

Impacts of Wireless Technology on Health: A symposium for Ontario's medical community

May 31st, 2019

Health Canada's Safety Code 6 and Global Trends Regarding Radiofrequency/Microwave Radiation Safety

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Canadians for Safe Technology

Environmental Health Trust

Outline

- 1. The Electromagnetic Spectrum**
- 2. Health Canada's Safety Code 6**
- 3. Safety Code 6 Shortcomings**
- 4. Global Trends**
- 5. International Actions**
- 6. C4ST Recommendations**
- 7. Next Steps**

Personal background and Organizations' Focus

- 40+ years in the technology industry
- Retired -most recent position, President of Microsoft Canada

C4ST: Canadians for Safe Technology (CEO and Chairman)

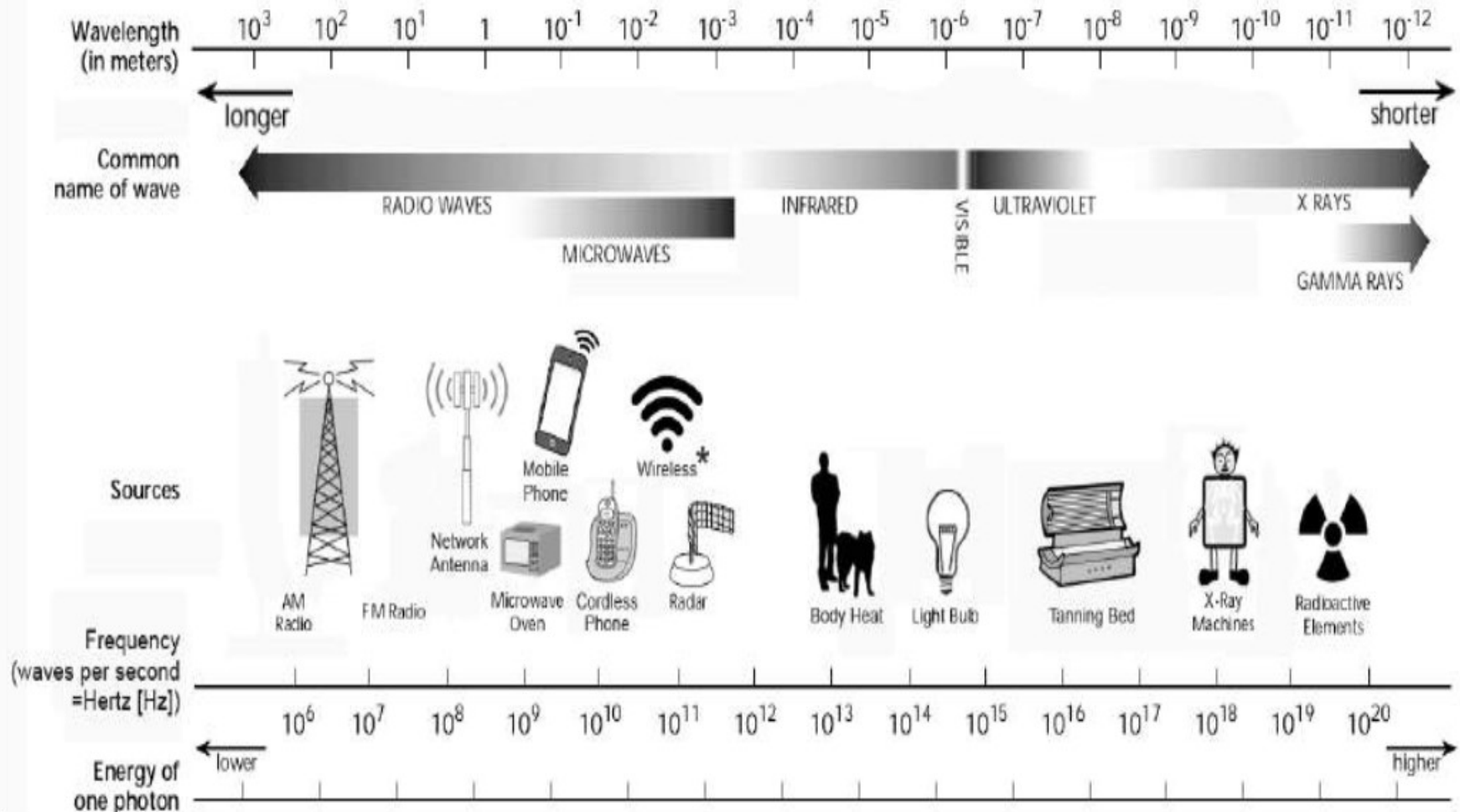
- Not-for-profit, completely volunteer-based, national coalition of parents, citizens and experts
- To educate and inform Canadians about the dangers of the exposures to unsafe levels of radiation from wireless technology
- To work with all levels of government to create healthier communities for children and families from coast to coast to coast.

