



**STAFF REPORT
ACTION REQUIRED**

Prudent Avoidance Policy on Siting Telecommunication Towers and Antennas

Date:	November 20, 2007
To:	Board of Health
From:	Medical Officer of Health
Wards:	All
Reference Number:	

SUMMARY

This report responds to the Board of Health’s request to include its Prudent Avoidance Policy for cell phone base stations into the City’s proposed harmonized Telecommunication Tower and Antenna Protocol. The Board of Health also asked for comments on health risks arising from the concentration of telecommunication towers.

Many telecommunication devices use radiofrequency (RF) waves. Health Canada’s guidelines for exposure to RFs (known as Safety Code 6) protect the public from short-term, high exposure effects of RFs. Citing concerns that existing guidelines may not be health protective for continuous lifetime exposures, several jurisdictions have adopted stricter limits than those in Canada. In 1999, the Board of Health recommended a prudent avoidance policy that RF waves from telecommunication towers and antennas be 100 times below Safety Code 6 in areas where people normally spend time. Industry Canada monitoring data shows that this level is readily met.

Recent scientific literature indicates that uncertainties in the science remain. Health Canada has not revised its guidelines to address the concerns raised in 1999. Authority for regulating telecommunications towers rests with Industry Canada, whose “Client Procedure Circular” allows local planning authorities, such as the City of Toronto to comment. The Medical Officer of Health recommends that the City continue with a prudent avoidance approach and use its harmonized Telecommunication Tower and Antenna Protocol to collect data from cell phone carriers on predicted RF levels of proposed towers and antennas. This will allow the City to monitor the potential impact of proposed telecommunications facilities in Toronto and to encourage voluntary adoption of the Prudent Avoidance Policy.

RECOMMENDATIONS

The Medical Officer of Health recommends that:

1. the Board of Health reaffirm the Prudent Avoidance Policy approach for radiofrequencies (RF) that would keep levels in areas where people normally spend time at least 100 times lower than Health Canada's *Safety Code 6* limits when siting new telecommunication towers and antennas in the City of Toronto;
2. the Board of Health recommend that City Council endorse a Prudent Avoidance Policy and use the new City of Toronto Telecommunication Tower and Antenna Protocol as a mechanism for collecting information on the estimated levels of radiofrequencies around cell phone towers and antennas in areas where people normally spend time;
3. the Board of Health recommend to Health Canada that public exposure limits for radiofrequency fields under *Safety Code 6* be made 100 times more strict as previously recommended by the Board of Health;
4. the Board of Health recommend to cell phone carrier proponents to consider voluntary adoption of the Prudent Avoidance Policy when proposing sites for new telecommunication towers and antennas, including considering proposed alternative sites when the City's review identifies potential concerns; and
5. the Board of Health encourage Industry Canada to conduct regular monitoring for radiofrequencies arising from telecommunications structures in Toronto, and to make that information publicly available.

Implementation Points

- City Planning will request proponents to provide estimates of radiofrequency levels in areas where people normally spend time as part of the supporting documentation for the consultation meeting with the City. These estimates can be obtained from the Safety Code 6 verification calculations and expressed as a percentage of Safety Code 6 permissible levels for the public.
- City Planning, in consultation with the Medical Officer of Health, will screen these data against the Prudent Avoidance Policy. In the event that the levels are above those recommended in the Policy, the City will encourage voluntary adoption of the Prudent Avoidance Policy and discuss alternative sites with the proponent. The City may also submit a letter to Industry Canada pertaining to the outcome of these discussions.
- The Medical Officer of Health will report back on the effectiveness of this approach to minimizing public exposure to radiofrequencies from telecommunication towers and antennas in Toronto.

Financial Impact

These recommendations will have no financial impact beyond what has already been approved in the current year's budget.

