

Wireless technology is an environmental stressor and there are engineering solutions that can reduce exposure.

by

Victor Leach¹, Steven Weller², and Julie McCredden³

Submitted: 03/02/2024

Accepted: 29/02/2024

Abstract

Electromagnetic signals from everyday wireless technologies are an ever-present environmental stressor affecting biological systems. More specifically, the experiments investigating exposures from real-world devices and the epidemiology studies examining the effects of living near mobile phone base stations were extracted from the ORSAA Database of EMF Bioeffects (ODEB). The number of papers showing effects was compared with those showing no effects. The results showed that two-thirds of the experimental and epidemiological papers found significant biological effects. The breadth of biological and health categories where effects have been found was subsequently explored, revealing hundreds of papers showing fundamental biological processes that are impacted, such as damage to proteins, lipids and DNA, biochemical changes and oxidative stress. Engineering solutions to limit exposure using the ICRP approach of Justification, Optimisation, and Limitation should be considered. Applying an As Low As Reasonably Achievable (ALARA) philosophy to wireless technology could make personal devices safer by reducing radiofrequency exposures and biological interference from low-frequency pulsing.

Key Words

environmental toxins, environmental health, environmental illness, electromagnetic hypersensitivity, wireless technology in health care.

INTRODUCTION

This paper communicates the main points from two recently published papers:

1. Wireless technology is an environmental stressor requiring new understanding and approaches in health care ¹.
2. Are there engineering solutions that can reduce exposure (ALARA) ² ?

The current state of affairs concerning bioeffects research investigating wireless radiation signals is unknown to many members of radiation protection societies. This article aims to summarise the research for this audience and to introduce the main concepts, issues and possible ways forward.

The literature regarding bioeffects of wireless radiation is dominated by animal experiments, mainly on rats and mice. There are several publicly accessible research databases, including PUBMED³ and EMF-PORTAL⁴, which researchers widely use. These broad-base databases include scientific literature on medical applications, diathermy applications and occupational exposure studies investigating incidents such as electrocution and overexposure. Searching these databases for specific experimental types, biological endpoints, and signal types can be time-consuming because they provide limited categorisation of information.

1 Radiation Protection Consultant App. Physics (RMIT) MSc (Melb.) MARPS, MORSAA (Member of the Oceania Radiofrequency Scientific Advisory Association Inc. (ORSAA) Correspondence: victor.leach@orsaa.org

2 B.Sc. (Monash) Microbiology and Biochemistry, PhD student (Griffith University), MARPS, MORSAA, recipient of the Bruce Rowe ORSAA PhD scholarship.

3 Psychology researcher PhD, Member of the Oceania Radiofrequency Scientific Advisory Association Inc. (ORSAA).

ORSAA Database of EMF Bioeffects (ODEB).

The Oceania Radiofrequency Scientific Advisory Association Database of EMF Bioeffects (ODEB)^{5,6} focuses on short-term and long-term biological effects that may result from non-thermal and thermal-based exposures to electromagnetic fields (EMF); in particular, exposure to fields in the frequency range of 3 Khz to 300GHz (RF). While current safety standards are predominantly based on thermal effects only, the literature has established that some non-thermal bioeffects occur, such as cellular oxidative stress⁷ which is linked to disease pathways (e.g. allergies, atopic dermatitis, diabetes, eye conditions, and fertility effects). ODEB also includes fields for experiment type, biological endpoints, and signal type, all of which have been comprehensively categorised. This database is freely available online⁶.

As of January 2024, there were over 5000 (peer-reviewed) publications in the ODEB. The main categorised groups are as follows;

- in vitro (cell) studies;
- in vivo (animal) studies;
- Epidemiology (human disease) studies;

- Human provocation studies; and
- Non-experimental Scientific Studies (NESS). (consisting of review, measurement, dosimetry, commentary, opinion articles, etc.).

An example ODEB screen showing the above categorisation scheme is depicted in Figure 1, which shows how studies are further categorised into exposed species types (plants, birds, insects, etc.). Each field or combination of fields is searchable, using several AND & OR queries. The query result includes the stored information for the selected arguments (Unique ID Number, Title, Authors, Result (Effect / No Effect / Uncertain Effect), URL, Date, Abstract) and can be downloaded in summary form to a CSV file. To appreciate the full capabilities of the database, a recorded webinar is available as part of the training information from the ORSAA website⁸.

