EMF RADIATION -

Are you sure it's not affecting you?

UNABRIDGED VERSION

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Planetary electromagnetic pollution: it is time to assess its impact

Priyanka Bandara [a] · David O Carpenter [b]
Affiliations & Notes Article Info

As the Planetary Health Alliance moves forward after a productive second annual meeting, a discussion on the rapid global proliferation of artificial electromagnetic fields would now be apt. The most notable is the blanket of radiofrequency electromagnetic radiation, largely microwave radiation generated for wireless communication and surveillance technologies, as mounting scientific evidence suggests that prolonged exposure to radiofrequency electromagnetic radiation has serious biological and health effects. However, public exposure regulations in most countries continue to be based on the guidelines of the International Commission on Non-Ionizing Radiation Protection[1] and Institute of Electrical and Electronics Engineers,[2] which were established in the 1990s on the belief that only acute thermal effects are hazardous. Prevention of tissue heating by radiofrequency electromagnetic radiation is now proven to be ineffective in preventing biochemical and physiological interference. For example, acute non-thermal exposure has been shown to alter human brain metabolism by NIH scientists,[3] electrical activity in the brain,[4] and systemic immune responses.[5] Chronic exposure has been associated with increased oxidative stress and DNA damage[6,7] and cancer risk.[8] Laboratory studies, including large rodent studies by the US National Toxicology Program[9] and Ramazzini Institute of Italy,[10] confirm these biological and health effects in vivo. As we address the threats to human health from the changing environmental conditions due to human activity,[11] the increasing exposure to artificial electromagnetic radiation needs to be included in this discussion.

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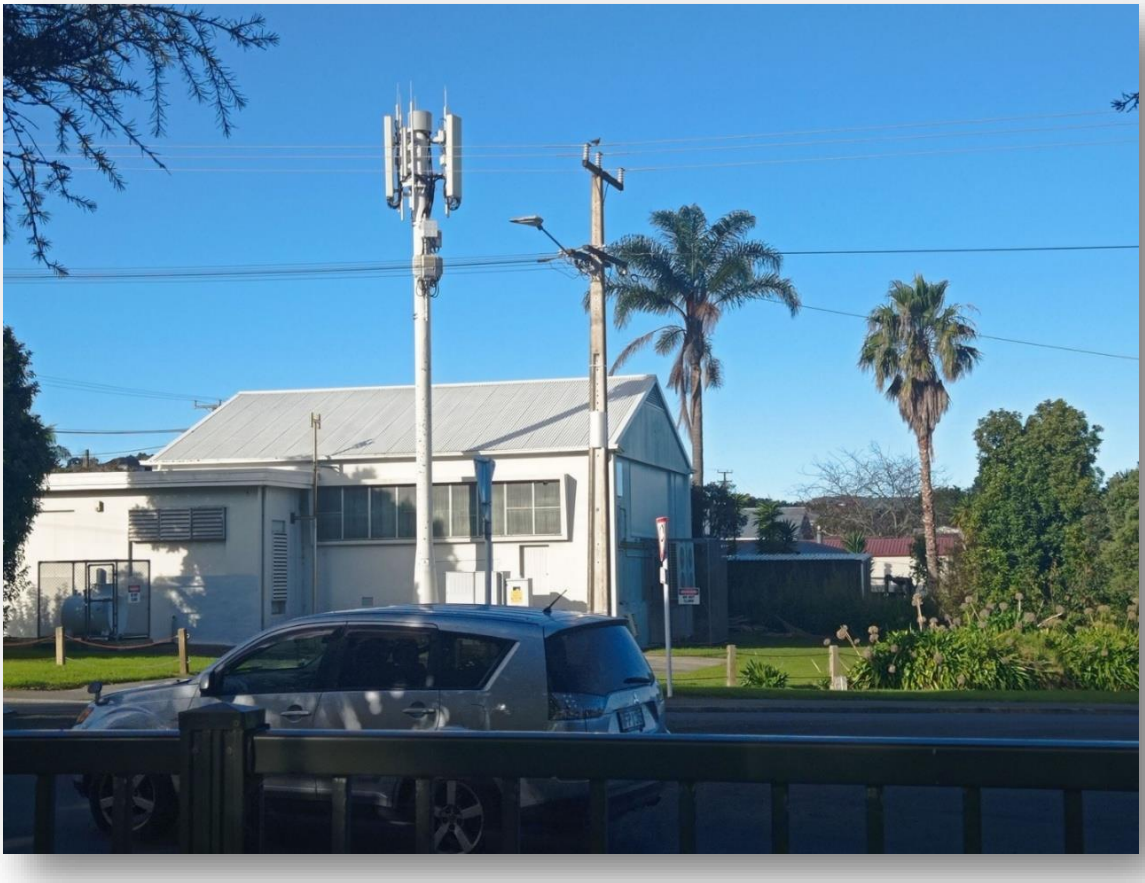
1. IMPORTANT LEGAL NOTICE & DISCLAIMER

As author of this monograph, I, Mr David Robert Lyon, assert the following:

1. I am providing this information without prejudice & with the best of intent – that intent being to safeguard and enhance the health of all New Zealanders.
2. Information is provided entirely free of charge, and I have no financial ties with any product, service, treatment, person, or Company mentioned within. I do not expect (or plan) to benefit financially, or in any other material way, from information provided.
3. I am a registered psychologist and **not** a medical health practitioner, nor physicist, nor telecomm engineer, but I am a deeply concerned and well-informed citizen. I am not legally or ethically permitted to diagnose or treat any disease or health condition, or to provide health advice. I have conducted research over 7 years and submitted my research to the critique of medical and scientific experts in New Zealand and Australia. Further, I have endeavoured throughout this document to back all opinions with referencing to relevant research or literature.
4. This work does not constitute health or medical advice.
5. If the reader has any health concerns, it will be vitally important to consult with a suitably qualified medical (or health) practitioner who is credentialed or experienced in this subject.
6. As will be apparent throughout this monograph, I have concentrated on presenting evidence **supporting the established thesis that current exposure levels of man-made microwave (MMM) radiation are likely to be causing multiple health harms to substantial numbers of the public**. Extensive research and investigation over the last 7 years, has led me to conclude that such apparently supportive evidence is significantly underrepresented in public, medical-scientific, and regulatory domains.
7. All statements with casual-sounding language are to be read as my opinion and interpretation, with acknowledgement that this area of research and investigation is not settled science and that current Government regulations are not in agreement with at least some of my statements.
8. It is hoped that this document may spark widespread interest, and rigorous open discussion, including amongst: scientists, medical practitioners, mental health practitioners, Governmental regulatory and advisory entities, health advisors, epidemiologists, and practitioners in health and safety, occupational health and environmental medicine.
9. Although this monograph has been meticulously reviewed by medical and scientific experts, I readily concede that there may be some unintended factual errors or misinterpretations contained herein. Also, with input from multiple experts over many months, it is possible that some of the footnotes may have become dislocated from citations in the body of the monograph.
10. Anthropic's *Claude AI* was used during the final review of this monograph to help better integrate research paper conclusions, to verify sources and citations, and assist with copy-editing. All editorial decisions, conclusions, and final wording are the author's.
11. I welcome and encourage debate of the evidence and acknowledge that this field continues to evolve.
12. As science in this area continues to advance, it will be important for the reader to stay open to new findings.
13. This publication is a free-to-access, open access document. As the information contained within is difficult to unearth, collate and synthesize, I will welcome the receiver of this document sharing it with others, should they decide to do so. For access, please use the following document citation: Lyon, D.R. (2026) EMF RADIATION: Are You Sure it's Not Affecting You? ISBN 978-0-473-79026-4.
14. Some previous versions of this monograph (earlier July 2026) are in public circulation. This version (12 July 2026) supersedes and replaces all previous versions and the author is not liable for any errors in the prior versions.



4G-5G mobile (macro-cell) cell tower only about 50 metres from the boundary fence of Onerahi Primary (Whangārei) – photo by author

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2. Summary Statement and Call to Action

Summary Statement

This paper finds that:

It appears that the New Zealand Government (including several preceding iterations) has incompletely considered the scientific evidence relating to the full range of risks associated with man-made microwaves (MMMs). (See information presented in Section 12, Section 13, Section 14 and Section 15).

Based on available public information, the writer is concerned that relevant New Zealand Ministries and the key safety advisory committee ICHEF, may possess insufficient scientific expertise with the multidisciplinary capacity required, to assess the complex health risks associated with relevant man-made technologies. (See Section 12)

Public and medical-scientific awareness of health risks increasingly documented in the scientific literature, appears low. [1]

Evidence presented indicates that man-made microwave exposure – such as from mobile phone systems and handsets, smart devices and Wi-Fi – pose serious risks to health. These risks appear to vary according to a number of factors, including age (with high vulnerability during early developmental stages) and health status. For example, it has been long-known that children are more at risk, owing to thinner skulls, more water in their brains, and a higher ion content. [2] These differing biological characteristics are estimated to cause twice the radiation absorption in their brains, and 10 times the radiation absorbed by their skulls. [3] Further, as children are likely to be exposed to increasing levels of MMMs and for their entire lives, the accumulating risks they will face [4] go very far beyond risks to someone already in middle-age or adulthood. (See Section 14, Section 15 and Section 18)

There are multiple key differences between man-made microwaves and naturally occurring ones. In the briefest of terms, MMMs appear to be biologically far more disruptive, owing to their higher power density, polarisation, and the chaotic nature of the pulses. Consequently, MMMs have much more potential to create accruing health damage, even at non-heating (non-ionising) levels. Sixteen differing characteristics of MMMs were identified, which are considered to be deleteriously active at a biophysical and/or biochemical level in the body. (Section 13)

In Section 14, multiple postulated pathways of action for MMMs are described in considerable detail.

In Section 15 the possible neuropsychological impacts of MMMs were explained, with 12 different effects posited.

Electromagnetic Hypersensitivity (EHS) is considered by the author to be a genuine medical condition, supported by the clinical and biomarker evidence developed by Professor Dominique Belpomme and colleagues over more than a decade.

At the level of clinical documentation, ICD-10-AM (a diagnostic-coding classification used by Health N.Z.) contains the codes a clinician applies when recording an EHS-attributed presentation - W90 for the radio-frequency exposure context, with effect codes G43, R42, H93.1 for the typical migraine, dizziness, and tinnitus symptoms. In the writer's opinion, in the interests of public health, this condition requires official

[1] See for example: See: Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect
[2] See: https://pubmed.ncbi.nlm.nih.gov/23705297/
[3] See: https://pubmed.ncbi.nlm.nih.gov/21999884/
[4] See: https://kompetenzinitiative.com/wp-content/uploads/2019/08/KI_Brochure-6_K_Hecht_web.pdf

public-health recognition, ongoing public education, and significant accommodations - for both prevention and treatment - by Government and other key advisory and regulatory authorities.

An important regulatory anchor for this monograph's mitigation case is the 2011 classification of radiofrequency electromagnetic fields as **Group 2B** - "**possibly carcinogenic to humans**" - by the International Agency for Research on Cancer (IARC), the cancer-research arm of the W.H.O. [1] The April 2025 W.H.O.-backed systematic review of animal cancer studies (discussed in **Section 6.2**) reaches a converging conclusion at higher certainty for several tumour types in animals, and provides empirical support for revisiting and tightening the IARC 2B classification. So the IARC 2B classification of RF-EMFs itself is unambiguous, authoritative, and highly relevant to public health. (See **Section 6** for the more detailed picture.)

Based on research reviewed, there may be many in our society who do **not** manifest symptoms severe enough for a diagnosis of EHS, while at the same likely suffering health impacts arising from ongoing exposure to man-made microwaves. [2]

Call to Action

If the reader finds information presented in this monograph to be significantly concerning (see especially research presented in Section 14 and Section 15), it will be vital to public health for any of the below suggestions to be considered for urgent implementation. Importance of **individual action** is high, given that public knowledge of potential harms from (man-made) microwave exposure is currently so limited, and that a major groundswell of concern throughout N.Z. is most likely to have a substantive effect.