DECISION HISTORY

In November 1999, the Board of Health adopted a policy of prudent avoidance respecting decisions regarding the location of cellular telephone base stations in the city. This policy recommends that consideration be given to keeping radiofrequency levels (measured in power density) from these installations 100 times below the current federal guideline (referred to as *Safety Code 6*) in order to provide a greater level of protection against potential health effects (see "Health Effects of Wireless Telephone Transmission Towers" <http://www.toronto.ca/health>).

At its meeting of May 15, 2006, the Board of Health requested that the Medical Officer of Health, in collaboration with the Chief Planner and Executive Director, City Planning, report on the incorporation of the Toronto Public Health Prudent Avoidance Policy into the City of Toronto Telecommunication Tower and Antenna Protocol and report on any health risks arising from the concentration of telecommunication towers. (<http://www.toronto.ca/legdocs/2006/minutes/committees/hl/hl060515.pdf>).

Telus Communications Company challenged the use of the City's site plan by-laws for approval of new telecommunication facilities. In March 2007, the court ruled that the City of Toronto could not apply its site plan approval process to new telecommunication facilities. At its meeting of April 2007, following consideration of a report by the City Solicitor on the City's appeal to the court's ruling, City Council directed the Planning and Growth Management Committee to develop a protocol for cell phone carriers to follow in siting telecommunications towers. City Council also directed the Chief Planner and Executive Director of City Planning to develop a protocol or guidelines with respect to municipal and community consultation for the installation of telecommunication towers that adheres to Industry Canada's policy.

City Planning, in consultation with the Medical Officer of Health, is preparing a Telecommunication Tower and Antenna Protocol that will be considered at the Planning and Growth Management Committee meeting early in 2008.

ISSUE BACKGROUND

Since 1999, there has been a rapidly expanding network of cellular phone towers and other wireless telecommunication structures throughout Toronto. This increasing concentration of telecommunication towers in many locations increases the level of radiofrequencies (RFs) to which the public in the immediate surrounding area is exposed involuntarily. Residents in some areas of Toronto have expressed concerns related to the potential health effects that may be associated with this exposure.

The development of the City of Toronto Telecommunication Tower and Antenna Protocol to establish a harmonized City-wide process and criteria for evaluating

telecommunication proposals now provides an opportunity for the City to formally incorporate prudent avoidance in its role as a commenting body in these siting decisions.

The research on exposure and health effects related to radiofrequency emissions has expanded substantially, with many studies and reviews having been published since 1999. Toronto Public Health staff, have reviewed and summarized this recent scientific literature (see “Update and Review of Research on Radiofrequencies: Implications for a Prudent Avoidance Policy in Toronto” <http://www.toronto.ca/health>).

COMMENTS

Radiofrequencies are waves that are part of the electromagnetic spectrum that includes infrared radiation, visible light and ultraviolet rays. Although the term electromagnetic field, or “EMFs”, is commonly used to describe waves generated from electrical power lines, the term technically refers to the electrical and magnetic fields from a wide range of sources and at different frequencies. Fields generated from electrical power lines are of “extremely low frequency (ELF)”, whereas RFs are higher frequency waves that include radio and microwaves and are mainly used in telecommunications.

Sources of RFs in Toronto are Increasing

In urban areas, RFs are present nearly everywhere. The use of wireless telecommunication devices has increased dramatically in Toronto, which has resulted in the installation of many antennas to receive and send communications signals. Cell phone base station antennas are an increasingly common sight on buildings throughout the city. In addition to these base stations, people are exposed to many other sources of RF, such as the cell phones themselves, cordless phones, pagers, some remote control devices and wireless Internet services (also known as WiFi).

The typical power output of a cell phone base station at its maximum is 60 watts, which is about 1000 times lower than the power output of a television antenna. Not surprisingly, a large part of people’s exposure comes from existing radio and television broadcast transmitters – a 2002 Industry Canada study found that, depending on the location, from 44% to 71% of total RF levels measured in Toronto were from broadcast services.

