

## Environmental Petition

Date: 12 June 2017

Name of petitioner(s) - Murray Cunningham

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Name of the group: Environmental Health Association of Manitoba

I hereby submit this petition to the Auditor General of Canada under section 22 of the Auditor General Act.

Signature of the petitioner: via email to - [petitions@oag-bvg.gc.ca](mailto:petitions@oag-bvg.gc.ca)

**Title of the Petition: Scientific evidence for more substantial actions regarding the Parliamentary Standing Committee on Health (HESA) 2015 recommendations regarding children and pregnant women (vulnerable persons) exposed to wireless radiation in the microwave/radiofrequency range covered by Safety Code 6, from wireless devices such as baby monitors, tablets, cell phones, smart meters, Wi-Fi routers and 5 G technology**

We request responses from Health Canada and Innovation, Science and Economic Development Canada.

### Background:

Canadians have a right to be fully informed about the risks of exposure to environmental agents for which there is scientific evidence of harm. There is a considerable body of evidence published by credible scientists from respected institutions that is not being incorporated in safety guidelines with regard to the environmental agent, radiofrequency/microwave radiation. This is especially true regarding the health risks of vulnerable persons such as children and pregnant women.

The developing fetus is exquisitely sensitive to some environmental agents. Exposure of a pregnant woman or child to harmful agents can disrupt critical developmental processes that can interfere with pregnancy and normal development resulting in adverse health outcomes that may include lifelong detrimental effects. This is known from experiences with alcohol resulting in fetal alcohol syndrome (FAS), tobacco (cigarette) smoke exposure, and pharmaceutical drugs such as diethylstilbestrol (DES) and thalidomide, to name a few examples.

Radiofrequency/microwave radiation emissions occur from many common wireless devices such as baby monitors, cell phones, computer tablets, smart meters, Wi-Fi routers, as well as from telecommunications infrastructure such as antennae on homes, apartment buildings, utility poles and towers. The installation of microcells, required for 5 G technologies and the Internet of Things (IoT) will further increase exposure levels and to a wider range of radiofrequency wavelengths.

In 2015, the Parliamentary Standing Committee on Health held hearings regarding the potential adverse effects of exposure to microwave/radio frequency covered by Safety Code 6<sup>1</sup>. Part of the range covered by this safety code is the same range used for the operation of wireless devices that children and pregnant women use or that are used in close proximity to them (second hand exposure).

On October 6th, the Honourable Jane Philpott, Minister of Health responded on behalf of the Government of Canada<sup>2</sup> to the recommendations<sup>3</sup> (Appendix 1). Dr. Philpott's response, in part, states:

*"Safety Code 6 human exposure limits, established by Health Canada, are designed to provide protection for all age groups, including infants and children, on a continuous basis (24 hours a day/seven days a week). This means that if someone, including a small child, were to be exposed to RF energy from multiple sources for 24 hours a day, 365 days a year, within the*

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1 Safety Code 6 (2015)- Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz. Safety Code 6. [http://www.HealthCanada-sc.gc.ca/ewh-semtpubs/radiation/radio\\_guide-lignes\\_direct/index-eng.php](http://www.HealthCanada-sc.gc.ca/ewh-semtpubs/radiation/radio_guide-lignes_direct/index-eng.php)

2 <http://www.ourcommons.ca/DocumentViewer/en/42-1/HESA/report-2/response-8512-421-78>

3 <http://www.ourcommons.ca/DocumentViewer/en/41-2/HESA/report-13>

*Safety Code 6 limits, there would be no adverse health effects.*" The response also describes the "incorporations of several tiers of precaution", "extreme case scenarios", "very large margin of safety", etc. when designing Safety Code 6 guidelines.

Furthermore, the Minister's response states "Based on a thorough review of all available data, it is Health Canada's position that there are no established adverse health effects at levels below the limits outlined by Safety Code 6".

To clarify, the Government of Canada considers valid, only the "established" adverse health effect of heating (i.e. cooking or burning effects)<sup>4</sup>, in its determination of safety to radiofrequency/microwave radiation from commonly used devices. The "design" of Safety Code 6 guidelines only incorporates calculations regarding heating i.e. thermal effects. Yet there is a large body of evidence published by credible scientists from respected institutions that non-heating (non-thermal) adverse biological effects occur at below Safety Code 6 guidelines.

Justification in not implementing recommendations for children and vulnerable persons of the HESA 2015 report is based only on the heating of tissue and not on the large body of literature showing adverse biological effects below Safety Code 6 that are non-thermal.

The Minister's response continues citing the International Commission on Non-ionizing Radiation Protection (ICNIRP), the European Commission's Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) and the World Health Organization (WHO), and the panel report of the Royal Society of Canada (RSC) on Safety Code 6, as supporting, or being in line with, that position that heating is the only adverse effect that needs to be taken into account.

None of these bodies have conducted a systematic review of the relevant literature. In fact, no systematic review following best international practices exists in the published literature with "all" of the relevant published literature. Furthermore, the ICNIRP reports, the RSC report and the World Health Organization publications are not up to date. The 2015 SCENIR report is controversial and the process followed and conclusions reached are highly questionable<sup>5,6</sup>.

The Minister's response also refers to the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) (which is also controversial<sup>7</sup>) yet does not mention that France has legislated no Wi-Fi in nursery schools and reduced use of Wi-Fi in lower grade classrooms<sup>8</sup>.