Actions to consider taking include sharing this monograph with any of the following:

1. Family, friends and work colleagues
2. Local Member(s) of Parliament
3. Local Ministry of Education and Ministry of Health - senior officials
4. Local G.P.s and Health Practitioners
5. Local municipal authorities such as City Councils and District Councils
6. Local or National Media
7. Local schools at all educational levels – Pre-school, Primary, Intermediate, Secondary and Tertiary
8. The Prime Minister, Deputy Prime Minister, and leaders of all other Parties currently occupying Parliament
9. Relevant Ministers of the Government such as: Minister for Broadcasting, Communications & Digital Media; Minister for Education; Minister for Health; Minister for Research Science & Innovation; Minister for Justice; Minister for Conservation; and Minister for the Environment
10. Your mobile phone provider – including the Company CEO, chief scientific/technical advisor, and your local Branch Manager
11. Relevant high-volume Websites and Social Media platforms
12. Local or National Human Rights agencies or organisations

[1] See: IARC Monograph Vol 102 - Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields (2013). The 2011 Group 2B classification press release: Baan et al. 2011, Lancet Oncology.
[2] See: Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect

Taking Action

For an extensive email contact list for MPs, DHB officials etc., please see **Section 25.**

If the reader chooses to forward this monograph to any public officials, requesting a follow-up, in-person meeting, could be expected to produce much added impact. Such a meeting would require no special expertise in this area, and might merely be to enquire:

1. If the official has read relevant Sections of the document? (If not, then by when this can be expected, and scheduling a follow-up appointment to fit this timeline.)
2. If the monograph has been perused, what was found to be important and to necessitate action?
3. What immediate and subsequent actions will be taken – with relevant timelines?
4. When the reader can next meet with the official to receive an update on progress made?

Taking notes during any such appointment is an added level of formalisation which could then include emailing the official a copy of the notes for her/his records.

Navigating this Monograph

Sections in this monograph that are most relevant to key sectors of society have been suggested in the **Executive Summary** below: How to Navigate This Document

The **Executive Summary** also includes recommended actions that can be taken by each specific sector.

Section 22 recommends immediate actionable steps available to be taken by a responsible Government.

> *"This Monograph makes an important contribution to understanding RF-EMF and its health effects in New Zealand. While non-thermal effects are well documented in the scientific literature, they remain unrecognised by public sector agencies, with no dedicated resourcing for independent scientific risk evaluation. When potential harms from technology are not formally acknowledged, society's ability to act in a precautionary and protective way is undermined."*

The Physicians and Scientists for Global Responsibility New Zealand Charitable Trust

(23 June 2026)

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3. Preamble

Intended Readership

The primary intended audience for this monograph is health practitioners, elected public officials, advisory and regulating entities throughout New Zealand, and concerned individuals. Many will be increasingly aware and concerned regarding the apparent deleterious environmental and health effects of ever-expanding exposure to electromagnetic radiation (EMR), including man-made microwave (MMM) emissions. In particular, health and medical advisors, and practitioners in the domains of occupational health, environmental medicine, and health and safety, may find the information and resources available in this monograph useful.

Another important audience that may obtain significant benefit from this monograph and its information, is those individuals and patients who suspect they are being deleteriously affected by exposure to man-made microwaves.

There may also be many who possess a general interest in health and wellbeing, who wish to increase their understanding of this rapidly encroaching and increasingly important area of adverse, high-likelihood, health impacts.

I dedicate this work to all those who may find benefit from this monograph, and gladly share it with you all.

Why I am Freely Sharing my Extensive Research

As I curated and reviewed more and more research on the potentially very harmful effects of man-made microwaves (Section 14 and Section 15) I found the evidence compelling, alarming, and of likely interest and importance to all.

If the reader experiences a similar response, a valuable outcome would be their choice to share this research with others. Among these, consider for example, sharing with friends and family who are interested or concerned; your local health practitioners or other medical people you may know; local school Principals and teachers; Ministry of Education Managers; local government and municipal individuals; local Media; your local M.P.; relevant high-traffic Websites; posting on Social Media; and anyone in Central Government that is already known, or for whom contact details are available. Casting the information net as widely as possible will help raise the awareness of a much larger number of people to this near-omnipresent, invisible, silent, man-made, likely exposure risk.

A key reason for authoring this monograph is that owing to our population being continually bathed in increasing levels of man-made microwaves, I hold grave fears for the mid-to-long term health of all New Zealanders. My fears arise from relevant published research articles over the preceding 20 years, thousands of which have indicated that man-made microwaves are associated with a wide range of health impairments and damage. This damage usually accrues over time to exposed individuals, though at early stages of exposure, there is often no awareness of malaise, or accruing toxicity. Further, as research has demonstrated – and will be evidenced in Section 14 and Section 15 below - during the developmental years of *in utero*, childhood and adolescence, brains are especially vulnerable to the likely effects of chronic microwave radiation exposure.

After several years of research and extensive medical testing, I became fully convinced that my health had suffered severely owing to continual exposure to high levels of Wi-Fi microwaves in the workplace. Since this health-saving insight, I have experienced a strong need to document what I have learned, in order to warn fellow New Zealanders of what they could be facing. And beyond this warning, I wish to outline steps

they could consider taking – after consultation with expert health professionals - to better protect themselves.

My commitment to publishing my study and the arising insights, has been strengthened by a commensurate burgeoning awareness that the apparent health dangers of man-made microwaves is something that a wide range of New Zealanders are unaware of – including many health professionals with whom I have had contact regarding these issues.

4G and 5G (macro-cell) mobile cell tower directly opposite Onerahi Primary (Whangārei) – photo by author

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4. Executive Summary

4.1 Introductory note

As will be apparent throughout this monograph, the author has concentrated on presenting evidence supporting the thesis that current exposure levels of man-made microwave (MMM) radiation are likely to be causing multiple health harms to substantial numbers of the public. This has been the chosen approach, as extensive research and investigation over the last 7 years, has led the author to conclude that such apparently supportive evidence is significantly underrepresented in public, medical-scientific, and regulatory domains. (See Section 14 and Section 15) for a wide range of likely health effects of MMMs.)

Evidence supporting this thesis is drawn primarily from published medical-scientific research, particularly from research where investigators are understood by the author to be fully independent of any commercial or political influence. Where relevant published (independent) research or reviews have not been readily available, the author has sometimes relied on resources such as YouTube or online Summit presentations, by physicians or scientists that the author considers to be recognised and established in the field. (Such sources are acknowledged as informal and not equivalent to peer-reviewed literature.)

As acknowledged in numerous instances in the monograph, the factors determining the possible effects of MMMs are manifold and complex, and often very difficult to accurately measure – at least over the short-term. Such difficulties are believed to be a key reason for the seemingly divergent findings when it comes to possible health effects of MMMs – with many research studies failing to find any significant link between exposure to MMMs and temporally subsequent health impacts. (See Section 9 for a detailed discussion of these and other research challenges.)

Regarding the safety of current MMM radiation levels in our society, it is readily acknowledged that NZ regulators and significant numbers in the medical-scientific community, currently hold opposing views to those of the author. Likely reasons for not perceiving any potential risks from MMM radiation are discussed in Section 9 and Section 12.

4.2 Main thesis

Electromagnetic Hypersensitivity (EHS) - also known as "Microwave Sickness". “EMR Syndrome” and “Wireless Sensitivity” - is a genuine, biologically-based health condition apparently caused by chronic exposure to man-made electromagnetic fields (EMFs). [1] The potential outcomes of exposure appear to be both dose and intensity dependent. (In some cases, very intense short-term exposure appears perceptibly deleterious.) Such ubiquitous exposure arises from microwaves utilised in wireless technologies, including Wi-Fi routers, mobile phones, mobile cell towers (and the associated networks), Bluetooth devices, smart meters, computer devices (especially in wireless mode), smart home devices (such as T.V.s), modern home alarm and ventilation systems, most baby monitors, smart watches, and smart homes. Exposure to such RF-EMFs (including man-made microwaves) is almost universal in all urban environments, and most domestic and institutional environments.

Man-made microwaves differ fundamentally from natural microwaves because they are polarized, irregularly pulsed, and chaotic, potentially making them biologically disruptive and damaging, even at low, non-heating power levels. [2] That is, even at non-thermal levels, they appear to be physiologically disruptive

[1] See: Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect
[2] FCC Knew Phones Exceeded Radiation Limits, Hid Info From Public and Courts

when compared against natural background microwaves - that are normally non-disruptive to human (biological) structure and function. (See Section 13 for a detailed discussion on this subject.)

The research presented contends that current safety standards appear to inadequately protect public health, and particularly so for children [1] and vulnerable populations. [2]

Risk mitigation involves taking practical steps to reduce exposure where there is credible evidence of potential harm, even while scientific uncertainty remains.

This monograph calls for urgent Government recognition of electromagnetic hypersensitivity and the non-thermal risks from EMFs, for improved medical understanding, and implementation of measures that mitigate human health risks - based on established (or suspected) biological mechanisms of harm.

4.3 Five compelling pieces of evidence

1. International Medical Recognition with Objective Diagnostic Criteria

Electromagnetic Hypersensitivity (EHS) has been recognised by the W.H.O. as a clinical syndrome since the 2004 Prague workshop, under the structured term Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF). International Classification of Disease ICD-10 / ICD-11 coding combinations support clinical documentation, and Health N.Z. uses ICD-10-AM. (**Section 6.1** unpacks the WHO position in detail). The case for risk mitigation is well supported by a clinical-research framework that was developed by leading European researchers, Professor Dominique Belpomme (medical oncologist) and colleagues. The scientists maintain an extensive clinical database of EHS sufferers and demonstrated an objective and consistent range of key diagnostic symptoms, biomarkers, and imaging findings. (See Section 6)

a) Low-grade inflammation markers in peripheral blood
b) Autoimmune response involving autoantibodies against O-myelin (a component of nerve cell sheaths)
c) Oxidative and/or nitrosative stress biomarkers present in 80% of EHS patients
d) Cerebral blood flow abnormalities detected through specialized brain imaging (ultrasonic cerebral tomosphygmography and transcranial Doppler ultrasonography), showing defects in middle cerebral artery hemodynamics and tissue pulsometric index deficiencies in the capsulo-thalamic area

They found that objective findings establish EHS as "a neurologic pathological disorder which can be diagnosed, treated, and prevented" (Belpomme & Irigaray, 2020) [3], refuting claims that EHS is purely psychological, or a psychological manifestation of the "nocebo effect." Further, in the same published research (see Section 6 below), they emphatically state that:

"*we show here there are objective pathophysiological changes and health effects induced by electromagnetic field (EMF) exposure in EHS patients* ***and most of all in healthy subjects****, meaning that excessive non-thermal anthropogenic EMFs are strongly noxious for health. In this overview and medical assessment we focus on the effects of extremely low frequencies, wireless communications radiofrequencies and microwave EMFs. We discuss*

[1] Wireless Radiation Exposure for Children Should Be 'Hundreds of Times Lower' than FCC Limits, Environmental Group Says • Children's Health Defense ; and Wireless technologies, non-ionizing electromagnetic fields and children: Identifying and reducing health risks - ScienceDirect
[2] New Report Contradicts Telecom Industry Claim That Wireless Radiation Is Safe
[3] Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It - PubMed)

*how to better define and characterize EHS. Taking into consideration the WHO proposed causality criteria, we show that **EHS is in fact causally associated** with increased exposure to man-made EMFs…"*

[**bold** emphasis added by the author]

2. Multiple Likely Biological Mechanisms (or pathways) of Harm

The research documents sixteen postulated biological mechanisms grouped into four thematic categories (Section 14) through which man-made microwaves appear to cause bodily or psychological harm, moving beyond simple correlation to explain how harm seems to occur.