Environmental Health Trust (Co-Chairman Business Advisory Group)

The only nonprofit in the world today that both:

- Carries out high-level critical research on controllable environmental health hazards
- Works directly with local communities, teachers, parents and students as well as policy makers to understand and mitigate these hazards through research, education and advocacy.

THE ELECTROMAGNETIC SPECTRUM



“radiofrequency” and “microwaves” are often used interchangeably.

THE ELECTROMAGNETIC SPECTRUM

NON-IONIZING

IONIZING

Wavelength
(in meters)

10^3 10^2 10^1 1 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9} 10^{-10} 10^{-11} 10^{-12}

longer

SAFETY CODE 6 –thermal only

shorter

Common
name of wave

RADIO WAVES

INFRARED

VISIBLE

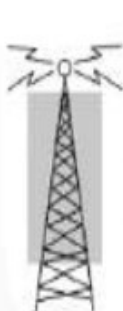
ULTRAVIOLET

X RAYS

GAMMA RAYS

***Thermal AND Peripheral Nerve Stimulation**

Sources



AM Radio



FM Radio



Mobile Phone



Microwave Oven



Cordless Phone



Wireless*



Radar



Body Heat



Light Bulb



Tanning Bed



X-Ray Machines



Radioactive Elements

Frequency
(waves per second
=Hertz [Hz])

10^6 10^7 10^8 10^9 10^{10} 10^{11} 10^{12} 10^{13} 10^{14} 10^{15} 10^{16} 10^{17} 10^{18} 10^{19} 10^{20}

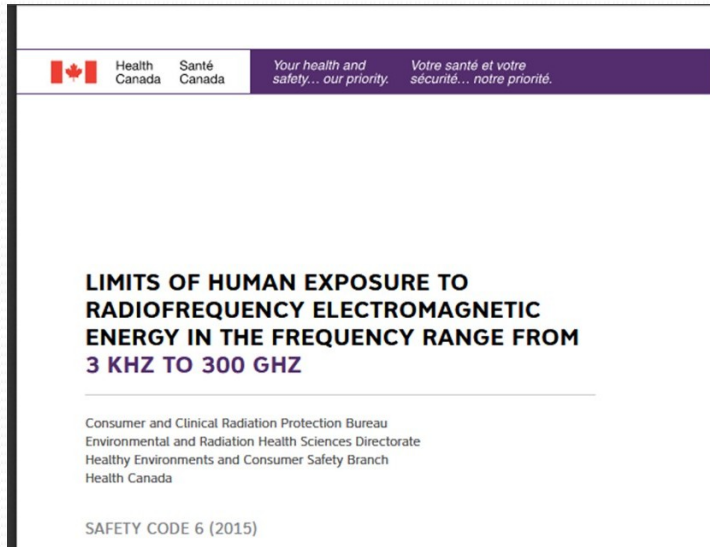
Energy of
one photon

lower

higher

Common wireless devices: 600 MHz to 6 GHz, Wi-Fi: 2.45 and 5 GHz
5G (5th Generation): > 6 GHz, includes millimeter wavelengths

Health Canada's Safety Code 6



- Established 1979. Minor revisions 1991, 1993, 1999, 2009, 2015
- The purpose is to establish safety limits for human exposure to radiofrequency (RF) fields in the frequency range from 3 kHz to 300 GHz.
- Originally intended for individuals working at, or visiting, federally regulated sites.
- Health Canada recommends limits for safe human exposure
- Health Canada does not regulate the general public's exposure to RF radiation
- Many provinces, territories and school boards apply the exposure limits in Safety Code 6 for general public exposure.
- Industry, Science and Economic Development Canada (ISED) regulate wireless devices and their associated infrastructure (such as cell towers) which are required to comply with Safety Code 6.