Wireless local area networks (WLANs) use wireless fidelity (usually called “WiFi”), the trademark name for one wireless communication technology. Devices that use WiFi, such as laptops or personal digital assistants (PDAs) use RF waves to transmit and receive data from a central antenna, also called an access point. The signal from the central antenna does not travel as far as that from cellular base stations since the maximum output power of a WLAN central antenna is very much lower (about 100 milliwatt). In Toronto, as in many other cities around the world, wireless Internet access points are often found in cafes, restaurants, hotels, airports, train stations and other public buildings. In 2006, Toronto Hydro Telecom activated One Zone™ which supports wireless internet access with antennas installed on street light poles.

Research on the Health Effects of RFs

Research on health effects in people, animals, tissue and cell cultures has continued steadily since Toronto Public Health reviewed the literature in 1999. Biological effects have been observed in animal and cell culture experiments at exposure levels typical for cell phones or cell phone base stations. However, it is still unclear whether these effects are harmful in themselves, or if they are relevant for predicting effects (positive or negative) in people.

The potential for RFs to cause cancer has been studied in both laboratory research and epidemiology studies. Those reviewing the science take the view that most animal studies indicate RFs do not damage cellular DNA and are not tumour promoters. However, the results from some individual studies have shown that RFs may produce changes in the cell that are signals for possible increased risk of cancer.

Generally, studies in humans are considered the strongest evidence for weighing the potential for effects in humans from exposure to an agent. Some epidemiological studies assessing impacts in communities near radio and television transmitters have reported increased risks of leukemia in children and adults. Similar research on cancer risks among populations living near cell phone base stations has not been conducted.

A great deal of the new research on human health effects from RFs has come from studying those who use cell phones. A cell phone user receives an exposure to RF waves that is higher than that from living near a cell phone base station or antenna. Typically, epidemiologists study those who are most exposed to a substance or agent, to learn more about possible effects from lower levels of exposure.

A large study called the Interphone study is assessing rates of brain cancer in people who use cell phones in 13 countries worldwide. Indications so far are that brain tumour risks are not higher with short or medium term use of a cell phone. However, there is still not enough data to shed light on the risks from longer term use (that is, for more than 10 years). A recent review, for example, found that even though brain tumour risk overall was not linked with cell phone use, there were 25% more brain tumours in a subgroup of long-term phone users. Swedish researchers have found increased risks of acoustic neuroma, a benign, slow-growing tumour of the auditory nerve in the brain, in connection with long-term cell phone use as well. The International Agency for Research on Cancer (IARC) is expected to finish its review on the carcinogenicity of RFs in 2008.

Studies of the impacts of cell phone RFs on children, while limited in number, do not rule out the possibility that children require greater protection from RF exposure. Unique properties of a child's ear, tissue and blood, suggest that children may have higher exposure to RFs from using a cell phone. Laboratory studies looking at cognitive function in children exposed to RFs from a cell phone have shown either no effect or a trend to better performance after exposure.

Research in populations near cell phone base stations in Europe indicates that people living within about 300 metres of a base station are more likely to experience symptoms

such as headache, memory changes, dizziness, tremors, depression and sleep disturbance, that are similar to a condition known as “microwave sickness”. Such studies are limited and have not yet been conducted in North America. Some scientists conclude there is need to ensure that RFs are kept as low as possible to protect people living close to cell phone towers.

The research published since the 1999 report does not resolve the question of whether exposure to RF radiation in the community can harm people. Although many studies have been published, this area of research poses many methodological challenges. Most experts agree that, although some sources of RFs have been around for many decades (for example, radar, radio and television broadcast antennas, among others) cellular and wireless technologies that rely on RFs give a different exposure pattern and have not been in use long enough to adequately assess the potential for long-term health effects. Also, levels of exposure for the general population have been low in the past but appear to be increasing. Most scientists agree that more research is needed and many conclude that the available data do not rule out the possibility of health effects from RF exposures.

Current Canadian Exposure Standards

The regulation of telecommunication installations and devices is under federal jurisdiction. Industry Canada is the federal agency responsible for overseeing the installation of telecommunication devices.