This petition presents detailed information indicating adverse effects on the fetus, pregnant women and pre-adults from exposure to radiofrequency/microwave radiation at everyday living exposures at non-thermal, less than Safety Code 6 levels. This information is presented in four tables:

TABLE I. ADVERSE BIOLOGICAL EFFECTS AT NON-HEATING (NON-THERMAL) EXPOSURES BELOW SAFETY CODE 6 GUIDELINES: EVIDENCE FROM THE SCIENTIFIC LITERATURE

TABLE II. ACTIONS TAKEN IN OTHER COUNTRIES

TABLE III. STATEMENTS BY HEALTH CARE PROFESSIONALS

Table IV. RELATED INFORMATION.

Overall, at least 40 peer-reviewed publications showing potential adverse effects on pregnant women, the fetus and children from human, animal and cell/tissue studies are presented. There are many more showing adverse effects on adults that support the scientific evidence in these 40 studies.

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4 Peripheral nerve stimulation, in addition to heating, also occurs at lower radiofrequencies not used commonly for telecommunications.

5 <http://www.iemfa.org/wp-content/pdf/Complaint-to-the-European-Commission-SCENIHR-2015-08-31.pdf>

6 <http://www.bioinitiative.org/rebuttal-emf-effects/> and <http://www.bioinitiative.org/submission-of-comments-on-final-scenihr-opinion-from-the-bioinitiative-working-group/>

7 [http://www.robindestoits.org/Le-Pr-Belpomme-critique-severement-le-dernier-rapport-de-l-ANSES-sur-les-champs-electromagnetiques-Le-Republicain\\_a2083.html](http://www.robindestoits.org/Le-Pr-Belpomme-critique-severement-le-dernier-rapport-de-l-ANSES-sur-les-champs-electromagnetiques-Le-Republicain_a2083.html)

8 [http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes\\_4565339\\_3244.html#meter\\_toaster](http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes_4565339_3244.html#meter_toaster)

**TABLE I. ADVERSE BIOLOGICAL EFFECTS AT NON-HEATING (NON-THERMAL) EXPOSURES BELOW SAFETY CODE 6 GUIDELINES: EVIDENCE FROM THE SCIENTIFIC LITERATURE**

Appendix 2 provides the references with relevant extracts to the following scientific evidence indicating potential risks.

1. PREGNANCY
  - 1.1 Women carrying to term
    - Spontaneous unexplained abortions
    - Embryo growth ceasing
    - Amniotic cells
  - 1.2 Animal
    - Implantation
  
2. EXPOSURE IN THE WOMB (PRENATAL) OR AS A NEWBORN (POSTNATAL)
  - 2.1 Human
    - Behaviour
    - Autism
  - 2.2 Animal
    - Hyperactivity and impaired memory
    - Kidney damage
    - Developmental abnormalities including testes
    - Memory loss
    - Abnormal brain cell development
    - Abnormal sperm quality
  
3. CHILDHOOD AND EARLY ADOLESCENCE
  - 3.1 Human
    - Attention Deficit Hyperactivity Disorder (ADHD)
    - Addiction, depression
    - Fatigue
    - Well-being
    - Cognitive and behavioural effects
    - Epigenetics
  - 3.2 Animal
    - Possible infertility
    - Abnormal spinal cord development
    - Poor spatial memory
  
- 4.0 LATE-ADOLESCENCE AND EARLY ADULTHOOD
  - 4.1 Human
    - Brain tumours/brain cancer
  
  - 4.2 Animal
    - Brain cell abnormalities
    - Brain cancer and schwannomas
    - Possible infertility

## TABLE II. ACTIONS TAKEN IN OTHER COUNTRIES

1. France: France has legislated no Wi-Fi in nursery schools and reduced exposures in kindergarten and lower grade classrooms.<sup>9</sup> The National Health and Safety Agency (ANSES) in France has recently recommended immediately reducing children's exposure to wireless devices.<sup>10</sup>
2. Belgium: As of March, 2014, it is illegal in Belgium to market cell phones to children less than seven years of age.<sup>11</sup>
3. Cyprus: The National Committee for the Safety of the Environment and Children's Health (established by the Council of Ministers of Cyprus to protect the fetus and the child from health threats in the environment, created the informational video called "*Protect the children from mobile phones and Wi-Fi*"<sup>12</sup>
4. Italy: The state of South Tyrol, Italy, has mandated its government to take considerable precautionary measures to reduce children's exposure to wireless radiation including that schools replace wireless networks wherever possible.<sup>13</sup>
5. Taiwan: Taiwan has passed legislation banning parents from letting their children less than two years old from using any electronic devices such as tablets and smartphones.<sup>14</sup>