Key apparent underlying mechanisms include:

a) Systemic ion channel disruption to cellular function: Man-made microwaves have been shown to activate voltage-gated calcium, sodium, chloride and potassium channels, leading to toxic ion influx into cells. This causes oxidative stress, cellular dysfunction, cellular damage, and early cell death throughout the body.

b) Mitochondrial damage: Disruption of the body's cellular energy production centres, leading to fatigue and systemic health decline

c) Blood-brain barrier permeability: Breakdown of the protective barrier between blood and brain tissue, allowing toxins and inflammatory chemicals to affect sensitive neural tissue

d) Oxidative stress and inflammation: Generation of reactive oxygen and nitrogen species and damaging inflammatory cascades throughout the body. If unalleviated, this can lead to a range of serious chronic diseases.

e) Blood cell aggregation: Under dark field microscopy, red blood cells are seen to clump together (Rouleaux Formation), much-reducing oxygen delivery to tissues, and thereby potentially leading to tissue damage in sensitive areas such as the brain and kidneys.

f) DNA damage: Cumulative genetic damage over time, potentially contributing to cancer development

g) Neurotransmitter and endocrine disruption: Altered brain chemistry and hormone regulation, negatively affecting brain and systemic function

This understanding of underlying physiological mechanisms is critical because it addresses a central criticism often levelled against man-made microwave health research, namely that there is an absence of plausible biological pathways. Most of these apparent mechanisms operate at non-thermal levels, explaining why current safety standards (based solely on heating effects) are very likely inadequate and incomplete.

3. RF-EMFs as a "Possibly Carcinogenic to Humans" (2011), and Recent W.H.O.-Linked Scientific Review (2025)

In the author's opinion, a highly important international classification for the risk mitigation case is the 2011 IARC **Group 2B classification of radiofrequency electromagnetic fields** as "**possibly carcinogenic to humans**". IARC is the cancer-research arm of the W.H.O. The classification was reached by a 30-person international working group on the basis of the Interphone study (2010) [1] and the Hardell group's case-

[1] Interphone Study. Results update. 2008. *http://www.next-up.org/pdf/Interphone_IARC_Results_update.pdf*

control studies (1999–2010) [1], both of which reported elevated odds ratios for glioma in heavy mobile-phone users. Group 2B is the same category that IARC applies to lead, DDT, gasoline engine exhaust, and other agents whose human carcinogenicity is supported by limited epidemiological evidence and limited animal evidence. The classification has remained in force since 2011, and the April 2025 W.H.O.-backed review of animal cancer studies (see below paragraph) provides empirical grounds for IARC to consider upgrading the alert status - which several authoritative bodies including the ICBE-EMF have now formally requested.

In 2025, the World Health Organization partially commissioned 12 meta-analysis studies examining the relationship between radiofrequency electromagnetic fields (RF-EMFs) and health conditions. One of these studies, utilizing narrative analysis rather than purely statistical methods, found "moderate certainty evidence of an increased risk of some rare cancers" associated with RF-EMF exposure. While this represents only partial acknowledgment from an international health body, it marks a significant shift toward recognizing potential health risks that were previously dismissed. This development strengthens the argument that the Precautionary Principle and risk mitigation strategies should guide policy decisions regarding man-made microwave exposure, particularly for children and vulnerable populations.

4. Personal Case Study with Documented Medical Evidence

The author's own health journey provides a detailed, documented case study of apparent EHS development and semi-recovery. After 13 years of excellent health, the author developed severe, debilitating symptoms in 2018 while working in an environment with high Wi-Fi exposure. Extensive medical testing (N.Z. and U.S.A.) revealed:

a) Elevated biomarkers consistent with inflammation and oxidative stress
b) Cognitive, neurological and physical symptoms matching EHS presentation symptomatology
c) Temporal correlation between significant exposure to (man-made) microwaves and onset of symptoms. And, with increasing microwave exposure levels, commensurate increase in symptom severity.
d) Significant (gradual) improvement following EMF (microwave) reduction strategies
e) A recent accidental, heavy exposure (daily) to Wi-Fi microwaves over 3 weeks, with a gradual increase in severity of my EHS-like symptoms. Also, a gradual improvement in most symptoms with the removal of this influence.

While personal experience is anecdotal, nevertheless a detailed case study forms part of the evidence hierarchy. It also provides a relatable narrative that many readers may recognize in their own experiences, or those of patients. The documented medical testing adds objective credibility to the personal account.

5. Extensive Research Foundation: Thousands of Studies

The research draws upon thousands of peer-reviewed studies from multiple databases including PubMed (PubMed), Google Scholar (Google Scholar), GreenMedInfo (www.greenmedinfo.com) and ORSAA (www.orsaa.org), spanning more than two decades of investigation by researchers. These studies collectively demonstrate strong associations between man-made microwave exposure and a wide range of harmful health effects [2] that include:

a) Acute symptoms: Fatigue, headaches, dizziness, tinnitus, sleep disturbances, cognitive impairment, anxiety, depression

[1] IARC Monograph Vol 102 (2013); Hardell & Carlberg 2020 - Health risks from RF radiation including 5G should be assessed by experts with no conflicts of interest (Oncology Letters).
[2] See: 5032457

b) Chronic conditions: Neurodegenerative diseases, fertility issues, developmental disorders in children
c) Severe outcomes: Increased cancer risk (particularly brain tumours and certain rare cancers)

The volume and consistency of findings across prominent independent researchers provide substantial weight to the argument that man-made microwaves pose genuine health risks that warrant serious consideration and urgent action to mitigate all risks to human health.

4.4 Key recommended actions for consideration by relevant sectors

Based on the collective findings presented in this monograph, the following recommendations are made:

1. Medical and Professional Education

Immediate actions for Government and the Medical regulatory agency to consider:

Mandate comprehensive EMF health education for healthcare providers, including GPs, occupational health practitioners, and specialists in neurology, environmental medicine, and public health. Based on the author's experience, many medical professionals in New Zealand appear to lack awareness of EHS as a recognized condition with objective diagnostic criteria. Such insufficient awareness can potentially lead to misdiagnosis, or worse, possible dismissal of symptoms of affected individuals. Education could include:

a) Recognition of EHS symptoms and clear diagnostic criteria
b) Understanding of available biomarkers and testing methods
c) Knowledge of mitigation and treatment strategies
d) Awareness of vulnerable populations - such as children, pregnant women, and those with pre-existing conditions

Rationale: Early recognition and appropriate intervention can prevent symptom progression and improve outcomes for affected individuals.

2. Risk Mitigation Measures in Schools and Workplaces

Priority actions for Government and Employers to consider:

a) Provide wired Internet options in all schools, allowing Wi-Fi to be turned off when not truly needed
b) Position Wi-Fi routers away from areas where students and staff spend prolonged time
c) Limit cell tower proximity to schools, establishing specific distance guidelines - based on expert, independent, scientific advice
d) Conduct microwave exposure assessments in workplaces and schools
e) Create microwave-reduced zones or "safe havens" for sensitive individuals – in schools and the workplace

Rationale: Children's developing brains and bodies appear particularly vulnerable to man-made microwave exposure. Implementing simple, low-cost measures to mitigate risks in educational and workplace settings, protects the most vulnerable population without compromising educational and workplace technology needs.

3. Independent Research Funding and Regulatory Reform

Immediate Actions for Government to consider:

a) Fund independent, non-industry-influenced research on (man-made) microwave health effects, particularly long-term, low-level exposure studies

b) Address possible conflicts of interest in regulatory bodies (notably **ICHEF** in New Zealand), where industry representation appears to the writer to be disproportionately high. Also, ensure that the multi-disciplinary expertise within the advisory Committee is sufficiently advanced and comprehensive to meet its entrusted responsibilities.

c) Establish independent research programmes examining high MMM exposure environments and possible resulting health impacts - over the short and longer-term. This could be in schools at all educational levels, and at workplaces or residential housing within proximity of cell towers. Illustrative working figures pending such independent assessment: approximately 400 metres for the larger main-lobe footprint of conventional 4G macro-cell sites (see Section 13 for the antenna-pattern / down-tilt derivation), and approximately 100 metres for the smaller-cell sites that often accompany 5G C-band (n78, 3.5 GHz) deployment. These figures are deployment-geometry working values and not derived from any specific risk-assessment study; they should be revised as the recommended independent research produces evidence on which distances offer meaningful protection via the mitigation of risks across the specific N.Z. operator-band mix (Section 8.1).

d) Support longitudinal studies following children in high vs. low MMM exposure environments.

Rationale: Current regulatory frameworks and research funding may possibly involve industry influence that if real, could bias outcomes. Independent research is essential for establishing evidence-based safety standards that the public can have full confidence in, and that reliably protect public health.

4. Individual Protective Measures and Public Awareness

Public Education Initiatives for Governmental and relevant Health Agencies to consider:

a) Provide accessible information about simple, cost-effective protective measures (using speakerphone, keeping devices away from body, turning off Wi-Fi at night, using wired connections, etc.)
b) Make EMF meters available for public use or loan programmes
c) Create educational materials for workplaces and community organizations
d) Establish support networks for EHS-affected individuals

Rationale: Individual empowerment through knowledge and practical tools allows people to make informed decisions about their own exposure levels.

5. Recognition and Accommodation for Affected Individuals

Government Policy Changes to be considered:

a) After impartial and expert review of the evidence, if warranted, to have EHS properly recognized under disability and employment legislation, requiring reasonable accommodations in workplaces
b) Establish medical protocols for EHS diagnosis and management within the New Zealand health system
c) Create pathways for affected individuals to request workplace accommodations without discrimination
d) Support research into effective treatment and management strategies for EHS
e) As per relevant recommendations above, provide similar support to those who already suffer from exposure to man-made microwaves, but who do not yet met the level of symptom severity required for a diagnosis of EHS

Rationale: EHS has WHO recognition under the IEI-EMF terminology adopted in 2004[1], can be documented in New Zealand clinical practice via ICD-10-AM coding combinations, and is supported by clinical and biomarker evidence from the Belpomme group and ICBE-EMF. Affected individuals report significant quality-of-life impact, and proper recognition and accommodation are important for social justice and public health.

4.5 How to navigate this document

This monograph is comprehensive (140+ pages) and designed to serve multiple audiences. Readers may navigate Sections based on their interests, as each Section is more or less discrete and self-contained:

- Health practitioners: May wish to focus on **Sections 6** (diagnostic criteria); **10** (reputable, independent sources of additional information); **13** (potentially harm characteristics of man-made microwaves); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); **19** (clinical presentation); and **20** and **APPENDIX** (treatment strategies)

- Policy makers and regulators: May wish to review **Sections 10** (reputable, independent sources of additional information); **11** (EMFs of most concern); **12** (regulatory issues); **13** (potentially harmful characteristics of man-made microwaves); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); **21** (key findings); and **22** (policy recommendations)

- Individuals concerned about EMF exposure: **Sections 10** (reputable, independent sources of additional information); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); **17** and **APPENDIX** (protective measures); **18** (risk factors); and **20** (further mitigation strategies)

- Those seeking scientific evidence: May wish to examine **Sections 10** (reputable, independent sources of additional information); **12** (regulatory issues); **13** (potentially harmful characteristics of man-made microwaves); **14** (apparent pathways of harm to bodily structure and function); **15** (apparent neuropsychological and behavioural impacts); and **23** (extensive additional references)

Owing to the intention to make each Section as self-contained as possible, the reader will necessarily encounter a degree of repetition throughout the monograph.

Section 6 contains a lot of medical jargon, so if necessary the reader can avoid that Section, or note the following summary:

Leading researchers, Belpomme and Irigary have built a very extensive database of EHS sufferers, and thereby been able to demonstrate an objective and consistent range of key diagnostic symptoms and tests. They state that, "… we show that EHS is in fact **causally** associated with increased exposure to man-made EMF."