Health Canada's Safety Code 6 Guidelines

- 1979 – Health Canada's Safety Code 6 first published.
 - “Far-field” (> 20 cm) - Power density –
 - e.g. radar emitting devices, cell-tower antennae
 - Set at 10 W/m^2 for the public
 - Rate of flow of energy per unit area
- 1991 “Near-field” added (< 20 cm) – Specific Absorption Rate (SAR)–
 - For devices close to the body (cell phones and tablets)
 - Set at 1.6 W/kg per 1 gram of a cube of tissue
 - SAR is a measure of the rate at which energy is absorbed by the body
 - SAR is calculated from tissue conductivity, electric field strength induced in the tissue and mass density of the tissue
- The only “established” adverse effect in range commonly used for wireless devices (100 kHz to 300 GHz) is thermal
i.e. if no heating, no harm.

Evidence for Non-thermal Effects

Martin Pall, Ph.D.

**Professor Emeritus of Biochemistry and Basic Medical Sciences
Washington State University, Unpublished report - 2017**

“List of 170 Reviews on Non-thermal Effects of Microwave/Intermediate Frequency EMFs”

- Each review cites at least a dozen primary literature citations showing non-thermal effects
- An indication of *“the size of the literature that contradicts the industry and Health Canada’s contention that there are no non-thermal effects of microwave frequency EMFs”*

Shortcomings of Safety Code 6

- Does not take into account proven biological effects, only tissue heating
- No significant changes since its first publication in 1979 for power density and 1991 for SAR
- SAR compliance testing is based on science conducted on a 220 lb (100 kg) mannequin
- No distinction for children, elderly, or other sensitive groups
- ISED does NOT measure the output from cell towers/antenna they license under Safety Code 6
- There are no measurements taken for the cumulative effect from multiple devices over a 7/24 timeframe
- 5G is automatically assumed to be safe since it lies between arbitrary limits of Safety Code 6 established in 1979

Global Trends Regarding Radiofrequency/Microwave Radiation Safety

Comparison of Standards Internationally

Power density e.g. for cell towers:

- **100x safer in China, Italy, Russia and Switzerland**

SAR e.g. for cell phones and tablets:

- **Canada and US safer than most other counties**
 - **1.6 W/kg (over 1 gram of tissue) vs 2.0 W/kg (over 10 grams of tissue)**

International Authorities - RF/MW Guidelines

1. International Commission on Non-Ionizing Radiation Protection (ICNIRP)

- Exposure guidelines used by many agencies worldwide
- Based only on established short term thermal effects
- Industry friendly, not accountable to any other body

2. The World Health Organization (WHO)

1) International Agency for Research on Cancer (IARC)

- Reviews agents for carcinogenicity
- In 2011, a working group of about 30 experts designated radiofrequency/microwave radiation as a Class 2B, *possible* carcinogen
- Comprehensive monograph published – thermal and non-thermal effects

2) International EMF Project

- Currently working on a monograph for RF/MW radiation to be used as a basis for guidelines
- The draft released to the public for comment was incomplete
- 5 of the 6 members of the core group are also ICNIRP members

For more information see: . Hardell, L. (2017). World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review). International Journal of Oncology, 51(2), 405-413

Medical Experts Worldwide Recommend Reducing Exposure

American Academy
of Pediatrics



DEDICATED TO THE HEALTH OF ALL CHILDREN®

"If you plan to watch a movie on your device, download it first then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure." - AAP