## TABLE III. STATEMENTS BY HEALTH CARE PROFESSIONALS AND RELATED INFORMATION

1. Over 50 Canadian doctors signed a submission to the Minister of Health in 2014: "*Out of sincere concern for the health of Canadians at all stages of life – from the developing fetus through childhood and into adulthood – we respectfully request that: Health Canada develop and support strategies to raise awareness about microwave radiation impacts and to minimize prolonged exposure to microwave radiation in schools and other places where children are regularly exposed*"<sup>15</sup>
2. The Canadian Pediatric Association has released a position statement (posted June 1, 2017) stating that for children under 5 years old, "*children's early media experiences involves four principles*" - one of which is "*minimizing*" use of screens"<sup>16</sup>
3. A joint statement has been signed by over 100 doctors, scientists and educators expressing their concern and urging "*pregnant women to limit their exposures*."<sup>17</sup>
4. Ronald L Melnick, PhD, a (now retired) Senior Toxicologist and Director of Special Programs, led the design of the \$25m US National Toxicology Program/National Institute of Environmental Health Science (NTP/NIEHS) Rodent Study. Dr. Melnick states: "*In my view, a pediatrician would be acting irresponsibly if he or she knew and understood the implications of the human and animal cancer data on cell phone radiation and did not offer precautionary advice to the parents of his or her patients*."<sup>18</sup>
5. "*Brain tumours are now the leading cancer in American adolescents, and incidence is rising in young adults according to the largest most comprehensive analysis*<sup>19</sup> of these age groups to date. Dr. Jacob Easaw, then from

9 [http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes\\_4565339\\_3244.html#meter\\_toaster](http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes_4565339_3244.html#meter_toaster)

10 ANSES Press release and report:

<https://www.anses.fr/fr/content/exposition-des-enfants-aux-radiofr%C3%A9quences-pour-un-usage-mod%C3%A9r%C3%A9-et-encadr%C3%A9-des-technologies>

<https://www.anses.fr/fr/content/exposition-des-enfants-aux-radiofr%C3%A9quences-pour-un-usage-mod%C3%A9r%C3%A9-et-encadr%C3%A9-des-technologies>

11 [expatica.com/be/news/belgian-news/TMag-Mobile-phones-to-be-banned-for-children\\_259994.html](http://expatica.com/be/news/belgian-news/TMag-Mobile-phones-to-be-banned-for-children_259994.html)

12 <https://www.facebook.com/1522020334715209/videos/1672938882956686/> (English subtitles)

13 <https://www.youtube.com/watch?v=996vzcYCN&feature=youtu.be>

14 <http://kompetenzinitiative.net/KIT/KIT/progress-in-south-tyrol-applying-the-precautionary-principle/>

15 <http://www.dailymail.co.uk/news/article-2929530/Does-toddler-play-iPad-Taiwan-makes-ILLEGAL-parents-let-children-two-use-electronic-gadgets-18s-limit-use-reasonable-lengths.html>

16 <http://c4st.org/doctors-call-protection-radio-frequency-radiation-exposure/>

17 <http://www.cps.ca/en/documents/position/screen-time-and-young-children> [accessed 3 June 2017]

18 <https://ehtrust.org/baby-safe-project-takes-off-protecting-pregnancy-from-wireless-radiation/>

19 <http://microwavenews.com/news-center/ntp-nyt>

19 Ostrom, Q.T., et al. (2016). American Brain Tumor Association Adolescent and Young Adult Primary Brain and Central Nervous System Tumors Diagnosed in the United States in 2008-2012. *Neuro-Oncology* 18.Suppl. 1. i1-50. First Author

the Tom Baker Cancer Centre in Edmonton: 'The astounding increases reported in this study, especially in young people, mirror what I am seeing in my clinic. Canada is in the process of establishing a comparable brain tumour registry, so these analyses will not be available here for 15 or 20 years. I am increasingly convinced that mobile phones are a major cause, and urgent action is needed.'<sup>20</sup> Australian brain surgeons, Dr. Vini Khurana and Dr. Charles Teo have stated they believe there is a direct causal link between brain cancers and mobile phone use.<sup>21</sup>

6. A research team led by Hugh S. Taylor, M.D., Chair of Obstetrics, Gynecology and Reproductive Sciences, Yale School of Medicine in a study published in 2011 concluded "We have shown that behavioral problems in mice that resemble ADHD [Attention Deficit Hyperactivity Disorder] are caused by cell phone exposure in the womb."<sup>22</sup>

#### TABLE IV. RELATED INFORMATION

1. In June 2015, Canada's Parliamentary Committee on Health (HESA), after their hearings on Safety Code 6, recommended: "That the Government of Canada develop an awareness campaign relating to the safe use of wireless technologies, such as cell phones and Wi-Fi, in key environments such as the school and home to ensure that Canadian families and children are reducing risks related to radiofrequency exposure"<sup>23</sup> (Appendix 1).
2. In Dec., 2010, the Standing Committee on Health for the 40<sup>th</sup> Parliament, 3<sup>rd</sup> Session created a report entitled "An Examination of the Potential Health Impacts of Radiofrequency Electromagnetic Radiation". Recommendation 4 states "Health Canada and Industry Canada offer to provide information, including awareness sessions on exposure to radiofrequency electromagnetic radiation."
3. Dr. Devra Davis, co-founder and former director of the Oncology Department of the University of Pittsburgh, along with colleagues from Yale University, has founded the site Environmental Health Trust which has launched the BabySafe awareness project to educate pregnant women: *What You Need To Know About Pregnancy and Wireless Radiation*.<sup>24</sup>
4. Over 200 other recent studies (some presented here), showing biological effects in human, animal and cell biology at below Safety Code 6 (2015) non-heating (non-thermal) limits and published in peer-reviewed journals further strengthen the weight of evidence of harm.<sup>25</sup>
5. A faster 5th generation (5G) technology is being rolled out utilizing the radiofrequency/microwave bandwidth of over 30 GHz. The infrastructure would support the "Internet of Things" (IoT), self-driving cars, and virtual reality streaming and requires the installation of microcells (small cell tower antennae) in close proximity to homes. A recent conference "The Internet Of Things Poses Human Health Risks: Scientists Question The Safety Of Untested 5G Technology"<sup>26</sup> looked at many health related issues, not the least being that there is very little study on the effects of what will be an inundation of more wireless radiation in the environment. Some of the main concerns are outlined by Dr.Cindy Russell.<sup>27</sup>

