account for the cumulative effects of this exposure to RF energy.

HC Fact: Canadians are protected from the cumulative effects of RF energy when Safety Code 6 is respected.

My Comments: Where is the evidence supporting the statement above? Instead of providing evidence, HC simply repeats their mantra that “no adverse health effects will occur from exposure to RF energy at the levels permitted by Safety Code 6.” What scientists are finding is that the long-term chronic and cumulative exposures are contributing to adverse health conditions including but not limited to cancers.

130. **Myth #7:** Safety Code 6 does not protect my health, as it's based on an exposure time of only six minutes. Given our constant exposure to RF energy, especially in urban environments, this is not enough.

HC Fact: Canadians are protected from continuous exposure to multiple sources of RF energy when Safety Code 6 is respected.

HC goes on to state: This reference period is not a maximum exposure time. It means that the levels of RF energy from *all sources combined* shall not exceed the exposure limits in Safety Code 6 in *any* six-minute time period throughout the day.

My Comments: Where is the evidence and who is measuring exposure of Canadians to ensure that SC6 is not exceeded? To my knowledge neither HC nor Innovation, Science & Economic Development Canada do routine monitoring of RF exposure. If you don't monitor it you can't enforce it!

131. **Myth #8:** The International Agency for Research on Cancer (IARC) classified radiofrequency energy as potentially carcinogenic. This means that I will get cancer due to my exposure to RF energy.

HC Fact: The IARC did not find a direct link between RF energy exposure and cancer.

HC goes on to state: IARC ... classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group 2B), based on an increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use. However, the vast majority of research to date does not support a link between RF energy exposure and cancers in humans.

My Comments: How many studies are needed to justify that there is a direct link between cancers (for example) and RF exposure? To date we have dozens of studies showing an association between cell phone use and gliomas, that occur on the same side of the head where the cell phone is placed; that rats exposed to RFR have a greater risk of developing various tumors including gliomas; that the age-standardized incidence rate for stage 4 gliomas in the frontal and temporal lobes are increasing in both the England and California according to cancer registries. Surely these studies provide enough scientific evidence to recognize a direct link between RF exposure and the formation of gliomas and other tumors.

132. **Myth #9:** Because Health Canada regularly reviews Safety Code 6, it must mean the current Code doesn't offer me enough protection.

HC Fact: The exposure limits recommended in Safety Code 6 protect the health of Canadians.

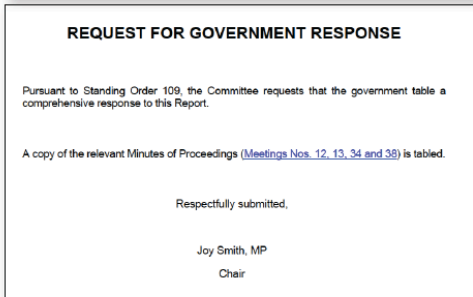
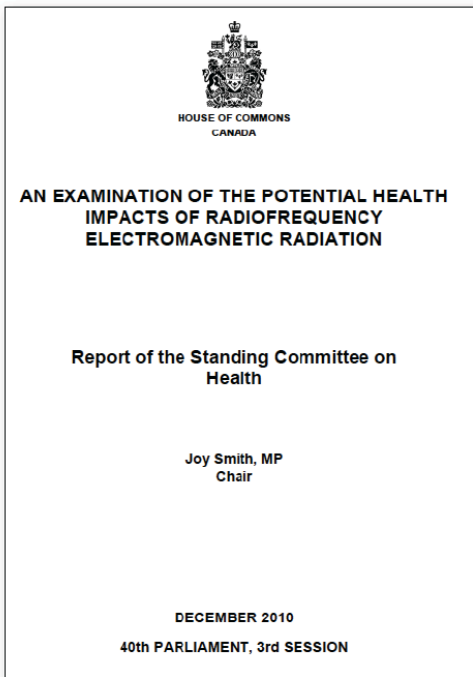
HC goes on to state: The Department continues to monitor and analyze ongoing scientific research on this issue and should new scientific evidence arise demonstrating that exposure to RF fields poses a health risk to Canadians, Health Canada will take the appropriate action to safeguard the health of Canadians.

My comments: While HC states that they continue to analyze ongoing scientific research there is no evidence that they recognize any of the research dealing with non-thermal effects. The health risk to Canadians from RF is clear yet HC fails to act and to protect the public. Indeed, no testing is done to find out what people are actually exposed to and whether the limits are exceeded. Health Canada and Innovation, Science & Economic Development Canada (ISED) (formerly Industry Canada) rely on the telecom industry to provide them with information on exposures. And since these companies report only on what they are emitting who is measuring the combined exposure from multiple antennas on towers where co-occupancy is required? Who is detecting "hot spots" when RFR is re-radiated by metallic objects?

VII. HESA RECOMMENDATIONS ON RADIO FREQUENCY RADIATION

133. In 2010 and again in 2015, The Standing Committee on Health (HESA) held hearings on Radio Frequency Radiation and made a number of recommendations to the Government of Canada. Those recommendations are summarized in [Tables 2 and 3](#).