Health Canada's Radiation Protection Bureau has set guidelines for environmental exposure to RFs. The guidelines are set out in the document “Limits of Exposure to Radiofrequency Fields at Frequencies from 3 kHz - 300 GHz”, called Safety Code 6. Safety Code 6 specifies that environmental RF exposures for the general public must be no more than 4.5 to 10 W/m² (known as the power density¹) depending on the RF transmission frequency². These power density maximum values refer to a whole-body exposure, averaged over a six-minute period of time.

The International Commission for Non-Ionizing Radiation Protection (ICNIRP) set out the current global guidelines upon which most countries base their public exposure limits for RFs in 1998. Like Safety Code 6, these guidelines are based on preventing damage to human tissues due to the well-understood heating effects of RF. Health Canada and ICNIRP incorporate a 50-fold safety factor to the threshold for thermal effects to account primarily for differences among people in sensitivity to heating effects. ICNIRP and other agencies assert that below this threshold harmful effects are not known to occur.

¹ Power density is a measure of the field strength of radiofrequencies. It is a measure of power per unit area, or the rate at which energy reaches the individual. Power density is often expressed in watts per square metre (W/m²) or microwatts per square centimetre (µW/cm²). While human exposure is best understood by a measure known as the Specific Absorption Rate (or SAR) which refers to an actual RF dose, or amount that is absorbed by the body, typically, outside of a laboratory setting, SAR is not easily measured.

² EMFs differ in terms of their frequency (or number of cycles per second), which is measured in units called hertz (Hz). Radiofrequency waves span the range between 3 kHz and 300 GHz, or from 3,000 to 300 billion hertz. The Health Canada exposure guidelines differ depending on the frequency of transmission: for example, for 900 MHz the standard is a power density of 6 W/m² and for 1800 MHz it is 10 W/m².

Understanding Environmental Exposure to RFs

As noted above, people are exposed to many sources of RFs. The amount of exposure varies depending on the source and other factors. Sources of exposure to RFs have existed for a long time. However, overall exposures to the general public have been very low. A number of recently published studies from around the world have looked at exposure to RFs around base stations. They indicate that despite large variability in RF levels, exposure around base stations is generally well below the levels specified in international guidelines for environmental exposure to the public. For example, the highest power density values for RFs near base stations in Ottawa measured by Industry Canada were thousands of times below the Safety Code 6 limits.

In 2000 and 2001, Industry Canada measured RF levels at 61 locations in Toronto, including residential, industrial and commercial areas, parks, schools and airports. The study showed that all but one of these sites had RF levels below the current Prudent Avoidance Policy recommendation of 100 times below SC6. The one site with levels above the prudent avoidance benchmark (but below SC6) was in the area between Metro Hall and Roy Thompson Hall which is close to a cluster of television and radio transmitters in the city's core. Overall, RF levels were highest at commercial sites and in the downtown for similar reasons. RF levels in residential areas, schools and parks were more than 5000 thousand times below the levels in the SC6 guidelines, which is well below the levels recommended by the Board of Health in 1999.

In general, emissions of RF from cellular base stations decrease with increasing distance from the source. The pattern of RF levels from cell phone antennas is quite complex and is influenced by the antenna's height above ground, its tilt and orientation, and any nearby structures or buildings which reflect, absorb and, therefore, reduce the energy. At ground level, the RF levels are typically very small and are usually only detected in the range of 50 to 250 metres away from the antenna base.

At Toronto Public Health's request, Industry Canada assessed the level, pattern and distribution of RF waves outdoors from cell phone antennas mounted near the top of a high rise building in the north region of Toronto. This was done to assess the impact of multiple sources of RFs in one area. This simulation indicates that RFs generally decrease with increasing distance away from the antenna. Exposure above the 1999 Board of Health's recommended level is localized to lobes that extend horizontally out from each antenna to about 45 metres from the building top. These areas of RF dispersion are not accessible to people in the building, on the rooftop or on the street, and they do not extend to neighbouring high-rise buildings. When modelling RF from all sources in the area, the only place where RF levels approached the Board's recommended maximum exposure levels was on the roof top of a building with a major transmitter.

