HEALTH RISKS OF WIRELESS TECHNOLOGIES

Authors' Response to the Letter to the Editor

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Karipidis and Tinker[1] have disputed our papers[2,3]. We reiterate our claims of inaccuracy and misrepresentation of the available scientific evidence on radiofrequency electromagnetic radiation (RF-EMR) by ARPANSA, particularly in their main report TRS-164. Our claims were based on an objective review of the scientific evidence. We have presented empirical evidence from the peer-reviewed literature rather than unsubstantiated claims. Whether low-intensity (non-thermal) RF-EMR poses health risks is an issue of utmost importance to the ARPS readership. We clarify below the poor basis on which ARPANSA scientists have made their claims and demonstrate that biological and health effects occur way below the ARPANSA standard.

Our overview of studies on oxidative stress induced by low-intensity (non-thermal) RF-EMR[3] had 216 (89%) out of 242 studies confirming oxidative stress. This refutes ARPANSA's claim "*many recent in vitro experiments reporting RF effects have pointed to the production of Reactive Oxygen Species (ROS) as a possible link between RF exposure and adverse bio-effects. However, the putative link between RF energy and altered ROS production remains tenuous*". Of this, 180 (74.4%) were *in vivo* studies. How did ARPANSA miss all the *in vivo* studies (whole animal studies which are more powerful than *in vitro* studies)? The answer is given by Karipidis and Tinker in admitting that ARPANSA accepted reviews by others instead of carrying out a formal literature review. As we demonstrated[2], TRS-164 mostly duplicated the UK's AGNIR report along with its flaws. As the sole government agency entrusted to protect health of Australians from rapidly increasing man-made RF-EMR, is it appropriate for ARPANSA to use the conclusions of other groups without doing their own validation? ARPANSA has an obligation and a duty of care to review the scientific literature independently, thoroughly and without bias, which have been neglected. What is the purpose of ARPANSA's collection of scientific studies if they are not reviewed objectively? We have witnessed representatives from the telecommunications industry claiming (in forums of concerned citizens and politicians discussing the health impact of wireless infrastructure) that ARPANSA has reviewed 1500 scientific studies and has not found **any evidence** of health risks.

We further present a fraction of the existing scientific evidence herein that anyone can access on the ORSAA database. In a snapshot of the RF-EMR studies (on 12/02/2018), most (n=1283, 67.1%) of 1913 *in vitro/in vivo* experimental studies and population studies reported significant biological effects while 24.4% reported no effect and 8.5% uncertain effects clearly indicating biological interference by low-intensity RF-EMR exposure. Our database is now the world's largest categorised database of peer-reviewed studies on RF biological/health effects[4]. In contrast to ARPANSA, ORSAA is fully independent of industry funding and ORSAA scientists are unpaid volunteers without conflicts of interest.

The ARPANSA standard (based on ICNIRP guidelines) is entirely based on short-term thermal effects. Wireless devices need to comply with a SAR ≤2 W/kg. There are 669 experimental studies in the ORSAA database where tested exposures were ≤2 W/kg, and 450 (70%) of them showed biological effects. A replication study published in *Nature* showed how extremely low levels could non-thermally induce heat-shock proteins at only 0.001 W/kg[5] which has implications in cancer. As these occurred at exposures below the ARPANSA standard, the claim "*the ARPANSA Standard incorporated large safety factors into the exposure limits i.e. the limits were set well below the level at which effects were known to occur*" is false. Moreover, human epidemiological studies investigating mobile phone use also indicate adverse health effects. A recent meta-analysis of

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24 case-controlled studies (26,846 intracranial tumour cases and 50,013 controls) showed a significantly increased risk of head tumours (especially glioma brain cancers) associated with long term use[6]. Studies that found a higher risk of brain cancer associated with occupational RF exposure also support this finding[7]. Given that, the reported >2-fold increase in the incidence rate of the most aggressive brain cancer, glioblastoma multiforme over the last two decades in England and supporting data from elsewhere are very concerning[8].

