C4ST Fact-checks Government of Canada Webpages Regarding Health Risks and Wireless Technologies, including 5G

(January 2021)

BACKGROUND:

Currently, the Government of Canada (GoC) provides assurances on its webpages that exposures to radiofrequency (RF) energy (=radiation) from 5G technologies and from everyday wireless devices such as cell phones and cell tower antennas are safe.

Canadians for Safe Technology (C4ST) has fact-checked some of these statements and found them to be inaccurate and misleading to the point of being "*misinformation.*"

Full rollout of 5G technologies will greatly increase exposure to RF radiation, because many more cellular antennas are required for the vast number of new devices. 5G technologies introduce new frequencies (millimetre waves) not previously widely used for wireless communications, as well as frequencies common to pre-5G technologies (2G, 3G, 4G and LTE).

Users and bystanders are exposed to RF radiation from antennas built into devices such as: cell phones, tablets, and laptops; wireless printers; smart wearables; wireless earpieces, headphones, and goggles; smart appliances; and many other wireless-enabled objects. **Whether or not they are using a wireless device, everyone is exposed to RF radiation.** Wireless "*coverage*," "*signals*" or "*connections*" are RF radiation emissions from antennas attached to cell towers, buildings, utility poles; Wi-Fi access points; and security system equipment.

The GoC relies on Health Canada's Safety Code 6 (2015)[1,2] with the stated goal to ensure that RF radiation exposure limits will keep Canadians safe. Innovation, Science and Economic Development (ISED)[3] has adopted Safety Code 6 guidelines, for compliance requirements for RF emitting wireless devices and equipment. No guideline or regulation addresses environmental effects on other mammals, birds, insects, vegetation and natural processes.

C4ST responds to the GoC website statements and provides scientific evidence that Safety Code 6 (2015) is not protective of the health of Canadians, and that a moratorium on 5G is essential to prevent additional widespread risks to our health.

C4ST and many Canadian groups launched an **"Urgent Appeal to the Government of Canada to Suspend 5G Rollout"** which we are asking all Canadians to sign.

For more information see: **"Engaging your Member of Parliament (MP) about 5G."**[4]

STATEMENTS ARE FROM THE FOLLOWING GOVERNMENT OF CANADA (GoC) WEBSITES:

1. HEALTH CANADA

1) Cell phones, cell phone towers and other antenna installations

https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/cell-phones-towers.html

2) Fact Sheet – What is Safety Code 6?

https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/fact-sheet-what-safety-code-6.html

2. INNOVATION, SCIENCE AND ECONOMIC DEVELOPMENT (ISED) – previously INDUSTRY CANADA (IC)

Radiofrequency Energy and Safety

https://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11467.html

C4ST RESPONSES TO SOME OF THE INACCURATE AND MISLEADING GoC WEBSITE STATEMENTS ARE ORGANIZED AS FOLLOWS:

Canadians for Safe Technology (C4ST) respectfully disagrees with the following statements on Government of Canada (GoC) webpages, and we offer clarifications and corrections based on expert knowledge and peer-reviewed science.

Reading Tip: To move easily between the main text of the C4ST responses and the "References and Endnotes" at the end of the document, merely double-click on the small superscript numbers.

1. HEALTH, 5G TECHNOLOGIES AND SAFETY CODE 6

Questionable Health Canada and ISED Website Statements

#01. *Safety Code 6 protects "those using 5G technologies."*

#02. *Safety Code 6 protects everyone exposed to radiofrequency EMF [electromagnetic fields].*[5]

C4ST Response

C4ST Response to GoC Statements #01 and #02:

These statements are inaccurate and misleading, for two reasons:

1) **No long-term human or environmental safety testing of 5G technologies has been reported.**

   Health Canada is turning a blind eye to the science and deaf ear to the warnings of scientists, medical doctors and other experts that 5G technologies have not been tested for harmful biological effects.[6,7] C4ST's position is that 5G rollout should be halted until scientists who are independent of industry influence demonstrate that 5G technologies are safe for Canadians.[8,9]

   5G will use millimetre frequencies, in addition to many of the same frequencies already in use (2G, 3G,4G and LTE). The science on the effects of exposure to millimetre frequencies on biological systems is sparse. Most studies have looked at only one frequency in the millimetre range and not the complex RF mixtures that 5G technologies will emit.

   Two recent literature reviews published in peer-reviewed journals analyzing the scientific evidence on the biological effects of 5G frequencies both concluded that there is not enough known about these 5G millimetre frequencies to assure safety.

   - The review by Dr. Myrtill Simkó and Dr. Mats-Olof Mattson (2019) from Sweden identified 94 relevant studies, with 80% of the *in vivo* studies and 58% of the *in vitro* studies showing biological effects. They concluded, *"The available studies do not provide adequate and sufficient information for a meaningful safety assessment."*[10]
   - The review by Finnish researcher Dr. Darius Leszczynski (2020) on skin and skin cells concluded, "*the scientific evidence concerning possible effects of millimeter-waves on humans is insufficient to devise science-based exposure limits and to develop science-based human health policies."*[11]

Furthermore, considering that many 5G technologies are still in development, Health Canada cannot possibly assure safety for biological effects of these complex technologies. Health Canada's basis for its statement on safety is based only on temperature simulations.

2) **Safety Code 6 (2015) is outdated. It does not protect the health of Canadians from RF radiation emitted by pre-5G technologies (cell phones, cell tower antennas, Wi-Fi, etc.).**

These points are elaborated on in the Sections below.

2. HEALTH RISKS

Questionable Health Canada or ISED Website Statements

#03. *Based on the available scientific evidence, there are no health risks from exposures to the low levels of radiofrequency EMF [electromagnetic fields] emitted by cell phones and antenna installations.*

C4ST Response

C4ST Response to GoC Statement #03:

This is an inaccurate statement. There is indisputable evidence that there are serious health risks from exposure to radiofrequency EMF (RF radiation) at and below the maximum exposure limits in Safety Code 6 (2015). C4ST responds to this and related statements under the following headings: cancer, sperm and DNA damage, children and cell phones.