Earlier in 2025, the **W.H.O.** partially commissioned 12 (meta-analysis) studies on a possible causal relationship between RF-EMFs and a range of health conditions and diseases. One of these studies uniquely utilised a **narrative** analysis of data – rather than statistical – and determined there is "**moderate certainty** evidence of an increased risk of some rare cancers …"

[**bold** font emphasis added by the author]

The full document (below) provides detailed evidence, citations, and comprehensive discussion of each topic. This Executive Summary provides an overview for those who need key information quickly, or who want to understand the document's scope before diving deeper into specific Sections.

4.6 Note on formatting of this document

While the author has strived to maintain high-level scientific rigor throughout the monograph, the formatting of this document does not strictly follow formal guidelines for monographs. For example, there are varying font sizes, font colours, and many hyperlinks that connect information within Sections and between them. The purpose of this variation has been to enhance readability and to expedite accessing relevant information. Regarding quotes from referenced research and reviews, these have been indicated either by the usual quotation marks, or by indenting relevant paragraphs with the text italicised.

Kensington (Whangārei) Shopping Centre – 2 dominating large (macro-cell) mobile cell towers – photo by author

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5. About the Writer

I have a strong background in education, psychology and health. I graduated as an Educational Psychologist in the early 1990s and apart from several years working in Thailand (in refugee camps), I have worked in the field of psychology ever since.

Regarding my psychology work, it has been predominantly in the area of education, but with many years working with survivors of trauma and torture, several years working with survivors of sexual abuse, and several years with clients with chronic pain conditions. I have also worked in numerous medical centres with clients presenting with a full range of mental health conditions (at a "moderate" level).

As a result of a serious (life-threatening) health challenge about 20 years ago, I have undertaken thousands of hours of online training in Naturopathy and Functional Medicine, although I do **not** possess a formal qualification as such.

Then, after enjoying 13 years of excellent health, in 2018 I unexpectedly developed a range of mysterious and debilitating health symptoms. This has led to an ongoing journey into learning about the very likely damaging health effects of (man-made) microwave radiation.

I have always loved science, technology and the latest gadgets, with my first PC computer in 1988, and I was an early "brick" cellphone owner. I also had a small (sole operator) computer business for several years. So, I am in favour of the advancement of technology, as long as any such innovation has been thoroughly safety tested, prior to roll-out in the public domain.

Several years ago, owing to ongoing personal health challenges, I undertook an online training course in remediating effects of man-made EMFs – including microwaves. (See: Electrosmog Rx)

As per throughout this monograph, information presented is for informational purposes only, and any health decisions made by the reader need to be only after full and frank consultation with a qualified medical or health practitioner.

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6. Is EHS a Real Health Condition & what may be causing it? – An Introduction

6.1 An introduction to Electromagnetic Hypersensitivity as a health condition

In this monograph the author will be discussing the apparent health dangers of electromagnetic radiation (EMR), **focusing principally on microwave radiation** within this spectrum. [1] "Microwave sickness" - a term which has been in the public domain for many years - is formally known as "Electromagnetic Hypersensitivity" (EHS) and appears to arise from over-exposure to man-made microwaves in particular.

In much of the literature, for convenience, Electromagnetic Hypersensitivity is shortened to "Electrohypersensitivity". This shortened form can be taken to have the same meaning as the full title of this condition. The author prefers the full term, "Electromagnetic Hypersensitivity". This is because there is solid research showing that both electrical currents and the magnetic fields they create, can cause damage to human and animal structure and function. [2] Also, in order to avoid possible confusion over terminology, the reader needs to be aware that recently, a new - more understandable and less judgemental - term has been coined for EHS: "EMR Syndrome". [3] This was by a group of independent experts in this field. So, all these terms can be taken to refer to the same medical condition.

A tangible and perceptible health condition is expected by Western allopathic medicine to have consistent signs and symptoms that are able to distinguish it from wellbeing, and other health conditions or diseases. Professor Dominique Belpomme is a medical oncologist of Paris University, who leads the European Cancer and Environmental Research Institute in Belgium. He has been researching EHS for more than a decade, and he and his colleagues are recognised leaders in the areas of EHS prevention, diagnosis and treatment.

The following quotes are from published (open-access) journal papers by Prof Belpomme and Dr Irigaray. The quotes are lengthy and contain technical medical jargon. However, they deserve close attention, as they appear to establish clear biometric blood markers, specialised imaging scans and symptomatology, all vital - in Belpomme and Irigaray's opinion - to a valid EHS diagnosis. They have established these assessment measures via comparison with control groups that were free of symptoms of EHS.

> *"Since 2009, we built up a database which presently includes more than 2000 electrohypersensitivity (EHS) and/or multiple chemical sensitivity (MCS) self-reported cases … EHS and MCS* ***can be characterized clinically by a similar symptomatic picture,*** *and* ***biologically by low-grade inflammation and an autoimmune response involving autoantibodies against O-myelin****. Moreover,* ***80% of the patients with EHS present with one, two, or three detectable oxidative stress biomarkers in their peripheral blood****,* ***meaning that overall these patients present with a true objective somatic disorder****. Moreover, by using ultrasoniccerebral tomosphygmography and transcranial Doppler ultrasonography, we showed that* ***cases have a defect in the middle cerebral artery hemodynamics****, and we localized a tissue pulsometric index deficiency in the capsulo-thalamic area of the temporal lobes,* ***suggesting the involvement of the limbic system and the thalamus****. Altogether,* ***these data strongly suggest that EHS is a neurologic pathological disorder which can be diagnosed, treated, and prevented****. Because EHS is becoming a new*

[1] As already discussed above, man-made microwaves are emitted by a large range of devices and systems, including cell phone towers, mobile phones, Wi-Fi routers and devices, Bluetooth devices, smart devices, etc.

[2] See: Frontiers | Some thoughts on the possible health effects of electric and magnetic fields and exposure guidelines; and The Influence of Electromagnetic Field Pollution on Human Health: A Systematic Review | Siriraj Medical Journal

[3] Wireless Radiation Sickness Gets a New Name: 'EMR Syndrome' • Children's Health Defense

insidious worldwide plague involving millions of people, we ask the World Health Organization (WHO) to include EHS as a neurologic disorder in the international classification of diseases."

(*Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It.* Belpomme & Irigaray, March 2020. [1]

"In this overview we distinguish the etiology of EHS itself from the environmental causes that trigger pathophysiological changes and clinical symptoms after EHS has occurred. Contrary to present scientifically unfounded claims, ***we indubitably refute the hypothesis of a nocebo effect to explain the genesis of EHS and its presentation****. We as well* ***refute the erroneous concept that EHS could be reduced to a vague and unproven "functional impairment"****. To the contrary, we show here there are objective pathophysiological changes and health effects induced by electromagnetic field (EMF) exposure in EHS patients* ***and most of all in healthy subjects****, meaning that excessive non-thermal anthropogenic EMFs are strongly noxious for health. In this overview and medical assessment we focus on the effects of extremely low frequencies, wireless communications radiofrequencies and microwaves EMF. We discuss how to better define and characterize EHS. Taken into consideration the WHO proposed causality criteria, we show that* ***EHS is in fact causally associated*** *with increased exposure to man-made EMF, and in some cases to marketed environmental chemicals. We therefore appeal to all governments and international health institutions, particularly the WHO, to urgently consider the growing EHS-associated pandemic plague, and to acknowledge EHS as a mainly new real EMF causally-related pathology."* [2]

[**bold** and underlined emphasis added by the author]

Following up on the work by Belpomme and Irigaray (March 2020), in July 2021, an important "Scientific Consensus International Report" was published by a large group of established experts in this field. The paper was titled, "The Critical Importance of Molecular Biomarkers and Imaging in the Study of Electrohypersensitivity." [3] The paper affirmed the clinical relevance of the Belpomme and Irigaray biomarkers such as thiobarbituric acid, oxidised glutathione and NTT oxidative stress. It outlined additional biomarkers such as increased plasma glucose levels. In addition, it stated that most symptoms of EHS have a neurological foundation, and that imaging studies have demonstrated brain neurovascular dysfunction.

For further discussion and details of assessment biomarkers and symptoms, please refer to Section 19.

Unfortunately, my experience (and that of other EHS sufferers I have met) suggests that many NZ medical / health experts do not understand the multiple ways that RF-EMFs may affect a person's health and how these may be measured. In addition, many of the bio-measures and imaging scans identified by Belpomme and Irigaray [4] (and other researchers) are not available in NZ.

6.2 W.H.O. Establishes EHS as a classifiable Functional Disability

(International Classification of Diseases v.10, 1991)

As early as 1991, with the release of the ICD-10, the W.H.O. established EHS as a classifiable Functional Disability. In its 2005 advisory update, it noted that the symptoms are certainly real, and can vary widely in

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[1] Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It - PubMed)

[2] (*Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment.* Belpomme & Irigaray September 2022. PMID: 35537497 DOI: 10.1016/j.envres.2022.113374)

[3] https://pmc.ncbi.nlm.nih.gov/articles/PMC8304862/

[4] See: (*Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment.* Belpomme & Irigaray September 2022. PMID: 35537497 DOI: 10.1016/j.envres.2022.113374)

their severity. However, it believed (2025) that there was no scientific basis to link EHS symptoms to EMF exposure. [1]

At the same time, the W.H.O., indicated in the 2005 advisory that, "There are also some indications that these symptoms may be due to pre-existing psychiatric conditions as well as stress reactions as a result of worrying about EMF health effects, rather than the EMF exposure itself." [ibid] That is, if you believe you are badly affected by EMFs, you likely will be: the Nocebo Effect. Wikipedia - which many in the populace commonly access [2] - seems to take an even more dismissive approach in its article on EHS:

> ***Electromagnetic hypersensitivity (EHS)*** *is a claimed sensitivity to electromagnetic fields, to which adverse symptoms are attributed. EHS has no scientific basis and is not a recognized medical diagnosis, although it is generally accepted that the experience of EHS symptoms is of psychosomatic origin.* [3]

Our N.Z. Public Health site, Te Whatu Ora, identifies the ICD-10-AM as one of the classification systems available to be used in New Zealand by medical practitioners to code diagnoses. [4] Under this system, an EHS-attributed presentation is coded with a context code - W90 ("injury/illness resulting from exposure to radio-frequency radiation") - together with the relevant effect codes - G43 (migraine), R42 (dizziness and giddiness), H93.1 (tinnitus), and others as clinically appropriate.

The W.H.O.'s position on EHS is likely best understood through the structured term it adopted at the 2004 Prague workshop on EMFs Hypersensitivity: Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF). [5]

Each part of that term encodes a deliberate W.H.O. position:

- Intolerance: the symptoms are real, can be disabling, and the W.H.O. recognises the syndrome as such.
- Idiopathic: the cause is officially unestablished.
- Environmental: the syndrome is triggered by something in the environment.
- Attributed to Electromagnetic Fields: the patient attributes it to EMFs, so the W.H.O. acknowledges the attribution without formally adopting it.

The W.H.O.'s position is therefore properly described as "recognition of the syndrome with the causal question kept formally open" rather than the simpler claim sometimes made that it "recognised EHS as an RF-caused disease." Fact Sheet 296 ("Electromagnetic fields and public health: Electromagnetic hypersensitivity," December 2005) sets out this position. [ibid] Separately, ICD-10 (1991) and ICD-11 (2022) provide coding combinations (W90 + relevant effect codes) that allow clinicians to document IEI-EMF / EHS-attributed presentations.