Studies have also found an increased risk of cancer near fixed RF transmitters: radio/TV/radar towers and mobile phone base stations (MPBS) that expose people to levels well below the ARPANSA Standard for wireless infrastructure (power density 2 -10 W/m^2 depending on the frequency). One study that investigated 7191 cancer deaths in a Brazilian city found a steady increase in the cancer mortality rate with proximity to MPBS[9] where RF exposure was 0.00042 to 0.4 W/m^2. While no such study has been conducted around Australian MPBS, the only large population study conducted more than 20 years ago, led by Dr Bruce Hocking (former Chief Medical Officer of Telstra) on a Sydney population around broadcasting towers, found a significantly increased risk of leukaemia[10]. Increased DNA damage and oxidative stress (independent of smoking etc.) have been found in healthy young people living close to MPBS compared to controls without such RF exposure. There was even a positive dose-response effect with respect to duration of exposure and intensity which was only 0.0012 W/m^2 at peak[11,12]. There was also significantly increased prevalence of various symptoms. Epidemiological findings of neurological, immunological and endocrine effects/symptoms near RF transmitters deserve urgent attention.

The experimental evidence of DNA damage caused by low-intensity RF is now very strong with >100 studies on our database. A 2009 review presented 43 positive studies on genotoxicity[13]. The National Toxicology Program (NTP) of NIH, USA recently found DNA damage induced by non-thermal RF exposure *in vivo* along with evidence of carcinogenesis and other pathologies[14]. Low-intensity RF induced PARP1 (a sensitive marker of DNA damage) more than a large dose of gamma radiation[15].

Even with acute exposures, currently permitted levels have demonstrated biological/health effects (Table 1). For example, significant immune effects were objectively demonstrated by blood tests at a Japanese hospital in double-blind provocation studies with mobile phones[17]. Exacerbation of allergic responses is an adverse health effect. These are some of the proven effects which Karipidis and Tinker claim not to occur under the ARPANSA Standard. This evidence indicates that currently permitted RF-EMR levels pose a health risk. We also referred to reputed medical organizations such as the European and American Academies of Environmental Medicine that have come to the same conclusion after independently reviewing the scientific literature.

Our findings also strengthen recent publications demonstrating how RF-EMR meets the criteria for an IARC class 1 carcinogen[22, 23]. ARPANSA should immediately pay attention to this evident risk considering that Australia has the world's highest cancer incidence rate out of 185 countries[24]. By adopting the world's least stringent exposure standards in 2002 and not evaluating the risk posed by biological effects of RF-EMR in an objective and unbiased manner, ARPANSA appears to have risked public health in Australia. It is unfortunate that ARPANSA ignored early warnings from CSIRO[25]. There is evidence showing that Australians are being exposed to more RF-EMR generated for wireless communication compared to communities in other countries[26].

ARPANSA's claim of "adequate protection" is questionable when ICNIRP guidelines for non-ionizing radiation (NIR) are not adequate as per ICNIRP: "*Different groups in a population may have differences in their ability to tolerate a particular NIR exposure. For example, children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of NIR exposure than the rest of the population. Under such circumstances, it may be useful or necessary to develop separate guideline levels for different groups within the general population, but it may be more effective to adjust the guidelines for the general population to include such groups*"[27]. ARPANSA adopted ICNIRP guidelines without adjustments to cover more sensitive individuals. Does this mean that ARPANSA has knowingly excluded a large fraction of the Australian population in their standard? As RF-EMR is now a pervasive NIR, any standard needs to be inclusive of the entire population. Many of the experimental studies show considerable inter-individual variability in responses indicating that some people/animals are more sensitive to RF-EMR.