2.1 HEALTH RISKS - CANCER

Questionable Health Canada or ISED Website Statements

#04. *The scientific evidence does not support a link between exposure to radiofrequency EMF and cancer at the levels permitted by Canadian exposure guidelines.*

#05. *In 2011, the International Agency for Research on Cancer (IARC), which is part of the World Health Organization, 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.*

#06. *While there have been some studies reporting an increase in incidence of brain cancer among long-term, heavy cell phone users, other studies conducted in many countries around the world, including studies assessing brain cancer trends among large populations, do not find changes in brain cancer incidence. This is despite widespread use of cell phones over the past 25 years.*

#07. *The Safety Code 6 limits for human exposure to RF energy are designed to provide protection for all age groups, including children, on a continuous (24 hours a day/seven days a week) basis.*

C4ST Response

C4ST Response to GoC Statements #04 and #05:

These are inaccurate and misleading statements. Experts maintain that a "*known human carcinogen*" classification is the appropriate classification. This is the same category as asbestos and cigarette smoke. Below are two high-quality published papers supporting our statement. For more studies, see: *http://c4st.org/wp-content/uploads/2020/05/Supplemental-Material-for-Suspend-5G-Canada-Appeal.pdf*

1) The publication "**Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102)"**[12] states, *"When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR [RF Radiation] should be categorized as carcinogenic to humans (IARC Group 1)*." Dr. Anthony Miller, lead author on this paper, a Canadian MD epidemiologist, has been awarded the Medal of Honour by the World Health Organization's International Agency for Research on Cancer (IARC) and in 2019 was named a Member of the Order of Canada.

2) In "**Comments on the US National Toxicology Program Technical Reports on Toxicology and Carcinogenesis Study in Rats Exposed to Whole-Body Radiofrequency Radiation at 900 MHz and in Mice Exposed to Whole-Body Radiofrequency Radiation at 1,900 MHz**," the authors conclude, *"Based on the Preamble to the IARC Monographs, RF radiation should be classified as carcinogenic to humans, Group 1."*[13] The research published by lead author Dr. Lennart Hardell and his team provided key evidence for IARC's decision in 2011 to designate RF radiation as a Class 2B, "*possible"* human carcinogen.[14]

Radiofrequency radiation is slated to be re-evaluated by IARC. A recent IARC report (pages 148-149)[15] summarizes more recent evidence, and states that the science is ready for evaluation and is a "*high priority.*"

C4ST Response to GoC Statements #05 and #06:

These are misleading and inaccurate statements. Many studies and reports show increased brain cancer. C4ST is not suggesting that *all* increases are *only* caused by exposure to RF radiation; however, it must be considered as a substantial contributor, not dismissed:

1) The incidence of neuro-epithelial brain cancers has significantly increased in all children, adolescent, and young adult age groups from birth to 24 years in the United States.[16,17]
2) A sustained and statistically significant rise in glioblastoma multiforme across all ages has been described in the UK.[18]
3) The incidence of several brain tumors is increasing at statistically significant rates, according to the 2010–2017 Central Brain Tumor Registry of the U.S. (CBTRUS) dataset.[19]
    - There was a significant increase in incidence of radiographically diagnosed tumors of the pituitary from 2006 to 2012.[20]
    - Meningioma rates have increased in all age groups from 15 through 85+ years.
    - Nerve sheath tumor (Schwannoma) rates have increased in all age groups from age 20 through 84 years.
    - Vestibular Schwannoma rates, as a percentage of nerve sheath tumors, have also increased from 58% in 2004 to 95% in 2014.

4) Canadian data indicates a doubled risk of a rare brain cancer for those with more than 558 lifetime hours' use of a cell phone.[21] (Over 20 years, that would be less than 5 minutes per day.)
5) A multicenter case-control study in France concluded, "*These additional data support previous findings concerning a possible association between heavy mobile phone use and brain tumours*".[22]
6) A 2020 review and meta-analysis has found "*evidence that linked cellular phone use to increased tumor risk."*[23]
7) A just published study on thyroid cancers in Nordic countries[24] concluded, *"These results are in agreement with recent results on increased thyroid cancer risk associated with the use of mobile phones ...."*

Furthermore, a 2020 review and meta-analysis found that RF radiation exposure *"significantly increased risk of breast cancer."*[25]

The Government of Canada webpages state that *"the vast majority of research to date does not support a link between RF energy and cancers in humans."* As any reliable scientist will tell you, science is not like a hockey game where the most points win. The quality of the studies is key, and rigorous methods are used to grade quality and to pool results. When high-quality studies show harm, as in this case, then this must be addressed. The risks of cancer and exposure to RF energy (=radiation) are affecting Canadians today, and the sooner Health Canada acknowledges this and revises Safety Code 6, the sooner the health of Canadians will be adequately protected.

2.2 HEALTH RISKS - SPERM AND DNA DAMAGE

C4ST Response to GoC Statement #03:
The evidence is indisputable that having a wireless device (such as a cell phone) next to the body poses risks for sperm damage and DNA damage at everyday levels of exposure.[26,27] Numerous studies also demonstrate harms from exposure to cell antenna installations.[28,29]

2.3 HEALTH RISKS - CHILDREN

C4ST Response to GoC Statement #07:
Children are not little adults. All of the "*safety*" information in Safety Code 6 is based on "*models,*" not real children. The modelling for cell phone safety is based on a 200-pound (91 kg) mannequin and tests only for temperature changes[30]—not for any of the biological effects such as DNA damage. A study showing RF radiation penetrates into deeper brain structures in children than in adults was conducted by Dr. Claudio Fernandez et al. (2018).[31] Dr. Tom Butler has summarized some of the studies about why children's health is of particular concern.[32]

2.4 HEALTH RISKS - CELL PHONES

C4ST Response to GoC Statement #06:
ISED is apparently disregarding Safety Code 6 limits even though it has adopted these guidelines for compliance purposes. Safety Code 6 (2015) states clearly that its established Specific Absorption Rate (SAR) limits for safe exposure to devices such as cell phones *"shall not be*

exceeded."[33] However, a recent ISED webpage update states that exceeding Safety Code 6 is acceptable because it includes a 50 times safety margin. The *CBC Marketplace* episode **"The Secret Inside Your Cellphone"**[34] showed that when held against the body, exposure levels are 3 to 4 times above maximum limits in Safety Code 6. In France, measurements of radiation from cell phones demonstrated over 90% of the phones tested exceeded the safety standards.[35]

3. SAFETY CODE 6 (2015)

3.1 SAFETY CODE 6 - ESTABLISHED ADVERSE EFFECTS

Questionable Health Canada or ISED Website Statements

#08. *There have been thousands of scientific studies carried out to evaluate the safety of radiofrequency EMF. In fact, the evidence from these studies establishes two adverse health effects that can occur at levels above the Canadian limits:*

- *tissue heating (such as the warming of your skin)*
- *nerve stimulation (which can cause a tingling sensation in your skin)*

C4ST Response

C4ST Response to GoC Statement #08:

The thousands of studies referenced above also include high-quality studies that show adverse health effects at or below Canadian limits. Ambient and commonly encountered levels of RF radiation are scientifically demonstrated to cause or contribute to cancers,[36,37,38,39] sperm damage,[40] reproductive harms,[41] learning and memory deficits,[42] and neurodegenerative, cellular and genetic damage.[43,44, 45 ,46,47,48]

If the evidence is so strong that the only adverse effects are heating and nerve stimulation, then this information should be available to the public, e.g., on GoC webpages.