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Affiliation: Case Comprehensive Cancer Center, Case Western Reserve University School of Medicine, Cleveland, OH USA; Central Brain Tumor Registry of the United States, Hinsdale, IL USA.

<sup>20</sup> <http://www.preventcancer.ca/brain-tumours-now-leading-form-of-cancer-in-adolescents>

<sup>21</sup> Reuter et al. (2010). Oxidative stress, inflammation and cancer: How are they linked? *Free Radic Biol. Med.* 49 (11):1603-1616.

<sup>22</sup> Dasdag, S., & Akdag, M. Z. (2015).The link between radiofrequencies emitted from wireless technologies and oxidative stress. *Journal of Chemical Neuroanatomy*. doi:10.1016/j.jchemneu.2015.09.001;

<sup>23</sup> <https://www.youtube.com/watch?v=mMKwtjO73Y8>

<sup>24</sup> Aldad, T. S., Gan, G., Gao, X.-B., & Taylor, H. S. (2012). Fetal radiofrequency radiation exposure from 800-1900 mhz-rated cellular telephones affects neurodevelopment and behavior in mice. *Scientific Reports*, 2, 312. doi:10.1038/srep00312 <http://www.ncbi.nlm.nih.gov/pubmed/22428084>

<sup>25</sup> Government of Canada, Parliamentary Standing Committee on Health (HESA) Report (2015): Radiofrequency Electromagnetic Radiation and the Health of Canadians.

<http://www.parl.gc.ca/housepublications/publication.aspx?DocId=8041315>

<sup>26</sup> <http://www.babysafeproject.org/>

<sup>27</sup> <http://c4st.org/200-scientific-studies-reporting-potential-harm-non-thermal-levels/>

<sup>28</sup> <https://ehtrust.org/internet-things-poses-human-health-risks-scientists-question-safety-untested-5g-technology-international-conference/>

<sup>29</sup> [https://ecfsapi.fcc.gov/file/10308361407065/5%20G%20Wireless%20Future-SCCMA%20Bulletin\\_FEB%202017\\_.pdf](https://ecfsapi.fcc.gov/file/10308361407065/5%20G%20Wireless%20Future-SCCMA%20Bulletin_FEB%202017_.pdf)

## QUESTIONS:

1. Given the large amount of peer-reviewed, scientific evidence presented in the background information and the fact that Health Canada admits there are studies that show harm below Safety Code 6<sup>28</sup> will Health Canada acknowledge that the concept of using heating as the only established effect<sup>29</sup>, and that using calculations based only on heating to set radiofrequency/microwave safe limits, are out of date? Will Health Canada begin to incorporate the new evidence, supported by older studies, of non-heating effects e.g. DNA damage, in its determination of Safety Code 6 guidelines?
2. Given that Health Canada states on its website "*It is true that there are no completed studies of the long term effects of Wi-Fi radiation specifically on children*"<sup>30</sup>, will it use the information provided here (more than 40 studies showing potential harm below Safety Code 6 guidelines, children absorb more radiation than adults, etc.) to issue precautionary warnings regarding small children and pregnant women to minimize exposures?
3. What peer reviewed, published studies on radiofrequency/ microwave radiation does Health Canada rely on (itself and not from other "authorities") to indicate long term exposures are safe from non-heating (non-thermal) effects?
4. Given that epidemiological studies (CEFALO on children) and on adults (INTERPHONE (13 countries), INTERPHONE Canada (odds ratio of 2.0),<sup>31</sup> the Hardell team and CERENAT) show an increased risk of brain cancer in long term avid users using regular cell phones (while meeting all current safety standards) and that children absorb more radiation than adults into the brain, will Health Canada update its archived "*Practical Advice on Safe Cell Phone Use*" issued in 2011<sup>32</sup> and post it prominently on its website, and will the Government of Canada examine and implement protective measures and messaging regarding the sale and marketing of cell phones? If not, why not?
5. What was the decision making process that Health Canada followed to give more weight to the information in the French ANSES report as justification for inaction on the HESA 2015 recommendations when that report also made the recommendation to immediately reduce children's exposure to wireless devices<sup>33</sup> and that France has, in fact, legislated reduced exposure of Wi-Fi for young children?
6. What has the Government of Canada done to identify what actions and for what reasons protective measures have been taken in France<sup>34</sup> (legislation) , Belgium<sup>35</sup> (no marketing of wireless devices to children under 14 years), Taiwan,<sup>36</sup> (legislation) and Cyprus<sup>37</sup> (strong precautionary messaging)?

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28 Health Canada's list of 36 studies that were in scope in response to C4ST's list of 140 omitted studies. 26 are below Safety Code 6 exposure guidelines.