In the writer's opinion – and that of many leading researches in the field - the W.H.O.'s history in this specific area has often appeared industry-influenced [6], and the divergence between its recognition of the

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[1] See: https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/non-ionizing/hypersensitivity
[2] While there are no publicly available statistics on use of Wikipedia by Country, based on Wikipedia's published global-usage statistics, ChatGPT estimates that around 3 million New Zealanders access Wikipedia on a monthly basis.
[3] See: https://en.wikipedia.org/wiki/Electromagnetic_hypersensitivity
[4] See: https://www.healthnz.govt.nz/about-us/data-management-and-standards/data-classification-and-clinical-coding?
[5] World Health Organization (2005), Electromagnetic fields and public health: Electromagnetic hypersensitivity, Fact Sheet 296, https://www.who.int/teams/environment-climate-change-and-health/radiation-and-health/non-ionizing/hypersensitivity
[6] See: PSGR NZ recent Substack article - The EMF Problem: RF Radiation Governance Without Democratic Risk Assessment, https://psgrnz.substack.com/p/the-emf-problem-rf-radiation-governance

syndrome (IEI-EMF) and its reluctance to endorse the causation, runs through much of the regulatory landscape that N.Z. clinicians and patients now navigate. [1]

In their September 2022 paper [2], Belpomme and Irigaray summarised positive milestones in the recognition of Multiple Chemical Sensitivity (MCS) and EHS in their Table 1 below:

D. Belpomme and P. Irigaray

Table 1
The different historical steps to identify and qualify EHS and MCS, including WHO official statements, statements from WHO-sponsored meetings, and other scientific consensus meetings and reports.

1962	First identification and description of MCS	Randolph (1962)
1991	First identification and description of EHS	Rea et al. (1991)
1996	Berlin WHO-sponsored workshop: MCS classified as idiopathic environmental intolerance (IEI)	Report of the Workshop on Multiple Chemical Sensitivities (1996)
1997	Stockholm possible health implication of EMF exposure: a report prepared by a European group of experts for the European Commission	Bergqvist and Vogel (1997)
1999	Atlanta (US), definition of MCS:1999 consensus meeting	Bartha et al. (1999)
2004	Prague WHO sponsored workshop: identification of idiopathic environmental intolerance attributed to EMF	Mild et al. (2006)
2005	WHO fact sheet n° 292 aiming at defining EHS	WHO (2005)
2014	WHO fact sheet n° 193: EMF and Public Health; mobile phone	WHO (2014)
2015	Brussels: Fourth Paris Appeal Colloquium; a focus on EMF and EHS	Carpenter and Belpomme (2015)
2021	The critical Importance of molecular biomarkers and imaging in the study of EHS. A scientific consensus international report	Belpomme et al. (2021)

6.3 Radio-Frequency EMFs as possibly carcinogenic to humans

In the author's opinion, an important international classification for the precautionary / risk mitigation case, and the urgent need for practical measures that mitigate health risks from MMMs, is the 2011 IARC Group 2B classification of radiofrequency electromagnetic fields as "**possibly carcinogenic to humans**".[3] IARC is the cancer-research arm of the W.H.O. The classification was reached by a 30-person international working group on the basis of the Interphone study (2010) [4] and the Hardell group's case-control studies

[1] See multiple statements from ICBE-EMF and from scientists detailed in Section 10; and. 'High Certainty' Cellphone Radiation Linked to Cancer in Animals, WHO Study Finds • Children's Health Defense)

[2] See: *Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment.* Belpomme & Irigaray September 2022. PMID: 35537497 DOI: 10.1016/j.envres.2022.113374)

[3] International Agency for Research on Cancer. 2011. *IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans [press release]*. Lyon, France: International Agency for Research on Cancer. Available from: http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

[4] Interphone Study. Results update. 2008. *http://www.next-up.org/pdf/Interphone_IARC_Results_update.pdf*

(1999–2010) [1], both of which reported elevated odds ratios for glioma in heavy mobile-phone users. Group 2B is the same category that IARC applies to lead, DDT, gasoline engine exhaust, and other agents whose human carcinogenicity is supported by limited epidemiological evidence and limited animal evidence.

The classification has remained in force since 2011, and the April 2025 W.H.O.-backed review of animal cancer studies (Section 6.4 below) provides empirical grounds for IARC to consider an upgrade - which several authoritative bodies including the ICBE-EMF have now formally requested.

6.4 April 2025 W.H.O. shift on causal health dangers of man-made microwaves

In fairly recent significant news, a W.H.O.-backed review published in April 2025, revealed the following major step forward (by the *W.H.O.*) regarding health dangers of cellphone microwaves. The following extensive quotes are from a summary provided by Children's Health Defense (CHD), a non-profit NGO in the USA. [2] The reader should note that this author does not necessarily share all the views elaborated by CHD below, including the statements about ICNIRP and the W.H.O.

> *The WHO-backed review, published online April 25 in Environmental International, determined radiofrequency-electromagnetic fields (RF-EMF) emitted by cellphones and other wireless devices were linked to an increased risk of malignant gliomas in the brain and malignant schwannomas, or nerve tumors, in the heart in studies on animals. Both tumor types were previously found in human studies, ICBE-EMF noted in a press release about the WHO study.*
>
> *The WHO's review also concluded there is "moderate certainty" evidence that cellphone radiation exposure causes an increased risk of rare liver and adrenal gland tumors.*
>
> *Ron Melnick, Ph.D, chair of the International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF) and a former senior toxicologist in the National Toxicology Programme (NTP), said in a statement:*
>
>> *"The evidence is now clear - cell phone radiation can cause cancer in animals in concordance with the tumor types identified in human studies of mobile phone users. As animal studies are essential for predicting cancer risk in humans, governments should develop science-based safety standards to protect human health."*
>
> *The WHO review prompted leading scientists with the ICBE-EMF on April 27 to call for "immediate policy action" to protect people from possible harm from wireless radiation exposure. "Given this high level of certainty," ICBE-EMF said in a press release, "government policymakers worldwide should immediately move to revise their RF radiation exposure limits to protect public health and the environment."*
>
> *ICBE-EMF is a consortium of scientists, doctors and related professionals" who study RF-EMF and make recommendations for RF-EMF exposure guidelines "based on the best peer-reviewed scientific research publications.*
>
> *The group warned that delaying such revisions "could have serious consequences amid the global surge in the use of wireless communication devices."*

[1] Hardell & Carlberg 2020 Stockholm 5G measurement campaign - Aspects on the ICNIRP 2020 Guidelines on Radiofrequency Radiation (World Academy of Sciences Journal).

[2] 'High Certainty' Cellphone Radiation Linked to Cancer in Animals, WHO Study Finds • Children's Health Defense)

WHO researchers analysed 52 studies:

The review, partially funded by the WHO, sought to systematically evaluate the effect of wireless radiation exposure on cancer in experimental animals.

For the review, the authors systematically analyzed 52 studies. They concluded there is "moderate certainty" evidence of an increased risk of some rare tumors, such as pheochromocytomas in the adrenal glands and hepatoblastomas in the liver.

They found "no or minimal" evidence of increased cancer risk in the kidney and mammary gland.

They also found "no or minimal" evidence of increased cancer risk in some body systems, including the gastrointestinal/digestive, endocrine, musculoskeletal, urinary, reproductive and auditory systems.

In their report, the authors of the WHO study acknowledged that animal studies are commonly used when assessing whether something might be carcinogenic to people. However, it's "complex" to extrapolate human cancer risk from animal studies when the thing being studied is wireless radiation, they said.

One of the 52 studies reviewed by the WHO researchers was the NTP's $30 million study on cellphone radiation that found "clear evidence" of malignant heart tumors in male rats, "some evidence" of malignant brain tumors in male rats, and "some evidence" of benign, malignant and complex combined adrenal gland tumors in male rats.

The NTP is an "interagency programme composed of, and supported by" the U.S. Food and Drug Administration, the Centers for Disease Control and Prevention, and the National Institutes of Health (NIH), according to the agency's website.

As The Defender reported, the NIH refuses to reveal nearly 2,500 pages of records related to the NTP's decision to shut down its research on how wireless radiation affects human health.

The WHO report is part of a WHO-commissioned series of scientific reviews of the possible health risks of wireless radiation. Prior to this, most of the other studies in the series have found no increased health risk from wireless radiation.

For instance, a review on the plausible link between wireless radiation and brain cancer in humans claimed it found no link. ICBE-EMR posted a rebuttal and called for its retraction.

Critics, including ICBE-EMF member Joel Moskowitz, Ph.D., and Mona Nilsson, have said this is likely because some of the studies' authors are biased against finding health risks linked to wireless radiation exposure.

Nilsson, co-founder and director of the Swedish Radiation Protection Foundation, said she found it surprising that the latest WHO review recognized wireless radiation's harmful effects.

"On the contrary, the WHO has a history of downplaying them and promoting industry-friendly opinions," Nilsson said.

In a March 7 post, on his Electromagnetic Radiation Safety website, Moskowitz noted that all of the WHO's scientific review teams have one or more members from the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Moskowitz directs the Center for Family and Community Health at the School of Public Health, University of California, Berkeley.

ICNIRP, which Moskowitz called a "cartel," [and stated that it is] a German non-profit that issues RF radiation exposure limits produced by its own members, their former students and close colleagues.

The wireless industry favors the ICNIRP limits because they're designed to protect people only from radiation levels high enough to generate heat - meaning the limits turn a blind eye to the possible health effects from radiation levels lower than those needed to heat human tissue.

… Miriam Eckenfels, director of Children's Health Defense's (CHD) Electromagnetic Radiation (EMR) & Wireless Programme, stated, "When even the WHO panel designed to whitewash the issue says there is a problem, you know we're in trouble."

Eckenfels added:

"It's ridiculous that, despite these clear health risks, residents cannot choose where cell towers are placed based on concerns that the radiation from a cell tower near their kids' school might impact their kids' health.

[**bold** emphasis added by the author]

Although the above study outcome is a milestone in W.H.O. admission of "moderate certainty" that cellphone radiation exposure causes an increased risk of some cancers, it should be appreciated that the W.H.O. actually commissioned 12 systematic reviews in total, on possible harms caused by microwaves. These studies looked at a wide range of health issues, including: cancer, EHS, cognitive impairment, birth outcomes, male fertility and oxidative stress. All studies but one relied on a statistical meta-analysis of published study results, with only one being based on examining written outcomes of each individual study, and aggregating outcomes based on non-statistical results: a narrative review. It was this latter study that produced the above significant outcome regarding microwaves and cancers.

In seeking to understand why the 11 other studies failed to find any likely causal link between MMMs and a range of health conditions, a group of highly regarded, multidisciplinary scientists, scrutinised methodologies of these studies. They were all members of the International Commission on Biological Effects of Electromagnetic Fields: (ICBE-EMF) It published its detailed findings in October 2025 in the Environmental Health Journal.[1]

Essentially, what they found was that these 11 studies had aggregated data from across a small number of disparate studies, and then wrongly statistically analysed the aggregated (numerical) data results. As the above authors pointed out, where the number of studies is small, and methodologies are inconsistent – including measuring non-identical dependent variables in each study - it is never appropriate to conduct statistical meta-analysis on such aggregated data. (See the academically recognised strict guidelines for conducting meta-analyses at: Cochrane Collaboration)

Professor Frank of ICBE-EMF suggested during the October press conference that the review teams did not have the necessary mixed expertise including epidemiological and bio-statistical experts, as well as substantive experts in the specific scientific field being reviewed. Problems created by deficits in the make-up of the teams should have been caught in the peer-review process.[2]

These same ICBE-EMF scientists also pointed out in their press conference, that in many of these 11 studies, a number of key (published) studies that had established likely causal links, had not been included in the systematic reviews. They also noted a lack of a framework for analysing complex processes such as those involved in cognitive functions.