The relationship between tissue heating and harm from RF radiation was first proposed in the 1920s.[49] There is substantial evidence that heating due to exposures exceeding the limit for temperature rise in Safety Code 6 is not a threshold for harm to tissues.

The nerve stimulation reported by Health Canada in Safety Code 6 relates to the lowest part of the RF range which is not presently in widespread use for wireless communications. Therefore, the general public does not experience much exposure to these frequencies.

A growing number of RF radiation exposed Canadians experience immediate and debilitating health problems (that could be prevented) such as headaches, irregular heartbeats, cognitive difficulties and insomnia, resulting in poor quality of life.[50] **All Canadians are susceptible to developing such health issues, unless their ever-increasing exposure to RF radiation is curtailed.**

3.2 SAFETY CODE 6 - METHODS TO MONITOR THE SCIENTIFIC LITERATURE

Questionable Health Canada or ISED Website Statements

#09. *Health Canada scientists consider all peer-reviewed scientific studies and consider many different potential health effects including thermal, non-thermal and biological effects.*

#10. *Canadians are protected from the cumulative effects of RF energy when Safety Code 6 is respected.*

#11. *Health Canada continues to monitor all domestic and international scientific evidence on radiofrequency EMF and health. Should new scientific evidence emerge to demonstrate that exposure to radiofrequency EMF at levels below the Canadian limits is a health concern, the Government of Canada would take action to protect the health and safety of Canadians.*

#12. *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.*
There are criteria that scientists use in order to establish scientific evidence for the existence of an adverse health effect. The evidence needs to be reproducible to ensure the results were not random or due to other factors. The evidence needs to be consistent across studies; for example, the evidence is stronger if different types of studies (epidemiology and laboratory) point to the same conclusion. The evidence needs to be evaluated in its totality, meaning that both positive and negative results are evaluated on their own merit and then evaluated as a whole. Finally, the evidence needs to be generally accepted by the broader scientific community.

#13. *There are thousands of studies on the health effects of RF radiation. You can access many of them through the following links:*

- *International Commission on Non-Ionizing Radiation Protection - publications*
- *EMF Portal*
- *Electromagnetic field literature search engine*

C4ST Response

C4ST Response to GoC Statements #09, #10, #11 and #12:

These are misleading statements. When Health Canada says it has "*considered*" studies, this seems to mean it may have looked at them but disregarded the results—general statements are made but no specific reasons for rejection provided. Health Canada has never published a systematic review that meets international standards[51] of transparent searching, data extraction, scientific synthesis and weighing of the evidence, nor a risk assessment based on measured and projected exposures, nor even a list of which studies it has considered. It seems the most Health Canada is willing to do is provide links to other agencies or organizations that also rely on the premise from the 1920s[52] that RF exposures cannot harm if there is no excessive heating of tissue within 6 minutes.

Health Canada provides no definition of "*consider*" or "*considered."* Although hundreds of high-quality studies show harm below maximum exposure limits (that, according to Health Canada, should be safe), none of these studies and none of their results have been incorporated into Safety Code 6.

Well over 200 peer-reviewed studies[53] published since the last revision of Safety Code 6 (2015) describe harmful effects of (RF) radiation on human health below Safety Code 6 limits. These 200 studies are discussed in the *CBC Marketplace* episode "**The Secret Inside Your Cellphone**."[54]

In 2015, during Parliamentary health committee hearings, Health Canada was asked to provide its rationale for ignoring the science in 140 studies omitted[55] from both the Royal Society of Canada's review and its own. The entire response (Appendix A) lacked any details. The Rationale document that Health Canada used to justify the changes (and lack of changes) did not mention these studies.[56] A summary of the omitted studies is in Appendix B.

The published paper "**Risks to Health and Well-Being From Radio-Frequency Radiation Emitted by Cell Phones and Other Wireless Devices**"[57] summarizes the strong evidence that there are health effects from exposures to low levels of RF radiation, below Safety Code 6 maximum limits. Furthermore, a systematic review and meta-analysis published in 2020 also supports that there are tumor risks with prolonged exposure to cell phone emissions.[58]

When new information becomes available, the proper scientific approach is to study and analyze the results to ensure a current premise is still correct. Health Canada appears to take the opposite approach and look for ways to dismiss any new evidence that challenges its underlying assumptions of Safety Code 6. In this case, Health Canada shows complete disregard for the $30 million US National Toxicology Program study with more than 2,000 rodents that showed clear evidence of cancer and DNA damage—despite the fact that this study passed through peer-review *three* times before publication.

Currently there are two main schools of thought among scientists and other experts who work in this field. There is a high degree of consensus within each group but not between the groups.

One group, including Health Canada and many scientists funded by the technology industry, remains firmly entrenched in the one hundred year old paradigm[59] that radiofrequency/ microwave radiation must heat to cause harm, and clings to this 1920s assumption to support the current (inadequate) guidelines.

Safety Code 6 was first published in 1979 and was based on the premise that if RF energy (=radiation) did not heat, it would not harm living tissue. Since then, Safety Code 6 limits have remained based on temperature change considerations.

The other group, consisting mainly of those who conduct work independent of industry influence, maintains that harm can occur at non-heating (non-thermal) levels. The findings in research published by these scientists and physicians demonstrate mechanisms and adverse outcomes from RF radiation exposures at low levels of exposure. Many of these experts treat and educate people to regain their health. Health Canada and other "*authoritative bodies"* and agencies in countries noted in the GoC webpages dismiss the findings in these studies.

Health Canada states that it will not take action before evidence is generally accepted by the broader scientific community. The broader scientific community, including those with vested interests, is obviously deeply divided on this issue. See more on this in Section 3.3. Just as with historical contested science on health effects of lead, asbestos, smoking, persistent organic pollutants and other concerns, a consensus may not be reached in the near future.

Questions are: on which side of history the Government of Canada will rest; how long it takes to learn "**Late Lessons from Early Warnings**."[60]

Given the enormous implications for public health and the strong science indicating health risks, it makes common sense to take precautionary measures. One action would be to post cautions on the GoC websites regarding health risks of wireless technology (such as cell phones, baby monitors and other wireless RF emitting devices) and to halt wireless 5G rollout (focusing on fibre to the premises, FTTP) until public health safety can be assured.[61]

C4ST response To GoC Statements #11 and #12:

A "*weight of evidence approach*" for determining conclusions requires transparency regarding both the evidence and how it is weighed. There are scientific standards for this process.[62] Over the years, scientists and other Canadians have repeatedly asked Health Canada to publish its scientific references and analyses of them. Health Canada fails to provide that information.

Health Canada's process to update Safety Code 6 (in 2015) was deeply flawed.[63,64] Health Canada has never completed a proper review of the scientific evidence according to international standards.[65] In fact, to the best of our knowledge, Health Canada still does not use appropriate systematic reviewing software tools to catalogue research, extract data and compile relevant data in order to perform proper analyses. If it did, then why do we not see this information on Health Canada websites?