[http://archives.c4st.org/images/documents/hesa/Health\\_Canada\\_Response\\_to\\_C4ST\\_References\\_of\\_140\\_Missing\\_Studies.pdf](http://archives.c4st.org/images/documents/hesa/Health_Canada_Response_to_C4ST_References_of_140_Missing_Studies.pdf)

29 At frequencies used in common wireless devices used by children and pregnant women.

30 <http://www.hc-sc.gc.ca/ewh-semt/radiation/cons/wifi/faq-eng.php#a7> [accessed 7 June 2017]

31 Odds ratio of 2.2 (95% confidence interval; 1.3,4.1) when adjusted for selection and recall bias, over 558 lifetime hours.

32 <http://www.healthycanadians.gc.ca/recall-alert-rappel-avis/hc-sc/2011/13548a-eng.php>

33 ANSES Press release and report:

<https://www.anses.fr/fr/content/exposition-des-enfants-aux-radiofr%C3%A9quences-pour-un-usage-mod%C3%A9r%C3%A9-et-encadr%C3%A9-des-technologies>

<https://www.anses.fr/fr/content/exposition-des-enfants-aux-radiofr%C3%A9quences-pour-un-usage-mod%C3%A9r%C3%A9-et-encadr%C3%A9-des-technologies>

34 [http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes\\_4565339\\_3244.html#meter\\_toaster](http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes_4565339_3244.html#meter_toaster)

35 [expatica.com/be/news/belgian-news/TMag-Mobile-phones-to-be-banned-for-children\\_259994.html](http://expatica.com/be/news/belgian-news/TMag-Mobile-phones-to-be-banned-for-children_259994.html)

36 <http://www.dailymail.co.uk/news/article-2929530/Does-toddler-play-iPad-Taiwan-makes-ILLEGAL-parents-let-children-two-use-electronic-gadgets-18s-limit-use-reasonable-lengths.html>

37 <https://www.facebook.com/1522020334715209/videos/1672938882956686/> (English subtitles)

<https://www.youtube.com/watch?v=996vzcYCN&feature=youtu.be>

7. Given the lessons learned from not acting sooner to protect unborn children in cases such as fetal alcohol syndrome (FAS), tobacco (cigarette) smoke exposure, diethylstilbestrol (DES) and thalidomide, will the Government of Canada act immediately to the scientific evidence linking radiofrequency/microwave wireless radiation to autism and other potential adverse health outcomes, and require warnings, similar to alcohol consumption and cigarette packaging, to warn pregnant women on the potential harmful effects of wireless devices to them and their unborn child as well as update its web page "Safety of cell phones and cell phone towers"<sup>38</sup> to include the most recent science and cautionary advice from other countries such as France<sup>39</sup>, Belgium<sup>40</sup>, Taiwan,<sup>41</sup> and Cyprus<sup>42</sup>? If not, why not?
8. Will the Government of Canada conduct an educational campaign such as the "Baby Safe Project"<sup>43</sup> from the United States, led in part by researchers at Yale University, to educate pregnant women on the potential harmful effects of wireless devices to their unborn child?
9. Given that few health related studies have been conducted on 5G technology and that this technology will be pervasive because it will be used for intense connectivity e.g. for the Internet of Things, what precautionary measures will the Government of Canada take to protect the health of Canadians, particularly pregnant women and children?
10. With the new scientific evidence presented here, what specific actions will Health Canada take regarding the recommendations from both the 2010 and 2015 Parliamentary Health Committee Reports to run awareness sessions and/or campaigns to educate Canadians, especially relating to children and pregnant women, on the safer use of wireless devices?

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38 <https://www.canada.ca/en/health-canada/services/consumer-radiation/safety-cell-phones-cell-phone-towers.html>

39 [http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes\\_4565339\\_3244.html#meter\\_toaster](http://www.lemonde.fr/planete/article/2015/01/29/une-loi-pour-encadrer-l-exposition-aux-ondes_4565339_3244.html#meter_toaster)

40 [expatica.com/be/news/belgian-news/TMag-Mobile-phones-to-be-banned-for-children\\_259994.html](http://expatica.com/be/news/belgian-news/TMag-Mobile-phones-to-be-banned-for-children_259994.html)

41 <http://www.dailymail.co.uk/news/article-2929530/Does-toddler-play-iPad-Taiwan-makes-ILLEGAL-parents-let-children-two-use-electronic-gadgets-18s-limit-use-reasonable-lengths.html>

42 <https://www.facebook.com/1522020334715209/videos/1672938882956686/> (English subtitles)

43 <https://www.youtube.com/watch?v=996vzcCYcNE&feature=youtu.be>

43 <http://www.babysafeproject.org/>

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Appendix 1. Recommendations from the 13th Report of the Standing Committee on Health (HESA), "Radiofrequency electromagnetic radiation and the Health of Canadians", June 2015, 41st Parliament<sup>44</sup>.

Recommendations relating directly to vulnerable persons are recommendations 8, 9 and 12.

