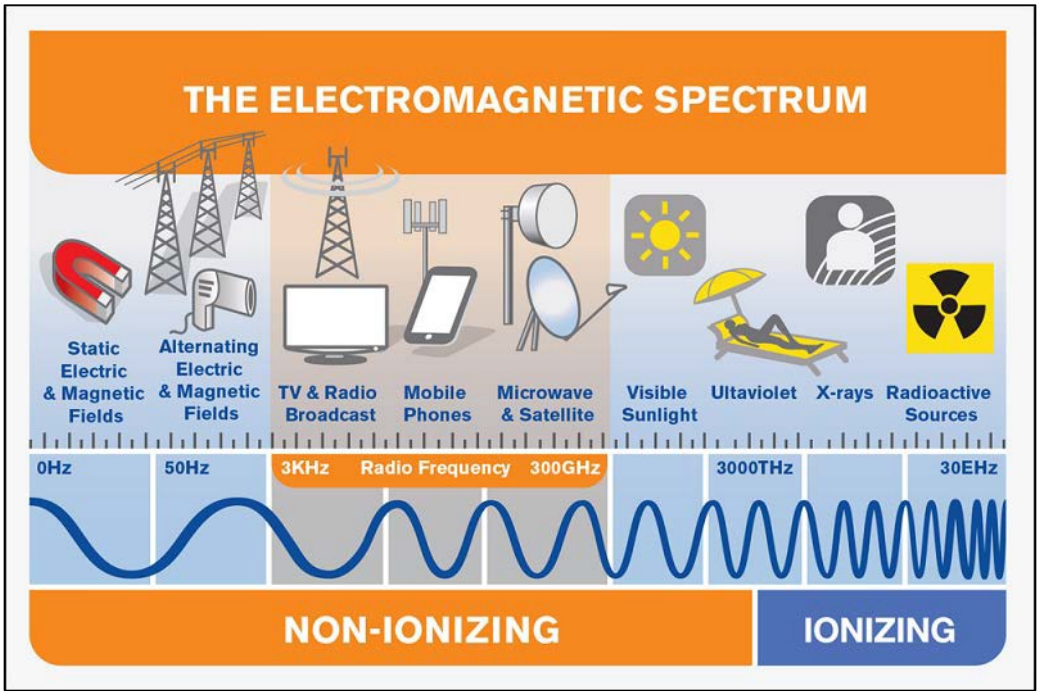
Radiofrequency and Health: a Summary

This summary is based on the "Radiofrequency Toolkit for Environmental Health Practitioners" (2013)[1] available on the BCCDC website.

http://www.bccdc.ca/health-info/health-your-environment/electro-magnetic-exposures/radiofrequency

What is radiofrequency (RF) radiation?

Radiation is the emission and transmission of energy in the form of waves or particles. The electromagnetic energy spectrum covers a wide range of radiation frequencies (Figure 1). Ionizing radiation is comparatively high in energy and can change atoms into “ions” (charged particles) by removing electrons. "Non-ionizing" radiation, including RF, is comparatively lower in energy but can cause molecules to vibrate. RF radiation is emitted from a variety of common wireless communication devices, including cell phones, cordless (DECT) phones, Wi-Fi computer networks, smart meters, and baby monitors.



Source: International Telecommunication Union[2]

Figure 1 – Electromagnetic Spectrum

How much RF radiation are we exposed to?

In general, the amount of radiation that we are exposed to varies depending on the distance from the source. One measure of exposure to RF is power density (Watt/cm^2), defined as the rate of energy transferred (in watts) to a surface area. To protect the public, there are both national and international guidelines for the maximum amount of total RF energy from all sources that we can be exposed to on a daily basis. Exposure to RF radiation to the public from individual devices is regulated by exposure limits, such as Health Canada's Safety Code 6 (2015)[3]: "*Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz"* and ICNIRP (the International Commission on Non-Ionizing Radiation Protection).[4] Estimates of exposure to RF for various RF-emitting devices given below are based on measurements of peak power density levels from studies performed locally by the BC Center for Disease Control and from EMC Technologies-Australia (2011),[5] converted to percentages of the exposure limits.