254 world-recognized scientists from 44 nations have appealed to the World Health Organization and the United Nations for standards that are more protective regarding RF radiation.[66] These scientists have published more than 2,000 studies on electromagnetic fields, including RF radiation, in the peer-reviewed literature.

Health Canada's lack of systematic review and research capacity—the ability to thoroughly monitor and update research syntheses—results in it being a laggard rather than a leader in public health.

C4ST response to GoC Statement #13:

Two of the website links provided at the GoC websites are to organizations that adhere to the 1920s paradigm[67] upon which the first 1979 Safety Code 6 was based, namely that RF radiation must heat to cause harm. Section 4 (below) discusses industry's influence on the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

The third link, EMF Portal (University of Aachen, Germany), can be very useful for finding RF radiation publications.

Two omissions from the GoC websites are the Australian based ORSAA database[68] (a non-governmental scientific team) and Electromagnetic Radiation Safety [69] (hosted by Dr. Joel Moskowitz, School of Public Health, University of California, Berkeley). Those are excellent resources to identify studies relevant to wireless radiation and health and the environment. C4ST has provided an overview summary of key peer-reviewed, published papers on our "**Suspend 5G Canada Appeal**" webpage.[70]

3.3 SAFETY CODE 6 - AUTHORITATIVE BODIES

Questionable Health Canada or ISED Website Statements

#14. *The limits in Safety Code 6 are science-based exposure limits that 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.*

#15. *The International Commission on Non-Ionizing Radiation Protection is referenced as an authority.*

#16. *To protect your health and safety, Health Canada scientists:*

- *Contribute to international efforts such as the World Health Organization EMF Project to assess potential health risks from radiofrequency EMF*

C4ST Response

C4ST Response to GoC Statement #14:

The science-based exposure limits referred to are based on temperature only. China, Russia, Italy and Switzerland have safety standards 50 times safer than Canada's for RF radiation exposures from equipment such as cell tower antennas.[71]

C4ST Response to GoC Statement #15:

Some of the biases and conflicts of interest in agencies that are involved in making recommendations for safe levels of RF radiation are discussed in the peer-reviewed paper by Frank Clegg et al. (2020).[72] The "*capture*" of the US Federal Communications Commission (FCC) has been well documented.[73]

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is a private non-governmental organization based in Germany. New expert members can only be elected by members of ICNIRP. Many ICNIRP members have ties to the industry that must adhere to ICNIRP guidelines. The guidelines are of huge economic and strategic importance to the military, telecommunications/Information Technology (IT) and power industries.[74]
The published paper "**Not entirely reliable: Private scientific organizations and risk regulation. The case of electromagnetic fields**"[75] outlines many reasons why governments should view critically any recommendations made by private organizations such as ICNIRP. More recently, a report was released by two members of the European Parliament about the conflicts of interests within ICNIRP.[76]

C4ST Response to GoC Statement #16:

ICNIRP has a substantial influence on the World Health Organization's International EMF Project as many of the key members are in both bodies.[77]

3.4 SAFETY CODE 6 - SAFETY MARGINS

Questionable Health Canada or ISED Website Statements

#17. *Exposure to RF energy below the Canadian limits is safe. The limits are set far below the threshold (at least 50-fold safety margin) for all known established adverse health effects. Health Canada has incorporated several tiers of precaution into the limits to ensure safety, including a conservative threshold for the occurrence of adverse health effects, the use of worst-case exposure scenarios and an additional safety margin beyond the threshold.*

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.

C4ST Response

C4ST Response to GoC Statement #17:

This statement is inaccurate. There is ample science to demonstrate that RF energy (=radiation) is not safe below maximum exposure limits in Safety Code 6.

For clarity, terms will be discussed in the order they appeared in the above statements.

RF energy

This term can be used interchangeably with RF radiation for cell phone, cell antenna and 5G frequencies and health discussed in this document. It took decades for health authorities to act on the science that ionizing radiation (energy), e.g., X-rays, can cause cancer. Science is also telling us that non-ionizing radiation (energy), such as RF radiation from cell phones, can cause a wide range of health effects, including cancer. See Section 1.0. HEALTH RISKS.

Tiers of precaution

At first, this sounds highly precautionary, until the reader realizes that all of it is only based on temperature. In "*tiers*," the only biological effect incorporated is heating of tissue that can be dissipated within 6 minutes. As a result, there is inadequate protection for Canadians.

Safe

There are two concerns regarding Health Canada's use of the word "*safe*." First, this use of "*safe*" is not consistent with terms used in the regulation of other potential toxicants. Health Canada's claim that a regulated exposure (in this case, to RF radiation) is "*safe*" is (unacceptably) different from the norm, which should be stated as "*poses acceptable risks when used according to the directions*." Second, the incorrect use of the word "*safe*" leads to over-assurance that engenders complacency, diminishes the perceived importance of hazards, and fosters unsafe behaviours.

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Established adverse health effects

Health Canada references known, established, adverse effects, with reference only to consequences of over-heating of tissues. "*Established*" thus presents a logical fallacy. The much lower RF radiation exposure thresholds for effects observed by RF radiation researchers challenge, on solid scientific grounds, the stronger exposures permitted by Health Canada. Intermittent harms and incapacitation must be avoided. Temporary effects during activities such as driving a car, or climbing stairs or a ladder, pose risks to individuals as well as others. Other agents such as drugs are not regulated to avoid only the most serious, irreversible and readily observable acute effects. Health Canada's process also disregards critical, subtle, long-term toxicities, as well as established synergisms with other toxicants.

For example, experiments may demonstrate an acute effect in particular individuals, at which point the argument is whether the established effect is adverse. Health Canada has taken the unrealistic stance that a reversible effect is generally not adverse because it is not permanent. As a result, individuals who experience non-permanent debilitating symptoms are left unprotected by Safety Code 6.

As ambient and unavoidable levels of RF radiation are increasing, and are projected to increase substantially with 5G, the portion of the population that is suffering daily is increasing. Effects that are initially reversible may become permanent in the long run, due to the cumulative effects of exposure, meeting Health Canada's definition of an adverse effect. Health Canada must re-assess its operational use of the word "*adverse*."

Safety margins

There are two major concerns with the 50-fold safety margin under Safety Code 6. The baseline is not sound; and furthermore, a 50-fold is not a large margin of extrapolation *("safety factor")*. Health Canada regulates other toxicants, such as pesticides, using extrapolation factors much greater than 50-fold; typically, many hundreds-fold. In addition, the investigation for the *CBC Marketplace* episode **"The Secret Inside Your Cellphone"**[78] found that for cell phones held against the body, exposure levels are 3- to 4-fold *above* maximum exposure limits in Safety Code 6. In France, measurements of radiation from cell phones demonstrated over 90% of the phones tested exceeded the safety standards.[79]

Effect on children

The assurances of no adverse health effects on children are based on temperature estimations. Health Canada has conducted no safety testing on children (Appendix C). See Section 2.3 for more on health risks of RF radiation and children.