[1] The WHO-commissioned systematic reviews on health effects of radiofrequency radiation provide no assurance of safety | Environmental Health | Full Text

[2] See: in video format; and their press release summarised

6.5 Very recent epidemiological study on widespread prevalence of EHS

Very recently (Vol. 8 June 26) there has been the publication (Science Direct) of a compelling epidemiological study on EHS, aka "wireless sensitivity. [1] This study utilised nationally representative, population-based data, from Australia, Canada and the U.S.A. There were over 1,000 randomly selected individuals from each Country, with data collected via online surveys. The study, with data averaged across three Countries, showed:

> *12.6% reported wireless sensitivity; 10.0% reported medically diagnosed electromagnetic hypersensitivity (EHS) and 14.0% reported either or both. Among all gender and age categories, males ages 25 to 34 reported the highest prevalence proportionally. In addition, among those with wireless sensitivity/EHS, 80.6% also reported chemical sensitivity/MCS, 73.2% reported asthma/ARCs, 53.8% reported autism/ASDs, and 84.8% reported fragrance sensitivity. Given these results, across the three countries, over 26 million adults would experience health problems from wireless radiation. Results underscore the need for further research on ways to prevent and reduce exposures and associated adverse effects.*

For unexplained reasons, Australians surveyed reported the highest incidence rate, with 1 in 6 of respondents affirming symptoms congruent with EHS, and attributed to wireless microwave exposure. The proportion in the U.S.A was 1 in 8 adults. [2]

The authors state that the link between wireless sensitivity, EHS and other environmental conditions suggests that similar effects might be occurring in the body. They added that previous research has also found common factors, such as inflammation, underlying sensitivity-related conditions.

Even though the prevalence of wireless sensitivity in this study is higher than in many previous studies in other countries, the authors believe that it could, nevertheless, **underestimate** the actual prevalence of wireless sensitivity in the population. The authors stated, "People experiencing symptoms of wireless sensitivity may not recognize wireless radiation as a possible cause." The authors additionally stated, "Medical professionals may not consider or diagnose wireless sensitivity/EHS. Further, the online format of the survey may preclude participation by individuals with wireless sensitivity/EHS." **ibid**

Summary of this Section

The Belpomme group's clinical and biomarker work (paragraphs above) is essentially a sustained challenge to the idiopathic (no-known-cause) part of the W.H.O.'s framing. The Belpomme group's position is that low-grade inflammation, autoantibodies against O-myelin, oxidative-stress biomarkers in 80% of patients, and cerebrovascular abnormalities on imaging do establish a measurable somatic basis for the syndrome and do support a causal connection to EMF exposure. The 2025 W.H.O.-backed review of animal cancer studies (Section 6.4) does not directly resolve the IEI-EMF causation question, but it represents partial movement in the W.H.O.'s broader RF (radio frequency band that microwaves lie within) position.

[1] Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect
[2] Wireless sensitivity and co-morbidities: A prevalence study in Australia, Canada, and the United States - ScienceDirect

Whangārei Central City with large (macro-cell) 4G-5G mobile tower dominating the landscape – photo by author

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7. Why is it Vital to Learn about Electromagnetic Hypersensitivity (EHS)?

1. Many people still believe that because we are not being told about health damage seemingly caused by man-made microwaves (MMMs), this damage may not exist. Such people (and possibly their doctors) will have no idea that chronic microwave exposure may be a key cause of at least some of their health concerns and issues.

2. Many people think that because our 5 senses can't detect MMMs, they are unlikely to be harming us. So again, such people will have little idea that chronic microwave exposure may be an important factor in their health concerns and issues.

3. Learning about EHS is vital, because apparent damaging effects of MMMs are likely to affect large numbers of people – with sufficiently intense, pervasive and chronic exposure. (See **Section 14** and **Section 15** below.) It remains unclear whether an overlapping and growing environmental toxicological burden expressed as Multiple Chemical Sensitivity (MCS), facilitates EHS or whether EHS aggravates subclinical consequences of MCS, or that they remain distinct and separate physiological challenges.

4. The information regarding the potential health risks of MMMs evident in the wider scientific literature does not appear to be currently recognised, formally rebutted or properly reflected by concerned policy makers in Government and the interested Telecommunication entities. This developing picture in NZ does not seem to represent a sufficiently full and balanced view of research outcomes over the last 20 years or more.

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8. Introduction to EMF Waves – including microwaves

Electric fields exist whenever charge is present and are measured in volts per metre (V/m). Magnetic fields arise from current flow. Their flux densities are measured in microtesla (μT) or millitesla (mT). At radio and microwave frequencies, electric and magnetic fields are considered together as the two components of an electromagnetic wave. Power density, measured in watts per square metre (W/m^2), describes the intensity of these fields, and this is closely associated with the heating intensity of the EMF wave. [1]

EMFs occur in nature, and are an essential part of the physical world and of life itself.

Electric and magnetic fields also occur naturally within the human body in association with nerve and muscle activity. We moreover experience the natural magnetic field of the Earth (to which a magnetic compass responds) and natural electric fields in the atmosphere. Human beings are very sensitive to these natural levels of EMFs which help to regulate and maintain the health of the body and brain. [2]

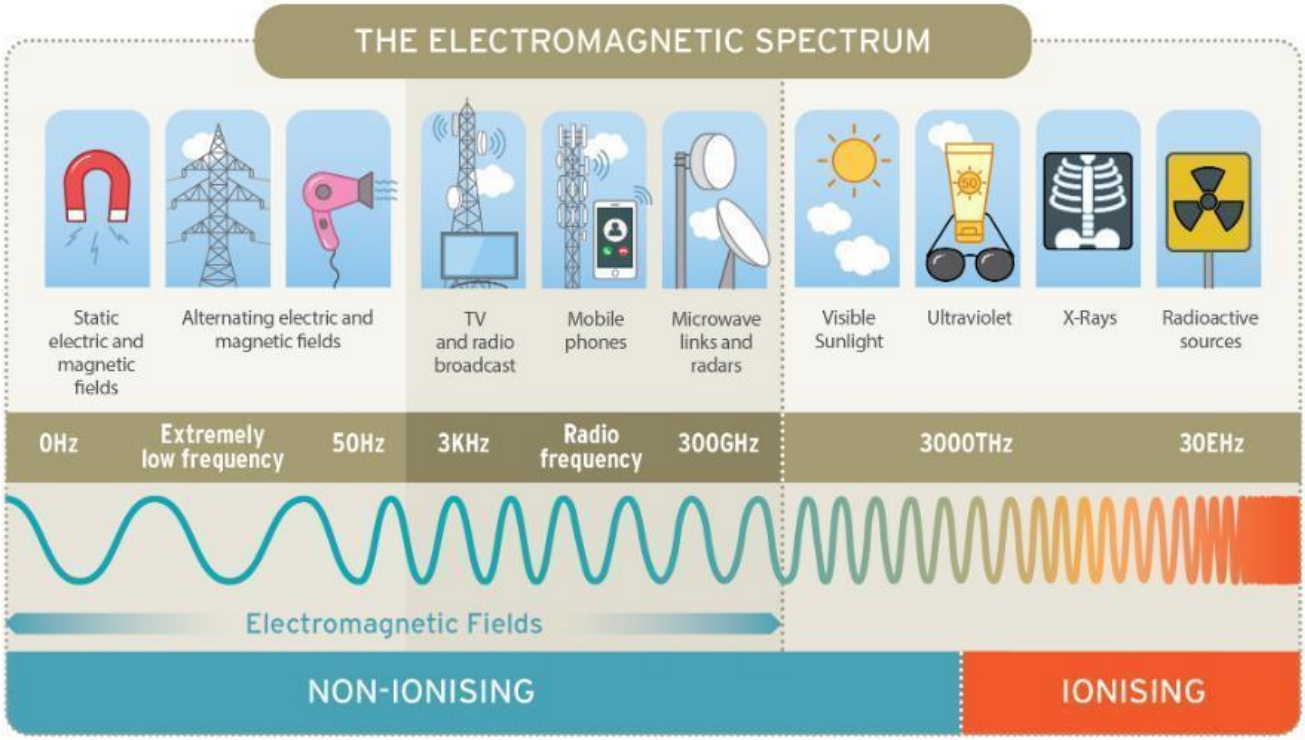
EMFs are produced by the movement of charged fundamental particles of matter (principally electrons and protons). This movement can occur through wires, or through the air or water. So besides occurring in nature, EMFs will be produced by man-made devices, such as: power lines, home and business appliances, electrical wiring in buildings, cell phone towers, cell phones, smart metres, and Wi-Fi routers.

The EMF spectrum embraces a vast frequency range, with radio waves (RFs) being one major segment of the full spectrum of EMF waves. (See diagram below.) This RF segment is often abbreviated to RF-EMFs. Microwaves comprise part of the RF frequency range. So cell phone towers, mobile phones, GPS and Wi-Fi, all operate using microwaves – similar in frequency to your microwave oven. The wavelength of microwaves is between 1 millimetre and 1 metre and with frequencies between 300 MHz (0.3 GHz) and 300 GHz. The higher the frequency of a wave, the shorter the wave length, and vice versa. [3]

[1] See: Radiation: Electromagnetic fields

[2] See: What are electric and magnetic fields? | EMFs; *Resonance – Beings of Frequency – Movie.wmv* in Resonance - Beings of Frequency - Movie 2016 - OneDrive

[3] See: Cyberphysics: Microwave Radiation



The Electromagnetic Spectrum (See: https://www.epa.ie/environment-and-you/radiation/emf/emf-monitoring-programme/)

A note on terminology. This monograph uses "man-made microwaves" (MMMs) throughout, as a label for the physics-band electromagnetic radiation between approximately 300 MHz and 300 GHz that is now widely produced by wireless infrastructure and consumer devices. The term "microwave" in this physics-band sense is broader than its everyday association with the kitchen microwave oven - oven exposures are produced at a single frequency near 2.45 GHz at power densities many orders of magnitude higher than ambient wireless exposures, with a quite different exposure geometry. The shared name reflects shared physics rather than equivalent biological exposure: the discussion of mechanism and effect throughout this document concerns the broader physics-band, not the kitchen-oven case.

8.1 What '5G' actually is in New Zealand

Several arguments later in this monograph distinguish 5G from earlier-generation cellular technology. Because '5G' covers a wide range of bands and a 'fourth-generation' (4G) anchor often runs in parallel, it is worth being explicit about which 5G is being discussed.

New Zealand's three mobile-network operators run their 5G networks across the following bands as of 2026:

1. Spark - 5G bands: n5 (850 MHz), n1 (2100 MHz), n40 (2300 MHz), n78 (3500 MHz); 4G bands: B28 (700 MHz), B3 (1800 MHz), B1 (2100 MHz), B40 (2300 MHz), B7 (2600 MHz).
2. One NZ - 5G bands: n8 (900 MHz), n7 (2600 MHz), n78 (3500 MHz); 4G bands: B28 (700 MHz), B8 (900 MHz), B3 (1800 MHz), B1 (2100 MHz), B7 (2600 MHz).
3. 2degrees - 5G bands: n78 (3500 MHz); 4G bands: B28 (700 MHz), B8 (900 MHz), B3 (1800 MHz), B1 (2100 MHz).

All three carriers share the n78 C-band (3500 MHz) as their high-capacity 5G layer. Spark and One NZ also operate low-band 5G (n5 850 MHz and n8 900 MHz respectively) using dynamic spectrum sharing

alongside their 4G traffic on conventional sector antennas. The 700 MHz band (B28) is heavily used in N.Z. but as 4G LTE only - it is not deployed for 5G. The millimetre-wave bands (24 GHz and above) often associated with 5G in international advocacy material are not deployed in N.Z. as of 2026 and are unlikely to be in the foreseeable future given population density.