A recent search on ODEB for experimental papers reveals that over 51% of all the stored papers are either in vivo or in vitro experimental papers (Figure 2). While no attempt has been made to categorise the quality of these papers, this

The screenshot shows the ODEB Study Categories search interface. It features a top navigation bar with tabs for Article, End Points, Exposure, Study Categories, Effects Categories, and Study Statistics. The main content area is divided into several sections:

- Study Categories:** A grid of checkboxes for selecting study types. The first column includes 'in vitro', 'in vivo', 'Animal Study', 'Plant Study', 'Insects', 'Avian', and 'Marine'. The second column includes 'Micobes', 'Human Provocation', 'Epidemiology', 'Prospective Design', 'Meta - Analysis', 'Case Study', and 'in silico'.
- Non-Experimental Supporting Studies (NESS):** A section with checkboxes for 'Dosimetry Studies', 'Measurement Studies', 'Guideline Reports', 'Questionnaire- Survey', and 'Computational/Modelling'.
- Other Categories Non-Experimental Supporting Studies (NESS):** A section with checkboxes for 'Review Studies', 'Non-EMF supporting study', and 'Letter to the Editor - Commentary'.
- ARPANSA Source:** A dropdown menu and buttons for 'ARPANSA Summary' and 'Summary Totals'.
- Funding Source:** A table with columns for Government, Private, Public Not-for-Profit, Industry, Institutional, WHO/United Nations, and Not Known, each with a checkbox.
- Funding Source:** A text input field for specifying the funding source.

At the bottom, a red banner displays the number '3088' and the text 'A novel database of bio-effects from non-ionizing radiation'.

Figure 1. Study Categories used in ODEB

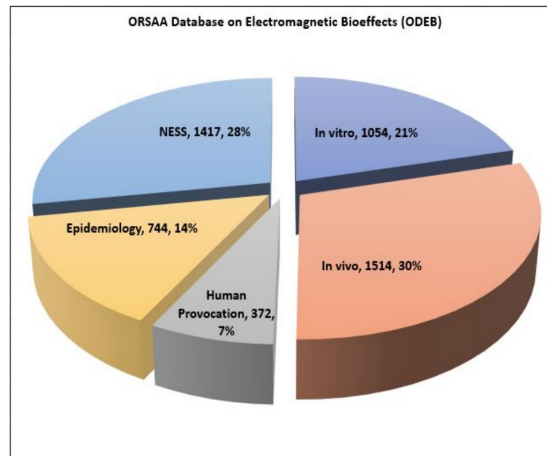


Figure 2. The relative proportion of study types found in in ODEB (October 2023)

database is a good starting point for those interested in conducting a systematic review.

Figure 2 shows that there are currently papers in the *in vivo* category. Within these, 128 have been deemed by their authors as providing evidence that some microwave exposures are useful for possible therapeutic applications (rather than having a detrimental effect). For example, promising research into the break-up of amyloid-beta proteins in the brain could lead to treatments using microwaves for degenerative diseases such as Alzheimer's⁹.

Simulated vs Real Mobile Phone Signals.

In vivo or *in vitro* experiments can use real or simulated signals. Real mobile phone signals cycle through the call sequence, such as dialling, answering or talking. Simulated signals usually use an RF signal generator set to produce carrier waves at a nominated frequency with or without low-frequency modulations. Experimenters prefer simulated signals because they are easily reproducible and the intensity can be fixed; however, such an exposure regime lacks the

variability in intensity and modulations that occur in signals from real-world wireless devices¹⁰. Most simulated signals use a 217 Hz modulation, which is used in GSM 2G signals. However, 3G and 4G signals use a low-frequency modulation of 100 Hz, while WIFI uses 10 Hz, respectively. Real mobile phone signals are complex and have been shown to be more bioactive than continuous waves of the same frequency¹⁰. Table 1 illustrates how experimental studies using real mobile phone signals have produced many more "Effect" outcomes than "No Effect" outcomes compared to studies using simulated signals from a signal generator⁵.