3.5 SAFETY CODE 6 - RESEARCH

Questionable Health Canada or ISED Website Statements

#18. *To protect your health and safety, Health Canada scientists:*

- *Conduct research on the potential health effects of radiofrequency EMF (electromagnetic exposures).*

C4ST Response

C4ST Response to GoC Statement #18:

This statement is misleading, as the reader would assume that Health Canada has conducted original research on frequencies that are of high relevance to Canadians, namely present-day cell phone, wireless network antenna and Wi-Fi emissions, and future 5G. **Health Canada has not.**

Among the RF radiation publications by Health Canada since 1983 (Appendix C), original research that examines the effects of non-thermal (non-heating) effects is sparse. Of the studies on biological effects, there are no original research studies on Wi-Fi (2.45 GHz) or on 5G millimetre frequencies. Both of these frequency types are of concern to Canadians.

Some of these concerns and unaddressed questions are outlined in the Auditor General Environmental Petitions.[80]

Health Canada did conduct studies on one frequency, 1.9 GHz, that is relevant to cell phone and some other wireless device exposures, but it must be remembered that RF radiation exposures from wireless devices are complex and studying one frequency is not adequate to determine *"safety"* of complex technologies using pulsed signals of multiple frequencies.

Also of concern, there are no Canadian studies on possible adverse effects of living near cell towers even though numerous studies from elsewhere demonstrate adverse effects.[81,82,83]

4. INNOVATION, SCIENCE AND ECONOMIC DEVELOPMENT (ISED) BIAS: AN EXAMPLE

C4ST Comment

An example of bias in reporting has been noted for Innovation, Science and Economic Development (ISED).

In its July 2019 decision to release millimetre wavelengths for 5G, ISED noted concerns about health impacts were submitted by nine Canadian civil society organizations and 237 individuals. The details of those submissions are not publicly available online.[84] However, favourable comments provided by commercial interests within an unpublicized Addendum are available to the public on an ISED webpage.[85]

5. 5G TECHNOLOGIES AND COVID-19

Health Canada and ISED Website Statements

#19. *A* recent addition to the Government of Canada websites states:
Misinformation and opinions on the health risks from exposure to radiofrequency EMF are increasing on social media and on the internet. Most recently, there have been claims linking the deployment of 5G networks to the novel coronavirus (COVID-19). There is no scientific basis for these claims. The World Health Organization (WHO) and the International Commission on Non-Ionizing Radiation Protection have also communicated this message.

C4ST Response

C4ST Response to GoC Statement #19:
C4ST agrees that there is no scientific cause and effect linking deployment of 5G and the development or spread of the coronavirus.

6. MISINFORMATION ON GOVERNMENT OF CANADA WEBPAGES ABOUT SAFETY OF WIRELESS COMMUNICATIONS RF RADIATION, INCLUDING 5G

C4ST Comment

Given the "*misinformation,*" i.e., misleading and inaccurate statements on the Health Canada and Innovation, Science and Economic Development (ISED) webpages, the Government of Canada should define what process is in place to assure the accuracy of information posted on its websites, and require the appropriate Ministers to undertake the necessary corrections, as misinformation harms public health.

REFERENCES AND ENDNOTES

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[2] Health Canada's Safety Code 6 (2015) recognizes only two "*established, adverse*" health effects from exposure to RF radiation: tissue heating with exposure to radiofrequencies in the higher range; and nerve stimulation at the lowest radiofrequencies. These lower frequencies are not presently in widespread use for wireless communications. C4ST's comments refer to the higher frequencies where tissue heating is the only recognized adverse effect.

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A Government of Canada webpage says, "*Radiofrequency electromagnetic fields (EMF) are a type of non-ionizing electromagnetic radiation found on the electromagnetic spectrum covering the range of frequencies below 300 GHz. Radiofrequency EMF are invisible waves that travel through space and exert force on charged particles. These waves have been used for many years to transmit information between an antenna and a device without the use of wires."* [https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/types-sources/radiofrequency-fields.html [Accessed 12 Dec 2020] Note: the frequency range covered by Safety Code 6 is 3 kHz to 300 GHz.

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APPENDIX A: The entire analysis of the 140 studies omitted by Health Canada, and the Royal Society of Canada during latest revision of Safety Code 6. Source: Health Canada. See Appendix B for a summary and complete references of the 36 studies considered by Health Canada to be "in-scope" and met quality standards for risk assessment (RA).

Total # Papers Submitted by C4ST (140 without duplicates)

By C4ST Category	# submitted by C4ST	# (in scope)	# with sufficient quality for inclusion in RA	
Cancer	9	6	6	
Generic Damage	14	13	2	
Infertility	14	13	1	
Dev./Learn./Behavior	30	24	7	*one paper excluded, not English/French
Brain/Nervous System	44	42	13	*one paper excluded, not English/French
Eye	6	5	2	
Cardiovascular	4	4	2	
EHS	8	3	1	
Biochemical	65	58	16	*two papers excluded, not English/French
	194	168	50	(See Note 1)

Note 1: many papers listed in the categories above are duplicates and appear in more than one category.

Total # of unique (in-scope, sufficient quality) technical references submitted by C4ST, with duplicates removed = 36.
Health Canada has evaluated these studies and does not consider them to impact on the previously identified thresholds for established adverse health effects, basic restrictions or derived reference levels in SC6 (2015).

List of "in-scope" technical references submitted by C4ST that meet quality standards for RA