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**RECOMMENDATION 1**

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

**RECOMMENDATION 2**

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

**RECOMMENDATION 3**

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

**RECOMMENDATION 4**

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

**RECOMMENDATION 5**

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

**RECOMMENDATION 6**

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

**RECOMMENDATION 7**

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

**RECOMMENDATION 8**

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

**RECOMMENDATION 9**

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

**RECOMMENDATION 10**

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

**RECOMMENDATION 11**

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

**RECOMMENDATION 12**

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

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44 <http://www.parl.gc.ca/content/hoc/Committee/412/HESA/Reports/RP8041315/hesarp13/hesarp13-e.pdf>



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Appendix 2. Adverse health effects at radiofrequency/microwave radiation exposure levels below Health Canada's "safe" Safety Code 6 human exposure guidelines have been documented for every life stage of human development (except for the egg where only insect studies have been conducted<sup>45</sup>).

The following are only some of the scientifically sound studies showing harm and potential harm from exposures below Safety Code 6 limits – some at many times below these limits – on pre-adult life stages. These studies include human, animal and cell/tissue studies.

In each section, human studies are listed first and are followed by animal studies which provide support for what is being reported in people, and in some studies report possible effects in humans which have not been yet identified.

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## 1. PREGNANCY

### 1.1. Women carrying to term

- Spontaneous unexplained abortions: A case-control study (292 women with unexplained spontaneous abortions/308 normal pregnancies). Conclusion: Our result suggests that use of mobile phones can be related to the early spontaneous abortions." Mahmoudabadi, F. S., et al. (2015)<sup>1</sup>
- Embryo growth ceasing: Watching TV and using mobile telephone during the first trimester of pregnancy may increase the risk of embryo growth ceasing significantly, in particular the high-risk pregnant women with embryo growth ceasing history." Han, J., et al. (2010).<sup>2</sup>
- Amniotic cells: exposure at 0.1 and 0.5 W/kg (6.3% and 31.3% of Safety Code 6).  
"... we conclude that membrane receptors could be one of the main targets that RFR [radiofrequency radiation] interacts with cells, and the dose-rate threshold, in the case of EGF [epidermal growth factor] receptors, is between SAR of 0.1 and 0.5 W/kg." Sun, W., et al. (2012).<sup>3</sup>

### 1.2. Animal supporting studies

- Implantation: Exposure 0.023023 W/kg (1.4 % of Safety Code 6): "We observed that implantation sites were affected significantly...Our findings led us to conclude that a low level of MW [microwave] irradiation-induced oxidative stress not only suppresses implantation, but it may also lead to deformity of the embryo in case pregnancy continues. We also suggest that MW radiation-induced oxidative stress by increasing ROS [reactive oxygen species] production in the body may lead to DNA strand breakage in the brain cells and implantation failure/resorption or abnormal pregnancy in mice." Shahin, S., et al. (2013).<sup>4</sup>

## 2. EXPOSURE IN THE WOMB (PRENATAL) OR AS A NEWBORN (POSTNATAL)

### 2.1. Human

#### 1. Behavioural problems:

- "The findings of the previous publication were replicated in this separate group of participants demonstrating that cell phone use was associated with behavioural problems at age 7 years in children, and this association was not limited to early users of the technology. Divan et al. (2012).<sup>5</sup>
- "Maternal cell phone use during pregnancy may be associated with an increased risk for behavioral problems, particularly hyperactivity/inattention, in offspring." Birks et al. (2017)<sup>6</sup>

- #### 2. Autism: A plausible link to exposure of wireless radiation to Attention Deficit Hyperactivity Disorder Spectrum (ADHDS) has been presented (Herbert and Sage (2013)<sup>7, 8</sup> and Herbert (2015).<sup>9</sup>

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45 Abnormal development: "All EMF [electromagnetic field] sources used created statistically significant effects regarding fecundity and cell death-apoptosis induction, even at very low intensity levels... well below ...guidelines..." Margaritis, L. H., et al. (2014). *Drosophila* oogenesis as a bio-marker responding to EMF sources. *Electromagnetic Biology and Medicine*, 33(3), 165–189 <http://www.ncbi.nlm.nih.gov/pubmed/23915130>

## 2.2. Animal

- Hyperactivity and impaired memory: "Neurobehavioral disorders are increasingly prevalent in children... we used a mouse model to demonstrate that in-utero radiofrequency exposure from cellular telephones does affect adult behavior. Mice exposed in-utero were hyperactive and had impaired memory... We present the first experimental evidence of neuropathology due to in-utero cellular telephone radiation." Aldad, T. S., et al. (2012)<sup>10</sup>
- Kidney damage: "[Exposure] during the prenatal period can cause pathological changes in kidney tissue in 21-day-old male rats owing to oxidative stress and decreased antioxidant enzyme levels." Odacı, E., et al. (2015).<sup>11</sup>
- Developmental abnormalities including testes: "... exposure throughout embryogenesis may cause reductions in serum total T levels and in the size and weight of the testes of male rats, while causing modest increase in apoptosis." Sehitoglu, I., et al. (2015).<sup>12</sup>
- Memory loss: "... exposure to continuous-wave MW [microwave] radiation leads to oxidative/nitrosative stress induced p53 dependent/independent activation of hippocampal neuronal and non-neuronal apoptosis associated with spatial memory loss." Shahin, S., et al. (2015).<sup>13</sup>
- Abnormal brain cell development: "In conclusion, our study results show that prenatal exposure to EMF [electromagnetic fields] affects the development of Purkinje cells in the female rat cerebellum and that the consequences of this pathological effect persist after the postnatal period." Odacı, E., et al. (2015).<sup>14</sup>
- Abnormal sperm quality: "We found a higher apoptotic index, greater DNA oxidation levels and lower sperm motility and vitality in the NEMFG [new born exposed group] ... rat testes exposed to 900 MHz EMF [electromagnetic fields] exhibited altered sperm quality and biochemical characteristics." Odacı, E., et al. (2016).<sup>15</sup>