"It is wise to reduce exposure..."
-Connecticut Department of Health



EMFscientist.org

Over 220 scientists from 41 Nations have appealed to the United Nations for Action



Athens Medical Association



Doctors for Environmental
Protection



Vienna Medical Association



Swiss Physicians Association of
Doctors for Environmental
Protection

[HealthAgenciesofover20Countries](#)



Cyprus Medical Association



[EHTCompilationofCountryAction](#)
[EHT Compilation of Medical Organization Action](#)

Cyprus National Committee
on Environment and Children's Health



Legislation in Other Countries

- China, Russia, Italy and Switzerland have guidelines that are 100 times safer than the US
- France 2017 - Cell Phones fully banned in all areas of elementary and middle schools
- France 2015 – Wi-Fi Banned in Nursery Schools; Restrictions on advertisements promoting cell phones
- Taiwan 2015- Ban on children under the age of two from using electronic devices
- Belgium 2014 - Illegal to market cell phones to children less than 14 years of age; Phones designed for children under 7 years are prohibited from sale
- Korea 2014 - mandated SAR labeling on cell phones and portable devices; public health recommendations to reduce exposure to cell phone radiation
- Chile 2012 - “Antennae Law” prohibiting cell antennae/towers in “sensitive areas” (educational institutions, nurseries, kindergartens, hospitals, clinics, nursing homes)
- India 2012 – limits EMF levels to 1/10th of FCC guidelines
- Greece 2000 - Mandates lower RF exposures near schools, nurseries and hospitals

National Policies, Recommendations and Warnings

- 2018 - Sri Lanka's Ministry of Health press release to reduce exposure
- 2016 – France declaration to protect workers against the risks arising from EMF's
- 2015 – France mandate for SAR Radiation Labeling on cell phone packages
- 2016 - European Academy for Environmental Medicine Guideline for the prevention, diagnosis and treatment of EMF-related health problems and illnesses
- 2016 - The Italian Society for Preventive and Social Pediatrics officially called to prohibit cell phones for children under 10 years old
- 2015/2009 – Finland Radiation and Nuclear Safety Authority recommendations to reduce exposure, especially to children

Why we are concerned

- **2019 - 9 billion mobile connections Worldwide¹**
- **2019 - 23 billion internet connected devices Worldwide²**
- **2020 - Cisco predicts 500 billion internet connected devices³**
- **Equates to 59 devices per person given the UN projection of 9.7 billion people⁴**

¹<https://www.bankmycell.com/blog/how-many-phones-are-in-the-world>

²<https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/>

³<https://www.cisco.com/c/dam/en/us/products/collateral/se/internet-of-things/at-a-glance-c45-731471.pdf>

⁴<https://www.un.org/sustainabledevelopment/blog/2015/07/un-projects-world-population-to-reach-8-5-billion-by-2030-driven-by-growth-in-developing-countries/>

C4ST Recommendations

- A moratorium on 5G and other deployment of microwave radiation infrastructure to which the public is exposed until science showing safety is conducted
- We must shift responsibility to industry to prove technology is safe before it is released to the market
- Need protection for those with electromagnetic hypersensitivity (EHS) and other vulnerable populations

Next Steps Until Safety Code 6 is Adequately Revised

- Stay current and educated:
 - <https://ehtrust.org/> and <https://www.saferemr.com/>
- Practice Safe Tech:
 - Handout cards at the back (take a bunch)
 - <http://c4st.org/reduce-exposure-from-wireless-transmitting-devices/>



Appendix

Actual Use vs. Tested Emissions

- Most industry warnings are buried several layers inside the cell phone
- CBC Marketplace “The Secret Inside your Cell Phone” ¹
 - 81% of Canadians have not seen the warning message in their phone or manual
 - 67% of Canadians say they carry their phones in their pocket or directly against their body
 - All 3 phones tested had emissions 3-4 times above Health Canada guidelines
- The National Agency ANFR of France²
 - Found 90% of the 450 phones tested exceeded guidelines
 - The % increase in SAR from the recommended distance to against the body ranged from 10% to 25%
- Industry states “We meet Federal Guidelines if used correctly”