Year	Authors
2010	Ammari, M., Gamez, C., Lecomte, A., Sakly, M., Abdelmelek, H. & De Seze, R.
2010	Augner, C., Hacker, G.W., Oberfeld, G., Florian, M., Hitzl, W., Hutter, J. & Pauser, G.
2009	Bas, O., Odaci, E., Kaplan, S., Acer, N., Ucok, K. & Colakoglu, S.
2010	Belyaev I, Markova E, Malmgren L.
2012	Bouji, M., Lecomte, A., Hode, Y., de Seze, R. & Villégier, A.S.
2013	Byun, Y.H., Ha, M., Kwon, H.J., Hong, Y.C., Leem, J.H., Sakong, J., Kim, S.Y., Lee, C.G., Kang, D., et al.
2011	Carballo-Quintás, M., Martínez-Silva, I., Cadarso-Suárez, C., Alvarez-Figueiras, M. et al.
2013	Cervellati, F., Valacchi, G., Lunghi, L., Fabbri, E., Valbonesi, P., Marci, R., Biondi, C. & Vesce, F.
2010	Céspedes, O., Inomoto, O., Kai, S., Nibu, Y., Yamaguchi, T., Sakamoto, N., Akune, T., Inoue, M., et al.
2014	Coureau, G., Bouvier, G., Lebailly, P., Fabbro-Peray, P., Gruber, A., Leffondre, K. et al.
2009	Dahmen, N., Ghezel-Ahmadi, D. & Engel, A.
2013	Deshmukh, P.S., Megha, K., Banerjee, B.D., Ahmed, R.S., Chandna, S., Abegaonkar, M.P. et al.
2010	Divan, H.A., Kheifets, L., Obel, C. & Olsen, J.
2011	Esmekaya, M.A., Ozer, C. & Seyhan, N.
2014	Furtado-Filho, O.V., Borba, J.B., Dallegrave, A., Pizzolato, T.M., Henriques, J.A. et al.
2010	Grigoriev, Y.G., Grigoriev, O.A., Ivanov, A.A., Lyaginskaya, A.M., Merkulov, A.V., Shagina, N.B., et al.
2011	Hardell, L., Carlberg, M. & Mild, K.H.
2013	Hardell, L. & Carlberg, M.
2013	Hardell, L., Carlberg, M., Soderqvist, F. & Mild, K.H.
2014	Liu, K., Li, Y., Zhang, G., Liu, J., Cao, J., Ao, L. & Zhang, S.
2013	Loos, N., Thuróczy, G., Ghosn, R., Brenet-Dufour, V., Liabeuf, S., Selmaoui, B., Libert, J.P. et al.
2012	Lu, Y., Xu, S., He, M., Chen, C., Zhang, L., Liu, C., Chu, F., Yu, Z., Zhou, Z. & Zhong, M.
2014	Lv, B., Chen, Z., Wu, T., Shao, Q., Yan, D., Ma, L., Lu. K. & Xie, Y.
2010	Lyaqinskaja, A.M., Grigoriev, Y.G., Osipov, V.A., Grigoriev, O.A. & Shafirkin, A.V.
2014	Maaroufi, K., Had-Aissouni, L., Melon, C., Sakly, M., Abdelmelek, H., Poucet, B. & Save, E.
2014	Maskey, D. & Kim, M.J.
2012	Megha, K., Deshmukh, P.S., Banerjee, B.D., Tripathi, A.K. & Abegaonkar, M.P.
2012	Misa Agustiño, M.J., Leiro, J.M., Jorge Mora, M.T., Rodríguez-González, J.A., Jorge Barreiro, F.J., et al.
2013	Moretti, D., Garenne, A., Haro, E., Poulletier de Gannes, F., Lagroye, I., Lévêque, P. et al.
2012	Nazıroğlu, M., Çelik, Ö., Özgül, C., Çiğ, B., Doğan, S., Bal, R., Gümral, N., et al.
2013	Ni, S., Yu, Y., Zhang, Y., Wu, W., Lai, K. & Yao, K.
2010	Sonmez, O.F., Odaci, E., Bas, O. & Kaplan, S.
2014	Souza, Lda C., Cerqueira, Ede M. & Meireles, J.R.
2013	West JG, Kapoor NS, Liao S-Y, Chen JW, Bailey L, Nagourney RA.
2014	Valbonesi, P., Franzellitti, S., Bersani, F., Contin, A. & Fabbri, E.
2013	Zhang, Y., Yao, K., Yu, Y., Ni, S., Zhang, L., Wang, W. & Lai, K.

APPENDIX B: Studies considered by Health Canada to meet quality standards for risk assessment but for which it does not provide a rationale for excluding the findings when setting Safety Code (2015).

Summary of potentially harmful effects documented in thirty-six (36) studies which Health Canada determined to be "in scope" for Safety Code 6 Risk Assessment (see minutes of House of Commons, Standing Committee on Health: HESA, 54, 2nd Session, 41st Parliament, 24 March 2015).

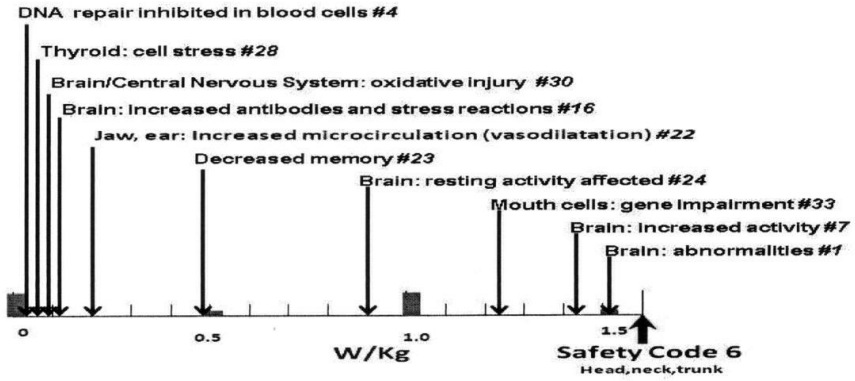
These studies are in the C4ST "140 omitted studies" report submitted to Health Canada, 15 July 2014. None are in Safety Code 6 Rationale (2015) nor in the Royal Society of Canada's Expert Panel report (2014) nor in any of their "Authoritative Reviews". All studies are in the cell/mobile phone frequency range of 900MHz to 2450 MHz, except #26 (2573 MHz) and some in IV. Specific Absorption Rate (SAR) levels were taken from the original papers and from EMF Portal http://www.emf-portal.de/

 # indicates the number of the reference on the next page.

I. Epidemiological-type studies (6), Case report (1), Literature review (1), Laboratory tests (1):

CONDITION	FINDINGS
Brain cancer: #17,18 Swedish case-control studies [note: Hardell et al. recently published a further study]	Dr. Hardell now recommends a World Health Organization, International Agency on Cancer Research (WHO/IARC) Group 1, ***known*** carcinogen classification [along with asbestos and cigarette smoke]. Dr. Hardell's work was used by the WHO/IARC to reach a near unanimous Group 2b, ***possible*** carcinogen classification in 2011.
Brain cancer: French case-control study #10	Higher cancer incidence among earliest and heaviest mobile phone users; findings are consistent with Hardell's group's work
Breast cancer: #35	USA case report of four (4) young women with no familial history of breast cancer in the precise location where they tucked their cell phones in their bras
Acoustic Neuroma: #19 Benign tumour on 8th cranial nerve	Confirmation of previous studies of an association with mobile/cordless phone use
Infertility: #21	Review found adverse effects. Conclusion: "... men should not keep mobile phone in their trouser pockets or near testicles to avoid potential harmful effect..."
Children: Attention Hyperactivity Deficit Disorder (ADHD) #6	Association with mobile phone use among children with higher lead levels
Children: 7 years in age #13	Behavioural problems associated with prenatal exposure
Electrohypersensitivity (EHS):#11	Laboratory tests: thyroid and liver dysfunction, chronic inflammation