Table 2. HESA 2010 Recommendations to the Canadian Government regarding Radio Frequency Radiation



RECOMMENDATIONS:

1. The **Government of Canada** consider providing funding to the **Canadian Institutes of Health Research** in **support of long-term studies** examining the potential health impacts of exposure to radiofrequency electromagnetic radiation.
2. **Health Canada** request that the **Council of Canadian Academies** or another appropriate independent institution conduct an **assessment** of the Canadian and international scientific **literature** regarding the potential health impacts of short and long-term exposure to radiofrequency electromagnetic radiation, which would include an examination of electromagnetic sensitivity and a comparison of public policies in other countries governing exposure to radiofrequency electromagnetic radiation; and report on its findings.
3. **Health Canada** and **Industry Canada** develop a comprehensive **risk awareness program** for exposure to radiofrequency electromagnetic radiation, which would include Health Canada making public in an accessible and transparent way all the studies and analyses undertaken by the Department on the impact of radiofrequency electromagnetic radiation on human health, as well as the provision of information promoting the safe use of wireless technologies.
4. **Health Canada** and **Industry Canada** offer to provide information, including **awareness sessions** on exposure to radiofrequency electromagnetic radiation.
5. **Health Canada** ensure that it has a process in place to **receive and respond to reports of adverse reactions** to electromagnetic radiation emitting devices.

134. To my knowledge, the Government of Canada and its various Departments and Agencies have largely ignored these recommendations.

Table 3. HESA 2015 Recommendations to the Canadian Government regarding Radio Frequency Radiation.

2015 HESA Recommendations



Radiofrequency Electromagnetic Radiation and the Health of Canadians, Report of the Standing Committee on Health; Ben Lobb, Chair; 41st Parliament, Second Session, June, 2015.

RECOMMENDATION 1

That the **Government of Canada**, in collaboration with the **health departments of the provinces and territories**, examine existing **cancer** data collection methods to improve the collection of information relating to wireless device use and cancer.

RECOMMENDATION 2

That **Statistics Canada** consider including questions related to **electromagnetic hypersensitivity** in the Canadian Community Health Survey.

RECOMMENDATION 3

That the **Government of Canada**, through the **Canadian Institutes of Health Research**, consider funding research into electromagnetic hypersensitivity testing, diagnosis and treatment, and its possible impacts on health in the workplace.

RECOMMENDATION 4

That the **Canadian Medical Association**, the **Royal College of Physicians and Surgeons**, the **College of Family Physicians of Canada** and the **World Health Organization** consider updating their **guidelines** and continuing **education** materials regarding the diagnosis and treatment of **electromagnetic hypersensitivity** to ensure they are based on the latest scientific evidence and reflect the symptoms of affected Canadians.

RECOMMENDATION 5

That the **Government of Canada** continue to provide reasonable accommodations for environmental sensitivities, including **electromagnetic hypersensitivity**, as required under the **Canadian Human Rights Act**.

RECOMMENDATION 6

That **Health Canada** ensure the openness and transparency of its processes for the review of **Safety Code 6**, so that all Canadians have an opportunity to be informed about the evidence considered or excluded in such reviews, that outside experts are provided full information when doing independent reviews, and that the scientific rationale for any change is clearly communicated.

RECOMMENDATION 7

That the **Government of Canada** establish a system for Canadians to **report potential adverse reactions to radiofrequency fields**.

RECOMMENDATION 8

That an **independent scientific body** recognized by Health Canada examine whether **measures taken** and **guidelines** provided in other countries, such as France and Israel, to **limit the exposure of vulnerable populations**, including infants, and young children in the school environment, to radiofrequencies should be adopted in Canada.

RECOMMENDATION 9

That the **Government of Canada** develop an **awareness campaign** relating to the safe use of wireless technologies, such as cell phones and Wi-Fi, in key environments such as the school and home to ensure that Canadian families and children are reducing risks related to radiofrequency exposure.

RECOMMENDATION 10

That **Health Canada** conduct a **comprehensive review** of all existing literature relating to radiofrequency fields and carcinogenicity based on international best practices.

RECOMMENDATION 11

That the **Government of Canada**, through the **Canadian Institutes of Health Research**, consider **funding research** into the link between radiofrequency fields and potential health effects such as cancer, genetic damage, infertility, impairment to development and behaviour, harmful effects to eyes and on the brain, cardiovascular, biological and biochemical effects.

RECOMMENDATION 12

That the **Government of Canada** and **manufacturers** consider policy measures regarding the **marketing** of radiation emitting devices to children under the age of 14, in order to ensure they are aware of the health risks and how they can be avoided.

135. Recommendation 3 above requests that Health Canada and Innovation, Science & Economic Development Canada make public *in an accessible and transparent way* all the studies and analyses undertaken by the Department on the impact of radio frequency electromagnetic radiation on human health. Nine years have passed and Health Canada has failed to provide the studies it relied on to formulate Safety Code 6.

136. HESA clearly recognizes the importance of electromagnetic hypersensitivity as it is mentioned in several of the recommendations above. It is unclear which of these recommendations have been implemented.

VIII. FINAL COMMENTS

137. Overall, the studies examining the effects of various types of electromagnetic pollution from power frequency electric and magnetic fields to microwave radiation are documenting adverse effects on reproduction, health and longevity of humans and wildlife as well as reduced productivity in agriculturally and commercially important animals, insects and

plants. Increased cancers in rats exposed to microwave radiation at cell phone and Wi-Fi frequencies under controlled conditions have also been documented in at least three large, well-funded studies. These effects and these studies cannot continue to be ignored. As levels of electromagnetic pollution continue to increase and as the areas of exposure continue to expand a growing number of people and species are being placed at risk. Some of these species have critical functions in ecosystems and their disappearance can have widespread adverse effects on societies around the world.

138. This concludes my testimony.

139. I affirm under penalty of perjury under the laws of Canada that, to the best of my knowledge, the foregoing is true and correct.



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April 2, 2020.

EXHIBIT A

CURRICULUM VITAE

Dr. Magda Havas, B.Sc., Ph.D., Professor Emerita

Provided separately

Warning about Future 5G Roll-Out in Municipalities and Adverse Consequences to Humans, Flora and Fauna

Dr. Magda Havas, B.Sc., Ph.D., Professor Emerita

EXHIBIT B

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