¹https://www.youtube.com/watch?v=Wm69ik_Qdb8 2.3 million views

²<https://ieeexplore.ieee.org/document/8688629>

History - Biological Effects and Setting of US Standard

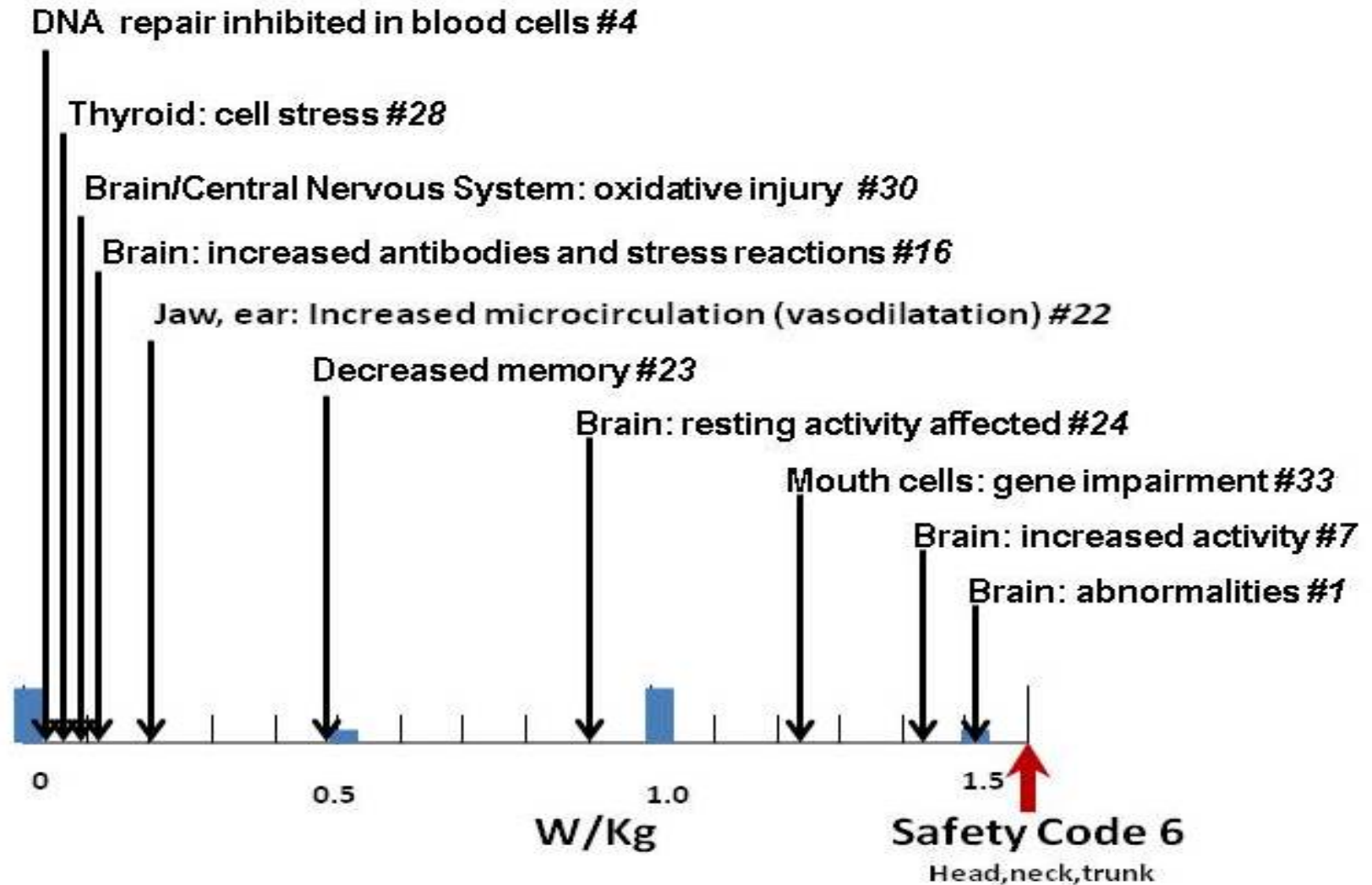
- **1885 to 1940: early work on benefits of short-waves and therapy**
 - **1928: with medically accepted applications, debate over thermal and thermal effects “started in earnest”**
 - **1929: “ the burden of proof still lies on those who claim any biological action of high frequency currents other than heat production”**
- **Early 1940s to 1960s: shift in research from medical benefits to military and industrial concerns about hazards to health**
 - **1942 - US military concerned about health effects reported by radar workers (headaches, flushing)**
 - **“... radar was virtually the only source of concern re public health over microwaves until the marketing of microwave ovens”**
- **1996 – adoption of US standard for exposure to microwave radiation (based on thermal effects only)**