Even the small sample of the existing scientific

RF-EMR Exposure	ARPANSA limit	Effect observed in objective clinical/biochemical studies	Study and Institution
Mobile phone – 50 min, max SAR 0.901 W/kg.	2 W/kg	Altered (increased) brain glucose metabolism in healthy volunteers detected by PET scanning.	Volkow[16], National Institutes of Health (NIH), USA
Mobile phone – 30 min, max SAR 1.62 W/kg	2 W/kg	Exacerbation of allergic immune responses with individual variability in young volunteers.	Kimata[17], Satou Hospital, Japan
Mobile phone – 35 min, max SAR 2.0 W/kg	2 W/kg	Increased resting blood pressure in healthy young volunteers (26 -36 yr) in single-blind placebo-controlled study	Braune[18], University of Freiburg, Germany
Mobile phone like exposure -30 min max SAR 2.0 W/kg	2 W/kg	Altered electrical activity of the brain (sleep EEG) in healthy young men with individual variability.	Schmid[19], University of Zurich, Switzerland
MPBS exposure at 900 MHz, 50 min, max exposure 2.1 $x10^{-3}$ W/m^2	4.5 W/m^2	Activated stress responses with clear individual variability in healthy volunteers in a double-blind randomised controlled study.	Augner[20], Public Health Department Salzburg, Austria;
Mobile phone – 15 and 30 min exposure max SAR 1.09 W/kg	2 W/kg	Increased oxidative stress markers in saliva in healthy young males.	Abu Khadra[21], Yarmouk University, Jordan .

Table 1
Some studies that presented empirical evidence of biological/health effects in human volunteers upon acute exposure to RF-EMR

evidence that we have presented casts a shadow over the claim that "*ICNIRP guidelines are developed by teams of international experts and are endorsed by health authorities such as the World Health Organization as international best practice*". The ethics committee of the Karolinska Institute, Sweden, determined in 2008 that ICNIRP has a conflict of interest. ICNIRP is a private group protecting their own guidelines and some members also have financial conflicts of interest due to funding from the industries that generate EMFs[28]. The self-appointed NGO (maximum 14 members, currently 13), has expertise predominantly in physical sciences and engineering with a shortage of biomedical expertise. Only one member appears to be qualified in medicine (with no original research publications on RF or ELF EMF and two general review/position papers as second and third author) and three qualified in biological sciences with apparently limited research experience in experimental biomedical research on EMFs. It is intriguing that while accepting the ICNIRP's view on the health impact EMFs, ARPANSA has dismissed the literature reviews by more qualified panels with extensive biomedical expertise such as the 29-member BioInitiative Group comprised of 10 MDs and 21 PhDs[29].

TRS-164 review panel (three external members assisted by three ARPANSA staff) lacked expertise in medicine and biological sciences. Why did ARPANSA appoint a single reviewer for the vast body of experimental studies on biochemical/ physiological effects including oxidative stress when this reviewer had no demonstrated expertise in oxidative stress or related areas of biochemistry? If ARPANSA truly held a commitment to the claimed "international best practice", a multi-disciplinary panel of several members with outstanding track records in biomedical sciences would have been appointed to properly assess the large number of studies demonstrating oxidative stress, alteration of voltage-gated ion channels, mitochondrial dysfunction etc.

Dr Ron Melnick, the lead scientist of the team that designed the US NTP study, recently reported on the misleading statements by ICNIRP on the NTP data[30, 31]. He stated: *"The 'P' in ICNIRP stands for Protection. One must wonder who this commission is trying to protect – evidently, it is not public health."*[31]. The International EMF Project at the WHO that only accepts the ICNIRP view (both organisations share the same founding leader), has operated in a dubious manner, as explained by oncologist Prof. Lennart Hardell[28]. The International EMF Scientist Appeal to the WHO and UN by 244 scientists from 41 countries has so far been ignored[32].

In conclusion, ARPANSA has ignored a large evidence base that challenges their position. The scientific evidence we have collated, presented and made publicly available demonstrates that there are biological/health effects occurring at exposures well below the ARPANSA standard. Therefore, ARPANSA's claim that there is "*no substantiated evidence that RF exposure at levels below the limits of the ARPANSA Standard causes harm to humans*" is misleading. A risk management approach should be adopted urgently for RF-EMR with ALARA as the mainstay of this plan. Wireless technology is not risk-free as implied by ARPANSA's claim of "*no established evidence of harm*". Australians need to be informed of the risks so that they can make informed decisions when it comes to the use of wireless technology, particularly with regards to more vulnerable groups such as children.

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