N.Z. deployments have until recently been predominantly 'Non-Standalone' (NSA), meaning the 5G NR radio carries data while every connection runs over a 4G LTE 'anchor' on another band - so a phone reporting '5G' on its display is simultaneously receiving signal from a 4G band on the same site. Spark began commercial Standalone (SA) 5G rollout in 2024 with Ericsson and Red Hat (NZ$40–60 M commitment), and is progressively migrating its network alongside the 3G shutdown that completed in March 2026. One NZ and 2Degrees remain primarily NSA as of this monograph's date. So 'a 5G connection' on different operators in N.Z. presently means somewhat different exposure profiles, depending on band, deployment mode, and traffic conditions. These band-level differences matter because the exposure profile around an n78 C-band site (3.5 GHz, active phased-array antennas) differs in shape from that around a low-band n5 or n8 site (850–900 MHz, conventional sector antennas with dynamic spectrum sharing alongside 4G), and from an NSA connection where a 4G anchor is also active on a different band on the same site. Section 13 (Why MMMs are damaging) returns to these distinctions in detail, including how penetration depth, modulation patterns, and beam geometry vary across bands.

Three mobile cell towers dominating Central Kamo (Whangārei) with nearest tower only about 30 metres from the Bush Rd Medical Centre and about 90 metres from Kamo Primary School – photo by author

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9. Cause for Confusion regarding Health Risks of Radio Frequency Electromagnetic Fields (RF-EMFs) – including man-made microwaves

Based on the author's experiences, a 15-minute Google search will find little documentary evidence regarding health damage potentially caused by RF-EMF radiation – including microwave radiation. Given that reputable websites such as www.orsaa.org hold over 5,000 published scientific papers on the subject, this apparent (Google) search engine selection bias seems self-evident.

More successfully, a search on the official U.S. medical curation site (for published research), PubMed (health effects caused by microwaves - Search Results - PubMed), turned up 265 results. However, many of these papers were clearly irrelevant. Google Scholar provided improved search success for the writer, as long as search descriptors were scientifically precise – which was not always easy to achieve.

So, given the very high number of published papers on this subject (www.orsaa.org etc.), it is concerning that those interested in pursuing this subject seem to need to go to significant effort to access relevant papers.

There are clear requirements for establishing a **causal** relationship between RF-EMF exposure and subsequent health damage, with one key requirement being fulfilment of the established Criteria of Causality. [1] Some of the challenges in this regard may be summed up as follows:

- Difficulties measuring exact amounts of exposure in humans
- Difficulties determining which frequencies and durations of exposure are more harmful – with some frequencies apparently almost benign to health, and many appearing to be significantly damaging
- Difficulties controlling for many environmental factors that may affect the outcome measure(s)
- Difficulties controlling for inter-subject variability in response to the same exposure dosage
- Difficulties knowing what outcome measures will be appropriate enough and accurate enough to register real effects on health
- Exposure effects are often gradual and accumulative, with a long prodromal period of "insignificant" or no symptoms
- Difficulties gaining ethical approval to experiment on human subjects, given that there is already significant concern that RF-EMFS could be damaging to health. Owing to these concerns, studies with rigorous methodology are usually animal studies – such as on rats. Human studies therefore, are usually prospective, cross-sectional, or retrospective, and can't have the same level of rigour as long-term RCT (blind or double-blind) studies on animals.
- Although more rigorous animal study outcomes - such as in rats – are often applicable to humans, there is not a one-to-one correspondence between animal and human biological structure and function. Also, dose equivalence ("dosimetry") is not straightforward to determine.

In addition to the above limitations, to establish a **causal** relationship between RF-EMF exposure and subsequent health damage, a key requirement is to demonstrate plausible pathways/processes of damage. Unfortunately, these are not simple or well-known in their function, and to identify them and describe them usually requires an advanced Degree in biophysics AND biochemistry – particularly related to human structure and function. (Or, at the least, having advanced knowledge in both areas, acquired via years of study and investigation.)

[1] See: https://www.acsh.org/news/2017/10/31/acsh-explains-hills-criteria-determining-causality-correlation-12013

Such an advanced level of knowledge is seemingly quite rare, owing to the extensive time and money required to complete studies, and the current academic and economic Zeitgeist that funnels scientists down increasingly narrowed subfields of expertise.

Fortunately, there are (in the writer's opinion) some sufficiently qualified scientists presenting with the requisite breadth and depth of knowledge, who have been raising compelling concerns for decades. This includes the following experts:

- Prof Martin Pall, Professor Emeritus of biochemistry and basic medical sciences at Washington State University, USA. He specialises in Chronic Fatigue Syndrome, Multiple Chemical Sensitivity and the effects of low-intensity microwave EMFs
- Prof Paul Heroux of McGill University, Canada. He has a PhD in Physics and is Professor of Toxicology and Health Effects of Electromagnetism at the Faculty of Medicine.
- Prof Henry Lai of University of Washington (editor-in-chief of Electromagnetic Biology and Medicine)
- Dr (Prof) Dominque Belpomme, medical oncologist of Paris University (leads the European Cancer and Environmental Research Institute in Belgium – doing ongoing research on EHS)
- Dr Dimitris Panagopoulos of the Choremeion Research Lab, Medical School, University of Athens, Greece
- Dr Magda Havas, Associate Professor of Environmental & Resource Studies at Trent University, Canada (She has served as an expert witness to the Canadian and US Governments on the health effects associated with EMF exposure.)
- Dr Devra Davis, a leading cancer epidemiologist and toxicologist, and founder and president of the Environmental Health Trust
- Dr Julie McCredden, PhD in Cognitive Science. (Over the last decade, she has been investigating the effects of EMFs on humans, particularly cognitive and emotional processes.) She is President of the Oceania Radiofrequency Scientific Advisory Association – ORSAA - Australia.
- Mr Victor Leach, radiation health physicist and atmospheric scientist for more than 40 years. Founding member of ORSAA. Former University Radiation Advisor at Queensland University of Technology and the University of Queensland, former member of the Radiation Laboratory, and QLD and NT State Health Departments.
- Dr Dimitri Panagopoulos, biophysicist. Panagopoulos works at the Choremeion Research Laboratory, 1st Department of Paediatrics, Medical School, National and the Kapodistrian University of Athens, Athens, Greece, Electromagnetic Field-Biophysics Research Laboratory, Athens, Greece

Prof. Martin L Pall, Washington State University

Prof. Dominque Belpomme, Paris University

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10. Sources of Information on Likely Dangers of RF-EMFs – including man-made microwaves

1. Articles, papers or talks given by the above scientists and medical experts – such as on PubMed (PubMed) or YouTube. For example, see the excellent ORSAA paper titled, *"Wireless technology is an environmental stressor requiring new understanding and approaches in health care".* This detailed paper is specifically designed to bring health professionals up to speed regarding known health impacts of this technology. [1]

2. The International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF). This was founded as a result of the International EMF Scientist Appeal (https://www.emfscientist.org/), signed by many thousands of scientists, medical practitioners (etc.). ICBE-EMF have collectively published over 2,000 papers on EMF, biology and health. The Commission's primary purpose is to make international recommendations based on the best peer-reviewed scientific publications.

3. The Australasian non-profit Oceanic Radiofrequency Scientific Advisory Association (ORSAA), already referred to in "1" above. (See their Website www.orsaa.org.) This Website has many thousands of published scientific papers (on dangers of RF-EMFs) that are helpfully categorised into:

   - DNA and cell damage in the brain, blood, body organs, immune and reproductive systems
   - Increased production of free radicals leading to a state of oxidative stress, and resulting in accumulated damage throughout the body
   - Neurodegeneration and blood-brain barrier breaches
   - Changes to neurotransmitter levels and signalling pathways in the brain
   - Damage to sperm and ovaries
   - Endocrine system effects
   - Damage to cellular systems and components such as mitochondria, mast cells and alterations to cellular signalling systems

   ORSAA endeavours to curate only reasonable quality, peer-reviewed studies and has the largest database of its kind in the world. (The database is referred to as the ODEB database.) ODEB allows for searches using multiple filters, including Exposure, Study Categories, Effects Categories and Study Statistics.

   ORSAA's ethos is to provide an independent perspective on the relevant science and facilitate evidence-based decision making by various stake-holders of modern society including clinicians, educators, safety officers and policy makers on issues regarding exposure to EMR.

[1] See: Frontiers | Wireless technology is an environmental stressor requiring new understanding and approaches in health care; and my OneDrive folder, Papers on EHS & Effects of RF-EMFs

Article | End Points | Exposure | Study Categories | **Effects Categories** | Study Statistics

Auditory Dysfunction / Hearing loss / Tinnitus	N	Apoptosis (Programmed Cell Death) / Cell Death	Y	Brain Tumours	N
Blood Brain Barrier Permeability Changes	N	Breast Cancer	N	Cellular Stress	N
Brain Development / Neuro Degeneration	N	Biochemical Changes	Y	EEG changes / Brain Waves	N
Neuro Behavioural Effect / Cognitive Effects	N	Cell Irregularities/ Damage/ Morphological Changes	Y	Mitochondrial Effects	N
Calcium Influx / Efflux	N	Fatigue	N	Altered Enzyme Activity/ Protein Levels / Protein Damage	N
Circadian Rhythm Changes	N	Altered Gene Expression	N	Headaches/Migraines	N
DNA Damage / Carcinogenic / Genotoxic	N	Altered Glucose Level / Glucose Metabolism	N	Inflammation	N
Endocrine / Sex Hormone Level Effects	Y	Cardiovascular Effects	N	Hepatic Effects (Liver)	N
Miscarriage /Spontaneous Abortion/ Foetus Resorption	N	Immune System Effects	N	Impaired / Reduced Healing/ Bone Density Changes	N
Memory Impairment	N	Oxidative Stress / ROS/ Free Radicals	N	Speech Impairment	N
Sperm /Testicular Effects	Y	Sleep Effects	N	Haematological Effects	N
Tumour Promotion	N	Neurotransmitter Effects	N	Synergistic/Combinative Effects	N
Thyroid Effects	N	Visual Disturbances/ Ocular Effects	N	Autism / ADHD / Hyper-Activity	N
Leukemia	N	Parotid Gland Malignancy	N	Neoplasis/ Hyperplasia (Abnormal Tissue Growth)	N
Depression	N	Induced Adaptive Response	N	Dizziness / Vertigo/ Vestibular Effects	N

51 Other Sub-Types Effects | Find Summary Totals

Research_Review_V4 (a037613) ORSAA database ODEB – Effects Categories & other search dimensions

ORSAA also publishes scientific articles on the subject. (See: Research Papers Part 1, and Research Papers Part 2)

For example, see the Table below from the December 2022 ORSAA-published paper. It reports on research studies with microwave wave form clearly described, where a high percentage of negative effects from exposure was found.

TABLE 1 Outcomes for selected experimental (*in vitro* and *in vivo*) studies.

Study outcome	Relevant experimental papers in ODEB with wave form clearly described *N* (%)	Relevant papers with wave form clearly described, using simulated signals *N* (%)	Relevant papers with wave form clearly described, using real mobile phone or WiFi signals *N* (%)
Effect	809 (73.1%)	221 (63.3%)	256 (79.1%)
No effect	229 (20.7%)	102 (29.2%)	49 (15.3%)
Uncertain effect	68 (6.2%)	26 (7.5%)	18 (5.6%)
Total	1,106	349	323

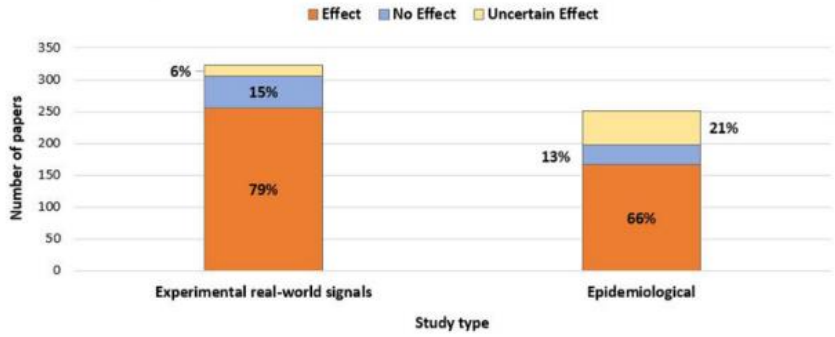

FIGURE 2
The relative numbers of selected experimental and epidemiological papers showing effects, no effects and uncertain effects.