Source: 1) Steneck, N. H., et al. (1980). The origins of US safety standards for microwave radiation. Science, 208. 2) Cook, H.J., et al. (1980). Early research on the biological effects of microwave radiation: 1940-1960. Annals of Science, 37.

C4ST: An example of evidence not assessed by Health Canada

- **C4ST identified 140 studies that showed harm at levels at, or below Safety Code 6 that the Royal Society's panel omitted in its 2015 report.**
- **Health Canada ignored all of this evidence-based information but did admit that some of the studies meet their criteria, However, no weight-of-evidence analysis was provided.**
- **When inquiries are made about the reasoning in excluding this evidence, Health Canada may provide an unpublished discussion paper *"Safety Code 6 (2015) –Rationale"* that has no rationale except to cite other authorities.**

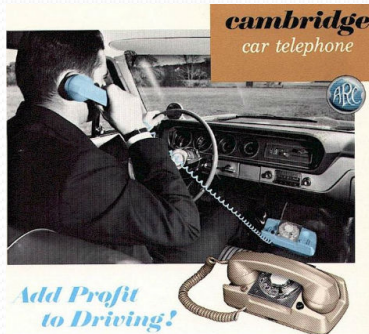
Biological effects deemed “in scope” by Health Canada for which no Weight-of-Evidence analysis has been provided



Safety Code 6 Controversy

- External reviewers, Anthony Miller and Martin Blank Ph.D., of the RSC 2014 report are critical of lack of adequate revisions to Safety Code 6 (2009)
- Series of articles by Paul Webster in the Canadian Medical Association Journal (CMAJ):
 - 2013. *Chair of Wi-Fi safety panel steps down.*
 - 2013. *Federal Wi-Fi panel criticized for undisclosed conflict.*
 - 2014. *Federal Wi-Fi safety report is deeply flawed, say experts.*
 - 2015. *Scientists decry Canada's outdated Wi-Fi safety rules.*

Wireless Device Proliferation



- Car phones were installed in some police cars in Detroit starting in 1921¹
- The first commercially available service from fixed to mobile telephones was offered in St. Louis in 1946²



1983⁴

- 150k subscribers WW⁵

1994 first mass-produced GSM phone⁴

- 55m subscribers WW⁵



- There are currently 8.98 billion mobile connections WW⁶
- There are currently 23.14 billion internet connected devices WW⁷
- Cisco predicts 500 million internet connected devices by 2020⁸
- That equates to 59 devices per person given the UN projection of 9.7 people⁹

Health Canada's response to international actions

- 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.
- Internationally, a few jurisdictions (cities, provinces or countries) have applied more restrictive limits for RF field exposures from cell towers, although there is no scientific basis to support the need for such restrictive limits.
- In many instances these more restrictive limits are not applied to other wireless devices in these same jurisdictions

Thirty-six (36) studies Health Canada determined to be “in scope” for Safety Code 6 Risk Assessment.

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)

Thirty-six (36) studies Health Canada determined to be “in scope” for Safety Code 6 Risk Assessment.

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 biologiiia, radioecologiiia / Rossiiskaia 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 impairment 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)