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Cell phones: The maximal power output (transmitted energy) of cell phones can be up to 250 mW (1/4 of a watt). The power varies, depending on data upload and download activity and coverage of the cell phone base stations. Power density measurements at various distances from base stations have been measured at 3000 to 1,000,000 times lower than Safety Code 6 exposure limits. Exposure to a bystander from a cell phone operating 30 cm away is approximately 2% of the exposure limit while RF exposure from a cell phone held to the ear can reach 10% - 70% of the ICNIRP exposure guidelines.

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Cordless (DECT) phones: Digital Enhanced Cordless Telecommunications (DECT) phones produce pulsed waves in the form of very short bursts at brief intervals. The peak transmitting power of the base station and handset is up to 250 mW, similar to cell phones. However, emissions are lower when averaged over time, since transmission is not continuous, but pulsed.

sv.wikipedia.org

Wi-Fi computer networks: Routers serve as base stations for wireless-enabled computers and peripherals (printers, scanners, etc.). Routers seldom exceed 100 mW in power and transmit only 10% of the time or less. Peak power density at 30 cm from a Wi-Fi router is 0.05% of the ICNIRP exposure guideline.

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Smart meters: These wireless devices collect data on utilities remotely. They have a maximal power of up to 1 W but emit for short periods of time, typically 1–6 minutes in a 24 hour period. At 30 cm from a set of smart meters indoors the averaged power density was measured at 0.001% of the Safety Code 6 exposure limit.

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Baby monitors: Depending upon the design, the power for a baby monitors can be up to 500 mW (1/2 of a watt). The distance of the RF-emitting device of the baby monitor from the infant is an important determinant of exposure. Averaged power density measured 30 cm from a crib was measured at 3.3% of the ICNIRP exposure guideline, compared to 0.3% when the distance was 1 meter.

Total personal exposure: We are exposed to many sources of RF energy at any one time and this is taken into account in the Safety Code 6 exposure limits. In all studies, overall exposure from multiple sources of RF exposure has never exceeded international exposure limits.

What are the health effects from RF?

- Thermal effects are well known and are due to RF energy causing molecules to vibrate, leading to tissue heating. This is the principle that is applied to household microwave ovens, which operate at relatively high power (e.g., 500W). There is no scientific consensus on the existence of non-thermal biological effects from exposure to RF, such as genetic damage, metabolic alterations and brain activity.
- Exposure to RF waves has been classified as ”possibly carcinogenic” by the International Agency for Research on Cancer (2013),[6] based on studies associating the incidence of glioma, a type of brain tumour, with frequent and long-term cell phone use. However these study findings are not consistent between studies and there has not been an clear increase over time in the occurrence of brain tumours. Studies of other cancers, such as melanoma, have not been linked to RF exposure.
- There is some indication of an association between RF exposure and sperm abnormalities, but the findings of the human and animal studies are controversial due to weaknesses in the study methods. Only at high thermal levels is there impaired development of an embryo or fetus.
- A concern about RF exposure is the potential for health effects on children, particularly on brain development. In general, children have thinner skulls, their brain tissues are more absorbent, and they absorb a greater amount of RF than adults do for a given exposure, due to their relatively small size. Existing evidence does not support this but further scientific studies are needed to determine whether there is an adverse impact on children from increasing exposure to RF from their use of cell phones and other devices.
- A number of symptoms such as itchy skin, insomnia, fatigue, headaches, vertigo and nausea, have been reported by people exposed to electromagnetic radiation. Although some population surveys have linked increased reports of symptoms with greater use of cell phones, a nocebo affect cannot be ruled out and numerous laboratory studies have not shown a relationship between exposure to RF and the appearance of acute symptoms during or shortly after exposure. Studies examining longer time frames may better identify the relationship between RF exposure and reported symptoms.

Please note that the Provincial Health Officer and public health authorities across Canada have determined that at present levels of exposure there is no evidence of harms to the population.

If, despite the paucity of scientific evidence of harm from RF, individuals wish to reduce personal exposure, there are a number of ways to do so:

- Spend less time on cell phones, switch off the cell phone when not in use.
- Keep the phone away from the body (i.e., not in pockets) and use the speaker or text options, or an earpiece (headsets) to increase the distance between the head and phone.
- Baby monitors can be placed at least a meter away from the cot and voice activation selected to avoid continuous transmission. There are alternatives wearable baby monitors with Bluetooth transmitters.
- Sit a meter or more from your router and switch it off when not in use.

Acknowledgements

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