Low-frequency pulsations can interfere with neurological systems. Brain wave frequencies are as follows:

- Gamma waves (30-100 Hz) Deep Focus;
- Beta waves (12 - 30 Hz) Thinking;
- Alpha waves (8 - 12 Hz) Awake;
- Theta waves (4 - 8 Hz) Day Dreaming;
- Delta waves (0.5 - 4 Hz) Asleep

Table 1: Number of bio-effect Mobile phone studies according to Signal Type and Wave-form¹²

Research Categories	Real Mobile Phone used in Experiments			Simulated Mobile Phone Signals used in Experiments		
Wave form	Pulsed			Pulsed		
Outcome	#Effect	#No Effect	#Uncertain Effect	#Effect	#No Effect	#Uncertain Effect
<i>in vivo</i>	213	30	14	174	70	19
<i>in vitro</i>	50	2	2	123	81	22
Total	263 (85%)	32 (10%)	16 (5%)	297 (61%)	151 (31%)	41 (8%)

The types of neural oscillations that can change biology are unique to individuals and affect memory in the hippocampus (beta waves) and clean up plaque (gamma waves) in the brain. It is clear from EEG studies that changes due to mobile phone exposures interfere with brain waves while sleeping ¹¹. Disturbed sleep has been linked to poorer health and well-being.

Wireless signals are complex and totally polarised.

Most of the experimental work has used signal modulations related to outdated technology (2G), so research must catch up to the current technology. No biological experiments have used real 5G signals, which are very complex. 5G signals use Orthogonal Frequency-Division Multiplexing (OFDM) and have a lower frequency sub-carrier in the 15 to 120 kHz range ¹². OFDM signals are called “New Radio” (NR). They are very complex and are being rolled out in three stages as follows:

- FR1 stage sub 7.125 GHz;
- FR2-1 mmWaves (millimetre waves) 24, 25-52.6 GHz;
- FR2-2 mmWaves 52.6 -71 GHz.

This man-made radiation is unpredictable (because it is connection or event-driven) and can cause constructive and destructive interference, even resulting in ever-present hot spots. It differs from natural radiation because it is totally polarised, resulting in a substantial total EMF force. For example, consider a situation where an Electromagnetic Radiation (EMR) signal of 1.0 mW/m² intensity emanates from an antenna composed of 1 GHz photons. In the far field (where a receiver is greater than one wavelength away from the source), these photons act in synchrony so that the number of photons contacting a surface of one square meter would be 1.5×10^{21} photons fluctuating in synchrony per second. This is 10^{17} photons per square centimeter (100,000,000,000,000,000) fluctuating in synchrony ¹³. The total flux is not trivial because the phonic energy is synchronised, and the overall force is summative. This example by Vriens gives an understanding of why an EMR wave can

produce a significant force, thus dispelling the myth that only ionising radiation can cause biological damage.

Bioeffects at non-thermal exposures are far from trivial.

Most known human diseases are characterised by cellular systems under stress. As well as thermal stress, there are many other forms of stress, such as mechanical and biochemical, one example being “oxidative stress”. This is caused by an imbalance between the production and accumulation of reactive oxygen-reactive species (ROS) in cells and tissues and the inability of a biological system to detoxify these reactive products. Oxidative stress is a significant stressor resulting from exposure to EMFs ¹⁴. People suffering from morbidities or genetic deficiencies can have problems eliminating toxins. This can lead to a type of Chronic Fatigue Syndrome (CFS) or Electrohypersensitivity (EHS) which can be diagnosed using biomarkers for oxidative stress ^{15,16}. EHS was also called “microwave sickness” by WW2 radar operators.

Other non-thermal effects resulting from EMF exposures are observed in a broad range of experimental studies stored in ODEB (see Figure 3) as follows:

- Digestive disorders;
- Memory loss and lack of concentration;
- Joint pain and inflammation;
- Premature ageing;
- Headaches and sensitivity to noise;
- Declining fertility/infertility;
- Histopathological changes;
- Neural degeneration;
- Cancer in more extreme scenarios.