RF levels inside buildings are typically about ten times lower than outside since the walls and ceilings absorb some of the RF waves. Studies in Spain and Austria have found that RF levels inside homes near base stations were several thousands of times below exposure limits. Even in buildings where there is a rooftop or side-mounted antenna, the RF values tend to be lower indoors, although they can vary by floor within a building.

Human exposure to RFs from WLAN installations and devices is very low relative to other RF signals present in the same environments. Exposure is higher when the devices are actively communicating with the WLAN, such as when they are downloading or uploading files or with video streaming and also if an individual puts a wireless laptop directly on their lap.

Generally the current evidence from outdoor monitoring in Toronto indicates that short-term exposure is likely to be far below the Safety Code 6 guidelines and usually within the levels recommended in 1999 by the Board of Health. However, there are large gaps in our understanding, especially the cumulative dose of RFs to people in the community, as well as exposure inside buildings. Industry Canada monitoring for RFs from all sources in Toronto should be conducted with greater regularity and made publicly available. This data would assist the City in monitoring RF levels for comparison against the recommended prudent avoidance levels.

There are also substantial gaps in understanding the exposure for any individual, in light of the ever-expanding use of many wireless technology and devices in society. For example, a cell phone user receives an exposure to RF energy from the antenna in the handset that is close to the head. This exposure is much greater than that from a cell phone base station and, in some cases, it can reach levels that are close to Health Canada's exposure limits.

Given the multiple and pervasive sources of RF in our environment, a city policy can not completely protect its citizens from potentially excessive exposures. However, a policy guiding the siting of towers can contribute to people's exposure overall and, in the long-term, reduce chronic exposures. Cellular telephone users who wish to reduce their exposure to RF can do so by minimising the use of hand-held units, opting for brands that emit only low radiation, using a remote ear piece, or by using a regular telephone as much as possible. Cell phone use is increasingly common among children ages 10 to 19 years, therefore, this cohort will be exposed to RFs for a longer period of life than any other before it. This alone justifies precautionary messages to children, teens and parents that suggest cell phone use be limited in this age group to avoid unnecessary exposure. Toronto Public Health promotes parents' awareness of the need to minimize children's use of cell phones through the "Playing it Safe" resource, which was produced with partners in the Canadian Partnership for Children's Health and the Environment (CPCHE).

Other Jurisdictions – Recent developments

An increasing number of countries have developed more stringent public exposure guidelines in response to concerns about the level of protection offered by existing standards. Typically these are at least an order of magnitude lower than international guidelines. The western European nations with stricter limits base these on the precautionary principle or focus on keeping RF emissions as low as reasonably achievable. In the case of eastern European nations and China, there is greater emphasis on setting standards so as to protect the public from the effects observed in their studies

among people chronically exposed to RFs through their work, such as changes in central nervous, endocrine and immune system functions.

There are already several jurisdictions that have adopted lower exposure limits for the public. Some, such as Bulgaria, China, the Czech Republic, Hungary, Italy, Poland, Russia and Switzerland, have established legally enforceable national levels. As well, several local jurisdictions have made exposure limits more protective, largely through cooperative or voluntary agreements with industry: Auckland, Brussels, Paris, Salzburg (Austria) and some municipalities in Australia. The 1999 Board of Health recommended exposure limits that are comparable to the limits of a number of countries such as Bulgaria, China, Hungary, Italy, Russia, and Switzerland.

Table 1 below provides details from some jurisdictions that have adopted stricter exposure standards.