## 3. CHILDHOOD AND EARLY ADOLESCENCE

### 3.1. Human

- Attention Deficit Hyperactivity Disorder (ADHD)-mobile phones: A total of 2,422 children at 27 elementary schools in 10 Korean cities were examined and followed up 2 years later... The ADHD [Attention Deficit Hyperactivity Disorder] symptom risk [was] associated with mobile phone use for voice calls but the association was limited to children exposed to relatively high lead." Byun, Y.-H., et al. (2013).<sup>16</sup>
- Addiction, depression: "...We analyzed three-year longitudinal data from the Korean Children and Youth Panel Survey conducted by the National Youth Policy Institute in Korea. A total of 1877 valid responses from 2011 to 2013 were analyzed....We found that each mobile phone addiction and depressive symptom in earlier years was associated with increasing severity in these conditions consistently over the three years." Jun S. (2016)<sup>17</sup>
- Fatigue: "The present study indicated that there was a consistent significant association between MP [mobile phone] use and fatigue in children. Further in-depth research is needed to explore the potential health effects of MP use in children." Zheng, F., et al. (2015).<sup>18</sup>

- Well-being:
  - "... New Zealand early-adolescents' subjective well-being and self-reported use of, or exposure to, wireless telephone and internet technology... increased risk of headaches ... . Using a wired cellphone headset was associated with tinnitus ... headache ... feeling down/depressed ... waking in the night... To safeguard young people's well-being, we suggest limiting their use of cellphones and cordless phones to less than 15 minutes daily, and employing a speaker-phone device for longer daily use..." Redmayne, M., et al. (2013).<sup>19</sup>
  - "...We recruited 619 fourth-grade students (8-11 years) from 37 schools around Melbourne and Wollongong, Australia... results for CP (cell phone) use were broadly consistent with our earlier study of older children..." Redmayne, M., et al. (2016).<sup>20</sup>
- Cognitive and behavioural effects: exposure median 285.94  $\mu\text{W}/\text{m}^2$  and maximum 2,759.68  $\mu\text{W}/\text{m}^2$  - 100kHz to 6GHz (0.01% and 0.14% of Safety Code 6<sup>46</sup>, respectively):
  - "A subsample of 123 boys belonging to the Environment and Childhood cohort from Granada (Spain), recruited at birth from 2000 through 2002, were evaluated at the age of 9–11 years...children living in higher RF exposure areas (above median SRMS [root mean-square] levels) had lower scores for verbal expression/comprehension and higher scores for internalizing and total problems, and obsessive-compulsive and post-traumatic stress disorders... Calvente, I., et al. (2016).<sup>21</sup>
  - "Two groups of healthy school-age children aged 11-14 ( $12.5 \pm 1.5$ ) years were included in the study, the one comprising those who are occasional users of a cellular phone (Group A) while the second those who do regularly use one (Group B)...CONCLUSIONS: HPA [The hypothalamic-pituitary-adrenal ] axis response to cellular phone after mental stress in children and adolescents follow a different pattern in frequent users than in occasional users that seems to be influenced by the baseline thyroid hormone levels." Geronikolou, S. A., et al. (2015).<sup>22</sup>
- Epigenetics: The subject of childhood development and epigenetics was recently reviewed by Sage and Burgio (2017).<sup>23</sup>

### 3.2 Animal

- Possible infertility: "Further, these adverse reproductive effects suggest that chronic exposure to nonionizing MW [microwave] radiation may lead to infertility via free radical species-mediated pathway." Shahin, S., et al. (2014).<sup>24</sup>
- Abnormal spinal cord development: Biochemistry results revealed significantly increased malondialdehyde and glutathione levels... LM [light microscopy] revealed atrophy in the spinal cord, vacuolization, myelin thickening and irregularities in the perikarya. TEM [transmission electron microscopic] revealed marked loss of myelin sheath integrity." Ikin, A., et al. (2015)<sup>25</sup>
- Poor spatial memory: "... exposed rats exhibited poor spatial memory retention when tested 48 h after the final trial... Structural changes found in the hippocampus of RF-EMR [radiofrequency - electromagnetic radiation] exposed rats could be one of the possible reasons for altered cognition." Narayanan, S. N., et al. (2015)<sup>26</sup>

46 Calculated using 2,000,000  $\mu\text{W}/\text{m}^2$  as the Safety Code 6 level. Safety Code 6 level at 6GHz is 10,000,000  $\mu\text{W}/\text{m}^2$ .