Table 2 shows the outcome of a search of papers from ODEB using real wireless signals in experimental studies at non-thermal exposures, which resulted in 68.4% of all the resultant studies showing biological effects. The current trend of company-funded studies is to claim that most studies are of poor quality and to diminish those experimental studies that show biological effects that may be harmful e.g., ¹⁷. Most biological experimental studies have their weaknesses, but these are not fatal, so applying the precautionary

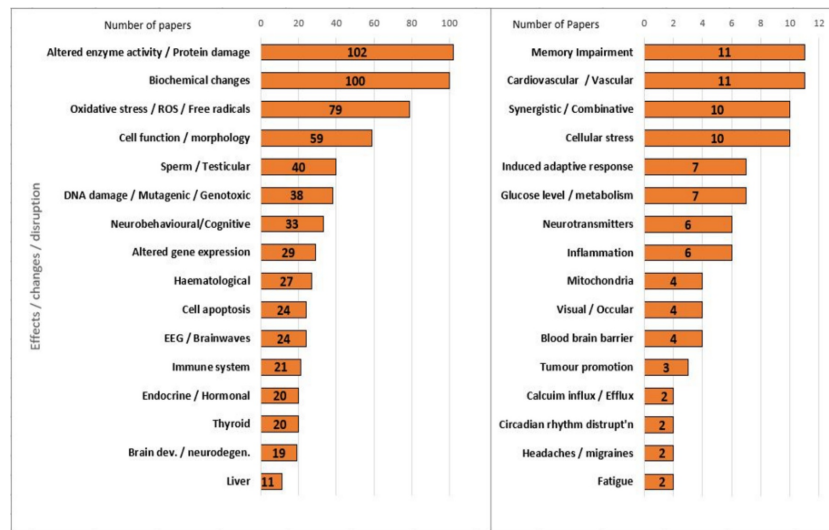


Figure 3: The number of experimental papers using real-world signals showing effects in each ODEB bioeffects category¹.

Table 2: Outcomes for selected experimental (*in vitro* and *in vivo*) studies ¹.

Study Outcome	N (%) of ODEB papers
	Relevant papers with wave form clearly described, using real world mobile phone or WiFi signals
Effect	573 (68.4%)
No effect	153 (18.3%)
Uncertain effect	112 (13.3%)
Total papers	838

principle is well-founded. This principle should be followed until the data on the long-term health effects materialise.

International Radiation Protection Association (IRPA) ICNIRP Charter

An International Radiation Protection Association (IRPA) charter formed ICNIRP at an IRPA congress in Montreal in 1992 ¹⁸. Since then, the IRPA NIR working group should have been

monitoring ICNIRP's implementation of the requirements of this charter, but this monitoring has not been conducted. The ICNIRP violations of the charter that have gone unchecked are shown in Table 3.

There have been many examples of inaction in the face of health risks from introduced carcinogenic agents, as shown in Figure 4. In each case, the conflict between government revenue-raising interests and the escalation of public health

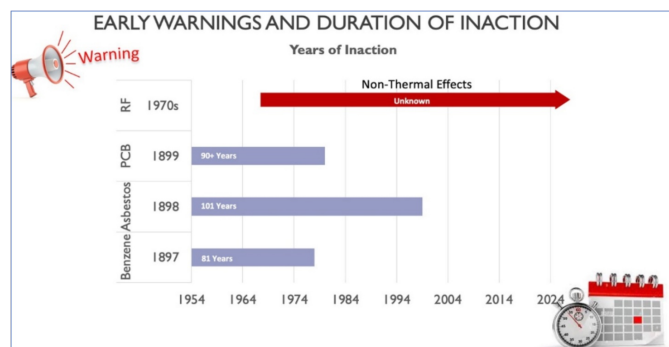


Figure 4: Early Warning Examples (derived from Gee, 2009 ²⁰)

Table 3: Non-Compliance of ICNIRP with IRPA charter (May 1992)