Table 1. Comparison of national standards for public exposure limits to RFs

Agency/Jurisdiction	General Public Exposure Limit[#] (W/m²)	Comments
ICNIRP	10	Guideline
Canada	10	Acute, thermal effects prevented
Toronto Board of Health	0.10	Cooperative agreement, precautionary
Italy	0.10*	Regulatory precautionary
Switzerland	0.10*	Regulatory, precautionary
China	0.10	Regulatory, science-based
Russia	0.10*	Regulatory, science based
Paris	0.10*	Cooperative agreement, precautionary
Salzburg	0.001	Cooperative agreement, precautionary

For RFs at a frequency of 1800 megaHertz

* approximate conversion from Volts per meter to Watts per square metre

Views on Need for Lower Exposure Guidelines

There continues to be debate about whether the current ICNIRP guidelines for RF exposure limits are adequately protective of human health. The World Health Organization (WHO) acknowledges that governments might want to adopt precautionary measures to reduce exposure to RF fields because of public concerns. The WHO and other countries acknowledge that biological effects are evident below the ICNIRP guidelines. Some scientists believe these biological effects should be considered when developing RF exposure limits.

Prudent Avoidance for Siting Telecommunication Structures

The Board of Health should encourage Health Canada to review current standards and set public exposure limits for RFs under Safety Code 6 so as to be 100 times more protective. As long as Health Canada maintains the current exposure standards, it continues to be prudent to limit public exposure to RFs below the limits set in Safety Code 6.

In 1999, the Board of Health recommended a policy of Prudent Avoidance due to the degree of uncertainty about health impacts of long-term, low level exposure to RFs. To address this uncertainty, the policy proposed reducing the potential exposure to RFs by using an added factor of protection, an approach that is consistent with the standard setting practices for chemical substances. This approach recommended that the RF emissions from any proposed cell phone tower installations be kept 100 times below Safety Code 6 in areas accessible to the public. This added degree of protection equates to a maximum public exposure limit of 0.045 to 0.1 W/m² (depending on the frequency of the RF waves).

Since the policy was adopted in 1999, TPH has been asked to review data from proponents showing estimates for RF emissions in the vicinity of an installation. Using these estimates, it has been possible for staff to verify if levels in areas where people normally spend time (that is, workplaces, residences or areas where the public has unrestricted access) would be within the levels recommended by the Board (that is, 100 times below SC6). This verification process has indicated that these levels are readily achievable and that the proponents have been able to voluntarily comply without compromise to technology or performance. Most importantly, the process has served as a check to demonstrate that RF exposure to the public is likely to be minimal.

A prudent avoidance approach has also been used to assess the exposures from other sources such as radio towers and Toronto Hydro's WiFi installation One Zone™. Industry Canada estimates for a wireless fidelity (WiFi) mono-pole antenna showed that within a 10 metre radius around the antenna, maximum RF levels would be 1,000 to 10,000 times below the SC6 limit. Further away from the antenna levels were estimated to be even lower.

The Board of Health has requested that the Prudent Avoidance Policy now be incorporated into the application process through the new City of Toronto Telecommunications Tower and Antenna Protocol ("the protocol"). The protocol establishes a harmonized City-wide process and allows the City to evaluate and comment on proposals for new telecommunications towers and antennas. Industry Canada has final regulatory authority over where telecommunications towers are sited; however, it encourages cell phone carriers to consult with local land-use authorities to determine the most suitable sites for such installations. The Medical Officer of Health will forward this report to cell phone and wireless internet carriers to encourage their commitment to prudent avoidance when they propose sites for new telecommunications facilities in Toronto.

The proposed City of Toronto Protocol will require a preliminary consultation meeting between the City and the proponent for all installations. This meeting should be used to consider the estimated levels of RFs around the proposed tower or antenna in areas where people normally spend time. If the estimates provided indicate that radiofrequency exposures would be higher than levels recommended by the Prudent Avoidance Policy,

the City will encourage the proponent to voluntarily observe the prudent avoidance limits and if necessary, in consultation with the proponent, seek an alternate site.

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SIGNATURE

A handwritten signature in black ink, appearing to read "D. McKeown". The signature is stylized with a large, looped initial "D" and a cursive "McKeown".

Dr. David McKeown
Medical Officer of Health