II Biological effects below Safety Code 6 SAR for the head, neck and trunk (1.6 W/kg): Human, animal and cell culture studies



III Biological effects below Safety Code 6 SAR for whole body (0.08) W/kg: Human, animal and cell culture studies

%SC6	BIOLOGICAL EFFECTS	%SC6	BIOLOGICAL EFFECTS
1%	Brain: single strand DNA breaks #12	21%	Thyroid: cell stress #28
1%	Brain: oxidative stress, cognitive impairment, inflammation #27	38%	New born decreased body weight, effects on biochemistry #15
20%	Brain nerve development: increase in damaged cells #3	63%	Brain: dopamine and serotonin changes, impaired behaviour # 25
20%	Brain: cell loss, decrease in Purkinje cells #32	75%	Liver: DNA strand breaks #15

IV Other studies

Other studies (n=10): All >SC6. All showed effects. #5, 8, 9, 14, 20, 26, 29, 31, 34, 36.

Thirty-six (36) studies Health Canada determined to be "in scope" for Safety Code 6 Risk Assessment. See previous page for a summary of the potentially harmful effects reported in these studies.

Name of first author, title, journal and country of first author (in brackets).

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1. Ammari (2010). **GFAP [Glial Fibrillary Acidic Protein] expression in the rat brain following sub-chronic exposure to a 900 MHz electromagnetic field signal.** *International Journal of Radiation Biology*, **(France)**
2. Augner (2010). **Effects of Exposure to GSM Mobile Phone Base Station Signals on Salivary Cortisol, Alpha-Amylase, and Immunoglobulin A.** *Biomedical and Environmental Sciences.* **(Austria)**
3. Bas (2009) **900 MHz electromagnetic field exposure affects qualitative and quantitative features of hippocampal pyramidal cells in the adult female rat.** *Brain Research.* **(Turkey)**
4. Belyaev (2009). **Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells Stronger than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk.** *Environmental Health Perspectives.* **(Sweden)**
5. Bouj (2012). **Effects of 900 MHz radiofrequency on corticosterone, emotional memory and neuroinflammation in middle-aged rats.** *Experimental Gerontology, 47*(6). **(France)**
6. Byun (2013**). Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study.** *PloS One.* **(Korea)**
7. Carballo-Quintás (2011). **A study of neurotoxic biomarkers, c-fos and GFAP after acute exposure to GSM radiation at 900 MHz in the picrotoxin model of rat brains.** *Neurotoxicology.* **(Spain)**
8. Cervellati (2013). **17-β-estradiol counteracts the effects of high frequency electromagnetic fields on trophoblastic connexins and integrins.** *Oxidative Medicine and Cellular Longevity.* **(Italy)**
9. Céspedes (2010). **Radio frequency magnetic field effects on molecular dynamics and iron uptake in cage proteins.** *Bioelectromagnetics*, **(Japan)**
10. Coureau (2014). Mobile **phone use and brain tumours in the CERENAT case-control study.** *Occupational and Environmental Medicine* **(France)**
11. Dahmen, (2009). **Blood laboratory findings in patients suffering from self-perceived electromagnetic hypersensitivity (EHS).** *Bioelectromagnetics.* **(Germany)**
12. Deshmukh (2013**). Detection of Low Level Microwave Radiation Induced Deoxyribonucleic Acid Damage Vis-à-vis Genotoxicity in Brain of Fischer Rats.** *Toxicology International* **(India)**
13. Divan (2010). **Cell phone use and behavioural problems in young children.** *Journal of Epidemiology & Community Health***. (USA-Denmark data)**
14. Esmekaya (2011). 900 **MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues.** *General Physiology and Biophysics*. **(Turkey)**
15. Furtado-Filho (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.** *International Journal of Radiation Biology* **(Brazil)**
16. Grigoriev (2010). **Confirmation studies of Soviet research on immunological effects of microwaves: Russian immunology results.** *Bioelectromagnetics.* **(Russia)**
17. Hardell (2013a). **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.** *Reviews on Environmental Health.* **(Sweden)**
18. Hardell (2011). **Re-analysis of risk for glioma in relation to mobile telephone use: comparison with the results of the Interphone international case-control study.** *International Journal of Epidemiology.* **(Sweden)**
19. Hardell (2013). **Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones.** *International Journal of Oncology.* **(Sweden)**
20. Liaginskaia. (2010). **[Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 5. Impact of the blood serum from rats exposed to low-level electromagnetic fields on pregnancy, foetus and offspring development of intact female rats].** *Radiatsionnaia biologiia, radioecologiia / Rossiĭskaia akademiia nauk* **(Russia)**
21. Liu (2014) **Association between mobile phone use and semen quality: a systemic review and meta-analysis.** *Andrology*. **(China)**
22. Loos (2013). **Is the effect of mobile phone radiofrequency waves on human skin perfusion non-thermal?** *Microcirculation* **(France)**
23. Lu (2012). **Glucose administration attenuates spatial memory deficits induced by chronic low-power-density microwave exposure.** *Physiology & Behavior.* **(China)**
24. Lv (2013). **The alteration of spontaneous low frequency oscillations caused by acute electromagnetic fields exposure.** *Clinical Neurophysiology: Official Journal of the International Federation of Clinical Neurophysiology*. **(China)**
25. Maaroufi (2013). **Spatial learning, monoamines and oxidative stress in rats exposed to 900MHz electromagnetic field in combination with iron overload.** *Behavioural Brain Research.* **(France)**
26. Maskey (2010). **Effect of 835 MHz radiofrequency radiation exposure on calcium binding proteins in the hippocampus of the mouse brain.** *Brain Research.* **(South Korea)**
27. Megha (2012**). Microwave radiation induced oxidative stress, cognitive impair[illegible]c and inflammation in brain of Fischer rats.** *Indian Journal of Experimental Biology.* **(India)**
28. Misa Agustiño (2012). **Electromagnetic fields at 2.45 GHz trigger changes in heat shock proteins 90 and 70 without altering apoptotic activity in rat thyroid gland.** *Biology Open* **(Spain)**
29. Moretti (2013). **In-vitro exposure of neuronal networks to the GSM-1800 signal.** *Bioelectromagnetics* **(France)**
30. Nazıroğlu (2012). **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.** *Physiology & Behavior.* **(Turkey)**
31. Ni (2013). **Study of oxidative stress in human lens epithelial cells exposed to 1.8 GHz radiofrequency fields.** *PloS On* **(China)**
32. Sonmez (2010). **Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field.** *Brain Research.* **(Turkey)**
33. Souza (2014). **Assessment of nuclear abnormalities in exfoliated cells from the oral epithelium of mobile phone users.** *Electromagnetic Biology and Medicine.* **(Brazil)**
34. Valbonesi (2014). **Effects of the exposure to intermittent 1.8 GHz radio frequency electromagnetic fields on HSP70 expression and MAPK signaling pathways in PC12 cells.** *International Journal of Radiation Biology* **(Italy)**
35. West (2013). **Multifocal breast cancer in young women with prolonged contact between** their breasts and their cellular phones. *Case Reports in Medicine*. **(USA)**
36. Zhang (2013). **Effects of 1.8 GHz radiofrequency radiation on protein expression in human lens epithelial cells.** *Human & Experimental Toxicology.* **(China)**

APPENDIX C: List of publications of research conducted by Health Canada on radiofrequency radiation-electromagnetic fields, since 1983. Obtained from Health Canada August 4, 2020.