Section	Requirements of IRPA Charter	Deficiencies of ICNIRP (our comments)
Activities	ICNIRP to give guidance for the protection of workers, members of the public, patients and the environment.	Guidelines have not addressed the environment. Members of the public guidelines are not fit for purpose as they address only short-term thermal effects and no longer consider vulnerable or sensitive populations (all are grouped under 'general population').
Activities	ICNIRP collating and reporting of information and coordination of studies.	Limited evidence of co-ordination of any studies except to follow the 'thermal effects only' dogma.
Activities	ICNIRP initiating and participating in educational and research programmes.	Very little evidence of any formal education in radiation protection philosophies.
Activities	ICNIRP to formulate appropriate regulations and codes of practice.	The appropriateness of the ICNIRP codes of practice is debatable because ICRP radiation protection philosophy is not followed.
Activities	ICNIRP to establish relationships with International Committee on Radiological Protection (ICRP) who write guidelines for ionising radiation. ICRP has been the foundation body for formation of ethical radiation protection societies around the world which make up IRPA. ICRP was founded in 1928.	No relationship was established with ICRP, probably because the radiation protection philosophies of the two organisations are very different when it comes to long-term member of the public exposure.
Activities	ICNIRP to establish relationships with United Nations organizations WHO, ILO, IAEA and UNEP and the Commission of the European Communities.	WHO relationships are funnelled via the EMF group who have industry connections. This group is an unbalanced group of thermal-only scientists, made up of ICNIRP researchers or their associates from various nations. Very little input is made from medical or biophysics disciplines. Medical input is limited to harm from UV radiation.
Relationship with IRPA	ICNIRP shall maintain a close liaison and working relation with the Executive Council of IRPA.	ICNIRP has failed to establish a relationship with IRPA. ICNIRP is a law unto itself accountable to no-one.
Relationship with IRPA	ICNIRP shall submit its formal recommendations on protection against NIR for comment by the IRPA Executive Council and the IRPA Associate Societies, prior to publication. Unless otherwise agreed between the IRPA Executive Council and the Commission, the period for comment will be 90 days.	ICNIRP has failed to use the IRPA executive for checks and balances on its recommendations.
Relationship with IRPA	Commission shall report on its activities, recommendations and programme at each IRPA Congress.	ICNIRP has failed to report at each IRPA Congress for over two decades.
Membership	Executive council of IRPA and the IRPA Associate Societies. with regard to an appropriate balance of expertise.	No medical input on wireless radiation, and some input on UV exposure only. Unbalanced expertise because all ICNIRP members agree that non-thermal bioeffects have no health implications.
Membership	The elections shall be organised at the last Commission meeting before the succeeding IRPA Congress	Not followed. ICNIRP operates autonomously with no referral to IRPA.
Membership	Election procedures shall ensure that not less than three members are changed from one IRPA Congress to the next.	
Funding and Accounts	IRPA financial support	IRPA has continued to fund ICNIRP. Questions regarding industry interests in ICNIRP remain unanswered.
Funding and Accounts	Accounts audited	Followed.
Operating Rules	The Chairman of ICNIRP shall maintain close liaison and working relationship with the Executive Council of IRPA	ICNIRP has failed to establish a relationship with the IRPA Executive.
Operating Rules	Responsible for reporting the proceedings and recommendations of the Commission at the next IRPA Congress.	ICNIRP has failed to report at each IRPA Congress for over two decades.
Operating Rules- Elections	Membership changes at the next Congress of IRPA.	Not followed. Membership is a closed process that explicitly excludes scientists with different viewpoints.

effects from such agents has lasted for over half a century.

The historical precedence for action shown in Figure 5 suggests that the long-term health effects due to ever-increasing exposures, including current trends in cancer statistics, will likely be viewed with scepticism for another 30 years. Besides the cancer risks, there are also trends in health effects similar to chronic fatigue syndrome that are being dismissed as psychological effects^{16,19}.

The European Union recommended that the trigger point for Precautionary action be set at the

seen as tacit admission to there being a problem. Admission of risk of harm thus equates to government and industry opening themselves potential liability and legal action.

Applying ALARA to wireless technology

To expose the population to levels that are As Low As Reasonably Achievable (ALARA), several engineering strategies can be used to reduce exposure², for example:

1. Blocking the phone's RFR emissions, but not its reception, when it is positioned close to the head or body;

Probability	Quantitative descriptor (Probability bands based on IPCC 2001)	Qualitative descriptor	Illustrations
100% probability	Very likely 90–99%	• "Statistical significance" • "Beyond all reasonable doubt"	• Part of strong scientific evidence for "causation" • Most criminal law. And the Swedish Chemical law, 1973, for evidence of "safety" of substances under suspicion-burden of proof on manufacturers
	Likely (66–90%)	• "Reasonable certainty" • "Sufficient scientific evidence"	• Food Quality Protection Act, 1996 (US) • To justify a trade restriction designed to protect human, animal or plant health under World Trade Organisation Sanitary and Phytosanitary (SPS) Agreement, Art. 2.2, 1995
	Medium Likelihood (33–66%)	• "Balance of evidence" • "Balance of probabilities" • "Reasonable grounds for concern" • "Strong possibility"	• Intergovernmental Panel on Climate Change 1995 & 2001 • Much Civil and some administrative law • European Commission Communication on the Precautionary Principle 2000 • British Nuclear Fuels occupational radiation compensation scheme, 1984 (20–50% probabilities triggering different awards up to 50% + , which then triggers full compensation)
	Low Likelihood (10–33%)	• "Scientific suspicion of risk" • "Available pertinent information"	• Swedish Chemical law, 1973, for sufficient evidence to take precautionary action on potential harm from substances-burden of proof on regulators • To justify a provisional trade restriction under WTO SPS Agreement, Art. 5.7 where "scientific information is insufficient"
	Very Unlikely (1–10%)	• Low risk • "Negligible and in significant"	• Household fire insurance • Food Quality Protection Act, 1996 (US)

Figure 5: The trigger point for Precautionary Action (adapted from Gee (2009)²⁰)

point where the balance of evidence becomes greater than 33%, which equates to a medium likelihood of cause and effect²⁰, as shown in Figure 5.

The current need by ICNIRP and Government regulators to confirm evidence of harm before taking action is a recipe for a public health crisis in the future. Given the size of the population being exposed, telecommunications companies and government agencies need to take precautionary action now. Another potential stumbling block that needs to be overcome is that if telecommunication companies and government agencies choose not to adopt a precautionary approach and apply radiation hygiene, this may be

2. Modifying the antenna so the emission pattern is more hemispherical and radiates away from the head and the body;
3. Limiting call durations according to an estimation of the effective radiated power emitted by the device.

CONCLUSIONS

Current international guidelines recommended by ICNIRP are not fit for purpose as evidenced by the broad range of biological effects, some with health implications found in research and

occurring below existing public exposure limits. There is a need to provide newly updated guidelines that protect humans and all species from potential harm, with a special focus on long-term chronic exposures and vulnerable populations.

The following additional points should be considered when writing new guidelines for man-made wireless radiation;

- The precautionary principle, as detailed in ICRP, needs to be adopted ²¹;
- Current ICNIRP guidelines do not consider the environmental impacts of this form of radiation on any lifeforms other than humans;
- Given the rapid increase in background levels of wireless exposures and as these exposures are, in most cases, non-consensual from the cradle to the grave, ensuring all life is adequately protected is important;

- Current ICNIRP guidelines only consider short-term acute exposures (unlike real-world exposures, which are continuous for a lifetime). They also only protect against known thermal damage. Non-thermal effects are not considered or protected against;
- Exposure limits set for members of the public need special consideration as not all members have the same health status, and many individuals carry a burden of disease, making them especially vulnerable;
- As radiation protection practitioners, we must discuss methods to make this form of man-made non-ionising radiation more bio-compatible ²²;
- We recommend that ICNIRP follow best practices for radiation protection and live up to the original charter established between IRPA and ICNIRP in 1992.

REFERENCES

1. McCredden J, Cook N, Weller S, Leach V. Wireless technology is an environmental stressor requiring new understanding and approaches in health care. *Frontiers in Public Health*. 2022;10:4893. <https://www.frontiersin.org/articles/10.3389/fpubh.2022.986315/full>
2. Héroux P, Belyaev I, Chamberlin K, et al. Cell Phone Radiation Exposure Limits and Engineering Solutions. *International Journal of Environmental Research and Public Health*. 2023;20(7):5398. <https://www.mdpi.com/1660-4601/20/7/5398>
3. PubMed. 2024;<https://www.ncbi.nlm.nih.gov/pubmed/>
4. Research Center for Bioelectromagnetic Interaction working group. EMF-Portal. 2024;<https://www.emf-portal.org/en>
5. Leach V, Weller S, Redmayne M. A novel database of bio-effects from non-ionizing radiation. *Reviews on environmental health*. 2018;33(3):273-280. <https://www.degruyter.com/document/doi/10.1515/reveh-2018-0017/html>
6. Oceania Radiofrequency Scientific Advisory Association. ORSAA Database of Electromagnetic Bioeffects (ODEB). 2024;https://a037613.fmphost.com/fmi/webd/Research_Review_V4
7. Schuermann D, Mevissen M. Manmade electromagnetic fields and oxidative stress—biological effects and consequences for health. *International journal of molecular sciences*. 2021;22(7):3772. <https://www.mdpi.com/1422-0067/22/7/3772/pdf>
8. ORSAA Database Training Video <https://www.orsaa.org/orsaa-database-training-webinar.html>. <https://www.orsaa.org/orsaa-database-training-webinar.html>
9. Arendash G, Mori T, Dorsey M, Gonzalez R, Tajiri N, Borlongan C. Electromagnetic treatment to old Alzheimer's mice reverses beta-amyloid deposition, modifies cerebral blood flow, and provides selected cognitive benefit. *PLoS One*. 2012;7 (4):e35751. <https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0035751&type=printable>
10. Panagopoulos DJ, Johansson O, Carlo GL. Real versus simulated mobile phone exposures in experimental studies. *BioMed research international*. 2015;2015 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4539441/>