## 4.0 LATE-ADOLESCENCE AND EARLY ADULTHOOD

### 4.1 Human

- Brain tumours/brain cancer

- Children are not little adults. Studies indicate that children absorb more radiation than adults.<sup>27,28</sup> Dr. Om Gandhi of the Department of Electrical and Computer Engineering, University of Utah, has published multiple research studies indicating that children absorb radiation deeper into their brains than adults.<sup>47</sup>
- Children absorb more radiation: “Computer simulation using MRI scans of children is the only possible way to determine the microwave radiation (MWR) absorbed in specific tissues in children. Children absorb more MWR [microwave radiation] than adults because their brain tissues are more absorbent, their skulls are thinner and their relative size is smaller... tumors induced in children may not be diagnosed until well into adulthood. The fetus is particularly vulnerable.” Morgan, L. L., et al. (2014).<sup>29</sup>
- First use before the age of 20 increases risk: “... pooled analysis of two case-control studies on malignant brain tumours with patients ... aged 20-80 years and 18-75 years, respectively, at the time of diagnosis... Mobile phone use increased the risk of glioma... Use of cordless phones increased the risk ... First use of mobile or cordless phone before the age of 20 gave higher OR [Odds Ratio] for glioma than in later age groups.” Hardell, L., & Carlberg, M. (2015).<sup>30</sup>
- Malignant brain tumors : A 2016 report published in the journal *Neuro-Oncology* and funded by the American Brain Tumor Association (ABTA) reports on the Central Brain Tumor Registry of the US (CBTRUS). Brain tumors are the most common cause of cancer-related deaths in adolescents and young adults aged 15-39, and the most common cancer occurring among 15-19 year olds. American Brain Tumor Association. (2016)<sup>31</sup>
- Canada: “The astounding increases reported in this study, especially in young people, mirror what I am seeing in my clinic,” responded Dr. Jacob Easaw, from the Tom Baker Cancer Centre in Calgary. “Canada is in the process of establishing a comparable brain tumour registry, so these analyses will not be available here for 15 or 20 years. I am increasingly convinced that mobile phones are a major cause, and urgent action is needed.” Quoted by *Prevent Cancer Now* (2016)<sup>32</sup>
  - Recently published Canadian data for the 13-nation INTERPHONE study, used for the World Health Organization -International Agency for Research on Cancer (WHO-IARC) Class 2B *possible* human carcinogen classification, confirmed the more than doubling of risk of glioma (odds ratio of 2.2 after adjustment for selection and recall bias).<sup>33</sup>
- Possible/probable/known human carcinogen: The 2011 WHO-IARC’s “*possible* carcinogen” designation was based primarily on the 13 country-wide INTERPHONE study<sup>48</sup>, as well as a series of studies led by Dr. Lennart Hardell.<sup>34</sup> In 2014, the well-designed CERENAT French study supported those findings.<sup>35</sup> The international CEFALO study of children and adolescents indicated increased glioma risk with increased time of subscription, with significantly increased odds among the longest subscribers.<sup>36,37</sup>
  - There is more recent evidence that the current classification of radiofrequency/microwave radiation should be upgraded to a Group 2A *probable* carcinogen or Group 1 *known* carcinogen. The 2011 classification of radiofrequency/microwave radiation as a Group 2B *possible* carcinogen was based largely on human studies. Baan, R., et al. (2011).<sup>38</sup> On May 27th, 2016, results of a US National Toxicology Program study were released showing strong evidence that cancer in rats can be caused by cell phone radiation (details below).
  - Recently Dr. Hardell co-authored a paper calling for radiofrequency/microwave radiation from wireless phones to be classified as a Group 1, *known* carcinogenic to humans.<sup>39</sup> Tobacco is in Group 1.

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47 Environmental Health Trust: <http://ehtrust.org/>

48 See Appendix 2. <https://academic.oup.com/ije/article/39/3/675/631387/Brain-tumour-risk-in-relation-to-mobile-telephone>

## 4.2 Animal

- **Brain cell abnormalities:** "... Histopathological evaluations were also performed on these sections. Histopathological observation showed abundant cells with abnormal, black or dark blue cytoplasm and shrunken morphology among the normal pyramidal neurons. ... Stereological analyses showed that the total number of pyramidal neurons in the *cornu ammonis* of the EMF-EG [electromagnetic fields -exposed group] rats was significantly lower..." Şahin, A., et al. (2015)<sup>40</sup>
- **Brain cancer and schwannomas:** In 2016 The US National Toxicology Program, National Institute of Environmental Health Science (NTP/NIEHS) released partial, but final, results of a major study finding a statistically significant association between cell phone radiation below USA safety standard (same as Health Canada's Safety Code 6) and cancer in male rats. "*The occurrences of two tumor types in male Harlan Sprague Dawley rats exposed to RFR [radiofrequency radiation], malignant gliomas in the brain and schwannomas of the heart, were considered of particular interest...*"<sup>41</sup> This study found that cancer occurred at non-thermal levels, below the Safety Code 6 danger threshold. DNA damage was also observed in the NTP animal study. Wyde, M., et al. (2016).<sup>42</sup>
- **Possible infertility:** "... chronic exposure to nonionizing MW [microwave] radiation may lead to infertility via free radical species-mediated pathway." Shahin, S., et al. (2014).<sup>43</sup>  
"...Data of the present study showed a significant increase in both excitatory and inhibitory amino acids in the cerebellum of adult and young rats and midbrain of adult animals after 1 hour of EMR [electromagnetic radiation] exposure...The present changes in amino acid concentrations may underlie the reported adverse effects of using mobile phones." Noor, N. A., et al. (2011).<sup>44</sup>

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