	Year	Study
1.	1983	Stuchly MA, Repacholi MH, Lecuyer DW. Operator exposure to radiofrequency fields near a hyperthermia device. Health Phys. 1983, 45(1):101-107.
2.	1983	Stuchly MA, Repacholi MH, Lecuyer DW, Mann RD. Radiofrequency emissions from video display terminals. Health Phys. 1983, 45(3):772-775.
3.	1987	Stuchly MA. Proposed revision of the Canadian recommendations on radiofrequency-exposure protection. Health Phys. 1987, 53(6):649-65.
4.	1991	Stuchly MA, Kozlowski JA, Symons S, Lecuyer DW. Measurements of contact currents in radiofrequency fields. Health Phys. 1991, 60(4):547-557.
5.	1999	Thansandote A, Gajda GB, Lecuyer DW. Radiofrequency radiation in five Vancouver schools: exposure standards not exceeded. CMAJ. 1999, 160(9):1311-1312.
6.	2002	McNamee JP, Bellier PV, Gajda GB, Miller SM, Lemay EP, Lavallée BF, Marro L, Thansandote A. DNA damage and micronucleus induction in human leukocytes after acute in vitro exposure to a 1.9 GHz continuous-wave radiofrequency field. Radiat Res. 2002, 158(4):523-533.
7.	2002	McNamee JP, Bellier PV, Gajda GB, Lavallée BF, Lemay EP, Marro L, Thansandote A. DNA damage in human leukocytes after acute in vitro exposure to a 1.9 GHz pulse-modulated radiofrequency field. Radiat Res. 2002, 158(4):534-537.
8.	2002	Gajda GB, McNamee JP, Thansandote A, Boonpanyarak S, Lemay E, Bellier PV. Cylindrical waveguide applicator for in vitro exposure of cell culture samples to 1.9-GHz radiofrequency fields. Bioelectromagnetics. 2002, 23(8):592-598.
9.	2003	McNamee JP, Bellier PV, Gajda GB, Lavallée BF, Marro L, Lemay E, Thansandote A. No evidence for genotoxic effects from 24 h exposure of human leukocytes to 1.9 GHz radiofrequency fields. Radiat Res. 2003, 159(5):693-697.
10.	2005	Moulder JE, Foster KR, Erdreich LS, McNamee JP. Mobile phones, mobile phone base stations and cancer: a review. Int J Radiat Biol. 2005, 81(3):189-203.
11.	2006	Chauhan V, Mariampillai A, Gajda GB, Thansandote A, McNamee JP. Analysis of proto-oncogene and heat-shock protein gene expression in human derived cell-lines exposed in vitro to an intermittent 1.9 GHz pulse-modulated radiofrequency field. Int J Radiat Biol. 2006 May;82(5):347-54.
12.	2006	Chauhan V, Mariampillai A, Bellier PV, Qutob SS, Gajda GB, Lemay E, Thansandote A, McNamee JP. Gene expression analysis of a human lymphoblastoma cell line exposed in vitro to an intermittant 1.9 GHz pulse-modulated radiofrequency field. Radiat Res. 2006, 165(4):424-429.
13.	2006	Qutob SS, Chauhan V, Bellier PV, Yauk CL, Douglas GR, Berndt L, Williams A, Gajda GB, Lemay E, Thansondote A, McNamee JP. Microarray gene expression profiling of a human glioblastoma cell line exposed in vitro to a 1.9 GHz pulse-modulated radiofrequency field. Radiat Res. 2006, 165(6):636-644.
14.	2007	Chauhan V, Mariampillai A, Kutzner BC, Wilkins RC, Ferrarotto C, Bellier PV, Marro L, Gajda GB, Lemay E, Thansandote A, McNamee JP. Evaluating the biological effects of intermittent 1.9 GHz pulse-modulated radiofrequency fields in a series of human-derived cell lines. Radiat Res. 2007, 167(1):87-93.
15.	2007	Chauhan V, Qutob SS, Lui S, Mariampillai A, Bellier PV, Yauk CL, Douglas GR, Williams A, McNamee JP. Analysis of gene expression in two human-derived cell lines exposed in vitro to a 1.9 GHz pulse-modulated radiofrequency field. Proteomics. 2007, 7(21):3896-905.
16.	2007	McNamee JP and Bellier PV, "Cytogenetic and Carcinogenetic Effects of Exposure to Radiofrequency Radiation" In: "Chromosomal Alterations: Methods, Results and Importance in Human Health. Obe, Günter; Vijayalaxmi (Eds.) 2007, XXIV, 515 p." Springer-Verlag, Heidelberg, Germany (ISBN:9783540714132).
17.	2009	McNamee JP, Chauhan V. Radiofrequency radiation and gene/protein expression: a review. Radiat Res. 2009 Sep;172(3):265-87.
18.	2012	Wasoontarajaroen S, Thansandote A, Gajda GB, Lemay EP, McNamee JP, Bellier PV. Dosimetry evaluation of a cylindrical waveguide chamber for unrestrained small rodents at 1.9 GHz. Bioelectromagnetics. 2012 Oct;33(7):575-84.
19.	2012	Wasoontarajaroen S, Thansandote A, Gajda GB, Lemay EP, McNamee JP, Bellier PV. Cylindrical waveguide electromagnetic exposure system for biological studies with unrestrained mice at 1.9 GHz. Health Phys. 2012 Sep;103(3):268-74
20.	2016	McNamee JP, Bellier PV, Konkle AT, Thomas R, Wasoontarajaroen S, Lemay E, Gajda GB. Analysis of gene expression in mouse brain regions after exposure to 1.9 GHz radiofrequency fields. Int J Radiat Biol. 2016 Jun;92(6):338-50.
21.	2019	Gajda GB, Lemay E, Paradis J. Model of steady-state temperature rise in multilayer tissues due to narrow-beam millimeter-wave radiofrequency field exposure. Health Physics. 2019. DOI: 10.1097/HP.0000000000001036 https://journals.lww.com/health-physics/Abstract/publishahead/Model_of_Steady_state_Temperature_Rise_in.99916.aspx#pdf-link