11. Arnetz B, Akerstedt T, Hillert L, Lowden A, Kuster N, Wiholm C. The Effects of 884 MHz GSM Wireless Communication Signals on Self-reported Symptom and Sleep (EEG)- An Experimental Provocation Study. PERS Online. 2007;3 (7):1148-1150. <https://www.emf-portal.org/en/article/15274>
12. 5G NR is the foundation to what's next. <https://www.qualcomm.com/research/5g/5g-nr>
13. Vriens L. On the Difference Between Man-Made and Natural Electromagnetic Fields/ Radiation, in Regard to Biological Activity. 2018; <https://www.stopumts.nl/pdf/Man-made%20and%20Natural%20EMF%20EMR.pdf>
14. Is there evidence for oxidative stress caused by electromagnetic fields? Department of Epidemiology and Public Health Environmental Exposures and Health Unit; 2021, 2021. <https://www.bafu.admin.ch/bafu/en/home/topics/electrosmog/newsletter-of-the-swiss-expert-group-on-electromagnetic-fields-a.html>
15. Belpomme D, Irigaray P. Electrohypersensitivity as a newly identified and characterized neurologic pathological disorder: how to diagnose, treat, and prevent it. International Journal of Molecular Sciences. 2020;21(6):1915. doi:10.3390/ijms21061915. <https://www.mdpi.com/1422-0067/21/6/1915/pdf>
16. Bandara P, Hunter J. Case study: Could electromagnetic-hypersensitivity be exacerbating this case of chronic fatigue syndrome? Journal of the Australasian College of Nutritional and Environmental Medicine. 2020;39(3):40-47. <https://search.informit.org/doi/abs/10.3316/informit.813198782782413>
17. Vijayalaxmi, Foster KR. Improving the Quality of Radiofrequency Bioeffects Research: The Need for a Carrot and a Stick. Radiation Research. 2021;196(4):417-422. <https://pubmed.ncbi.nlm.nih.gov/34270779/>
18. Charter of the International Commission on Non-ionizing Radiation (ICNIRP) adopted at the general assembly of the International Radiation Protection Association (IRPA) Montreal, May, 1992. <https://www.icnirp.org/cms/upload/doc/charter.pdf>
19. Bandara P, Chandler T, Kelly R, et al. 5G wireless deployment and health risks: Time for a medical discussion in Australia and New Zealand. Journal of the Australasian College of Nutritional and Environmental Medicine. 2020;39(2):27-34. <https://www.researchgate.net/publication/343416307>
20. Gee D. Late Lessons from Early Warnings: Towards realism and precaution with EMF? Pathophysiology. 2009;16(2-3):217-231. <https://www.sciencedirect.com/science/article/abs/pii/S092846800900008X>
21. Touzet R, González AJ. Protection against ionizing radiation vis-à-vis. Protection against non-ionizing radiation: different approaches. 2021; https://inis.iaea.org/collection/NCLCollectionStore/_Public/53/059/53059619.pdf
22. Meijer DK, Geesink HJ. Favourable and Unfavourable EMF frequency patterns in Cancer: perspectives for improved therapy and prevention. Journal of Cancer Therapy. 2018;9(03):188. https://www.scirp.org/html/2-8902709_82944.htm



**TAKE NOTE OF THE DETAILS OF THE NEXT ARPS CONFERENCE.
I HOPE TO SEE YOU THERE**