Table 1 – outcomes for selected experimental (in vitro and in vivo) studies
From: "Wireless technology is an environmental stressor requiring new understanding & approaches in health care" McCredden et al. (2022) [1]

4. The excellent health Website, www.greenmedinfo.com curates relevant papers from PubMed, and also has thousands of published research papers on therapeutic benefits of "natural health" approaches such as nutraceuticals. (See my OneDrive folder for 4 MS Word documents from GMI, that in sum contain over 1,000 published studies – abstracts - on health damage from RF-EMFs and ELFs: Papers on EHS & Effects of RF-EMFs)

5. The excellent Website run by Dr Erica Mallery Blythe in the U.K. Her Website https://phiremedical.org/ has many expert resources for medical practitioners and patients, particularly on EHS and the numerous ways in which MMMs can impact on health. Her Website also details Court cases won by people suffering from EHS.

6. The excellent in-depth book (or e-book) by the internationally recognised health expert, Dr Joseph Mercola, "EMF*D": EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books (If enquiring into Dr Mercola's work and reputation, please **don't** rely solely on Government-regulated mass media, a Google search, or websites such as Wikipedia.)

7. SaferTech NZ: https://www.safertechnz.co.nz/
8. The Environmental Health Trust: www.ehtrust.org

[1] Frontiers | Wireless technology is an environmental stressor requiring new understanding and approaches in health care

9. EMF News: http://www.emfnews.org
10. EMF Scientist: https://www.emfscientist.org
11. Physicians for Safe Technology: https://mdsafetech.org
12. EMF-Portal: https://www.emf-portal.org/en
13. RF Safe: www.rfsafe.com
14. Electric Sense: https://www.electricsense.com/emf-scientific-research/ - run by Lloyd Burrell who also hosts annual online summits - EMF Health Summit – with many respected experts
15. The annual EMF Hazards Summit that is run by Nick Pineault ("The EMF Guy") has many interviews of some of the top experts in the world. See also, www.theemfguy.com)
16. The US Government official medical website PubMed – though there is a fairly limited number of studies, and studies appear to favour research that finds no adverse effects of microwaves (and other RF-EMFs): https://pubmed.ncbi.nlm.nih.gov/

5G mobile cell tower outside homes (Onerahi, Whangārei) – photo by author

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11. What are the EMF Frequencies considered of Most Concern to Health?

As per the diagram in Section 8, microwaves are electromagnetic radiation between the frequency of 300 MHz and 300 GHz. They are a major segment of the larger EMF band called Radio-frequency EMFS (RF-EMFs).

Below the RF-EMFs band are the **Extremely Low Frequencies** (ELFs) that have been used for military communications for decades, as they travel over very long distances, and pass through solid objects and water.

Many people are not aware that modern microwave transmissions carry information not as a smooth continuous wave but as bursts of microwave energy that switch on and off at characteristic low rates determined by the protocol. The microwave carrier itself sits in the GHz range, but the *envelope* of the signal - how its intensity varies in time - contains components at much lower frequencies, often falling within the Extremely Low Frequency (ELF) band. For example, the GSM mobile-phone protocol transmits in 4.6 ms frame structures that produce a characteristic 217 Hz envelope component; Wi-Fi access points emit beacon frames roughly every 100 ms, producing about a 10 Hz envelope component; and 4G LTE and 5G OFDM systems impose 1 ms subframe boundaries on the carrier. A growing body of research suggests these ELF-range envelope features may be biologically more relevant than the carrier frequency alone - that is, that the time-domain *pattern* of pulsation matters, not just the average power or the GHz-range frequency in isolation.

Microwaves naturally occur in nature owing to being emitted by interstellar gas, and by the gaseous shrouds of newly formed stars. However, there are major differences between naturally occurring microwaves (NMs) and man-made microwaves (MMMs). All these differences may lead to a major impact on health – which will be elaborated in Section 14 below.

Most of the research on possible health damage caused by EMFs has focused on the microwave frequency band. Devices (or systems) which use microwaves to operate, include: cell phones; cordless phones; Wi-Fi routers; Bluetooth devices; smart devices (such as tablets and notepads); smart home appliances; smart (electricity) meters; Fitbits; smart watches; baby monitors; game consoles; smart diapers; recent home ventilation systems and home security systems (both of which used to have hardwired sensors instead of Wi-Fi sensors); and smart homes.

Health symptoms and apparent damage from microwaves were first noticed during World War 2, when radar operators on ships came down with seemingly inexplicable neurological and mental health symptoms. These effects were effectively covered up by Navies as it was an inconvenience that could get in the way of winning the war. [1]

In 1977, investigative science journalist Paul Brodeur published the book, "*The Zapping of America: Microwaves, Their Deadly Risk, and the cover-up*." [ibid]

Industry-internal concerns about handset RF exposure also emerged in the same period. As BBC News reported in 2001, Nokia, Ericsson and Motorola had filed multiple patents from 1993 onwards for shielding technology designed to reduce the radiation absorbed by the user. Two Nokia patent applications, from 1995 and 1998, contained the explicit acknowledgement that "in the worst case, it has been suggested that

[1] Brodeur P (1977), 'The Zapping of America: Microwaves, Their Deadly Risk, and the Cover-up', W.W. Norton.

malignant tumours could develop", language difficult to reconcile with the industry's contemporaneous public position that no health concerns have been established. [1]

The Moscow Signal exposure during the 1970s and 1980s

During the 1970s and 1980s, there was the ongoing alleged Russian microwave attack on the US Embassy in Russia – and on other Embassies such as the Canadian and U.K. Embassies. Officials from the Embassies used a spectrum analyser to measure the microwave beams. Reported carrier frequencies in the declassified record fall in roughly the 2.5–4 GHz range. The signal's average power density at the embassy is now generally placed in the region of 5 μW/cm^2 - substantial for sustained close exposure but well below contemporary safety limits, and orders of magnitude below earlier popular figures of around 10 mW/cm^2. This signal is now usually referred to in the literature as the "Moscow Signal", and was the subject of the Johns Hopkins / Lilienfeld Foreign Service Health Status Study (contracted 1976, final report 1978), commissioned by the U.S. State Department, which compared health outcomes among Moscow embassy staff with control populations from comparable postings in Eastern Europe. [2]

The original report's headline finding was that no clear excess in cancer mortality was demonstrated, but elevated rates of several morbidity outcomes were observed; later reanalysis by Goldsmith (1995, 1997) argued the original report had under-reported some of the harm signals it documented. The source of these signals was never established, and long-term health consequences not followed up. However, there was high consistency in terms of the characteristics of the microwave radiation, and the abnormal symptoms reported by numerous staff in each Embassy. [3]

The Moscow Signal exposure put in the current-day context

The roughly 5 μW/cm^2 average power density at the U.S. Embassy is approximately 200× below current ICNIRP and FCC public-exposure limits, which sit near 1 mW/cm^2 in the 2–3 GHz range relevant to the Embassy's reported carrier frequencies. It is, however, in the same order of magnitude as ambient far-field exposures measured in publicly accessible areas around modern macro cell sites - median European measurements are around 1% of the ICNIRP limit (~10 μW/cm^2), with peaks under 8% (~80 μW/cm^2) per the systematic review by Sagar and colleagues of European personal-exposure measurements. [4] For most members of the public the comparison is partial, because residents move during the day, change rooms at night, and leave the house, varying their position relative to dominant sources. The Moscow embassy staff did not have that mobility - they sat in the same offices, day after day, year after year, with sustained directional illumination from a single source.

Two populations now have exposure geometries that more closely resemble the Moscow Signal pattern. The first is anyone working from home, which since 2020 has become a substantial share of the white-collar workforce in N.Z. and elsewhere. The second is infants, the chronically ill, the elderly, and the housebound, a population that overlaps significantly with those most likely to be vulnerable to RF exposure on independent grounds (compromised mitochondrial function, blood-brain-barrier integrity, and oxidative-stress baseline; in the case of infants, developing brain tissue, thinner skull bone, and

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[1] BBC News (25 July 2001) - 'Mobile firms patent "brain shields"'. The referenced 1998 Nokia application corresponds to US Patent 6,088,579A (granted 2000), specifying a shielding layer "between the antenna means and the user."

[2] See: https://pmc.ncbi.nlm.nih.gov/articles/PMC3509929

[3] Goldsmith 1995 - Epidemiologic evidence relevant to radar (microwave) effects (Environmental Health Perspectives). Reviews the Lilienfeld 1978 Moscow embassy study (Foreign Service Health Status Study, Johns Hopkins).

[4] Sagar et al. 2018 - RF EMF exposure in everyday microenvironments in Europe: A systematic literature review (J. Exposure Science & Environmental Epidemiology). Median measured exposure around macro cell sites ≈ 1% of the ICNIRP public limit, peaks under 8%.

elevated tissue water content that together produce higher fractional RF absorption per unit body mass - see Section 12.5).

A person spending twelve or more hours a day at a fixed location a few hundred metres from the panel antenna of a cell phone base station, an elderly resident in a fixed chair near a smart-home Wi-Fi router, or an infant sleeping in a cot a few metres from that same router, are all receiving sustained directional RF from a single physical infrastructure source - structurally Moscow-Signal-like in exposure geometry, even if at variable duty cycle and across multiple bands. The recommendations for measures to mitigate risks discussed by this monograph (Section 22) explicitly account for these populations.

Two caveats are important to keep this comparison in proportion. First, modern handset use produces local exposures roughly 20–200× higher than the Moscow Signal at the relevant tissue depth, intermittently, handset-against-head dominates individual RF dose for the general population, as discussed below. Second, the Moscow Signal was a single narrow carrier whose envelope was pulsed in a specific pattern; modern macro cell exposure is broadband across five to seven bands per operator at an urban cell tower site. [1] So the comparison drawn here is to exposure geometry - the Moscow signal that was sustained, directional, single-source, rather than the modern-day exposure spectrum.

The Havana Signal exposure – 2016 to 2018

Between 2016 and 2018, a number of officials at the U.S. and Canadian Embassies in Havana, Cuba became unwell, with symptoms reminiscent of those reported during the Moscow Signal years. These effects were dubbed “Havana Syndrome”. More than 130 U.S. diplomats, intelligence officers, and their family members reported experiencing headaches, ear pain, dizziness, fatigue, cognitive issues, and difficulty sleeping. Some attributed these symptoms to a targeted attack using directed, pulsed electromagnetic energy or microwaves. A 2020 report by the U.S. National Academies of Sciences, Engineering, and Medicine concluded that “many of the distinctive and acute signs, symptoms and observations reported by [affected personnel]… are consistent with the effects of directed, pulsed radio frequency (RF) energy.” The U.S. Government has never released details of any measured microwave signal or its source, so the technical record of the alleged exposure remains incomplete. [2]

Subsequent investigations have produced findings that pull in different directions. In March 2023, the U.S. Office of the Director of National Intelligence released an unclassified summary of the Intelligence Community’s assessment, concluding that it was “very unlikely” that a foreign adversary was responsible for the reported incidents. In March 2024, two large studies funded by the U.S. National Institutes of Health, comparing 81 affected personnel against matched controls, found no statistically significant differences on MRI brain imaging, clinical evaluation, or biomarker testing. [ibid]

These findings cut against a single-cause directed-energy-weapon explanation for Havana Syndrome as a whole. They do not, however, settle the underlying biophysical question of plausible harm from such signals. Dr David Relman’s two expert panels for the U.S. Government (referenced below) continued to conclude that “pulsed electromagnetic energy” was the most plausible explanation for a *subset* of cases, and the 2024 imaging studies did not address whether episodic RF exposure could produce transient neurological symptoms without leaving structural damage detectable months or years later.

In relation to the measures to mitigate risks to health that are discussed in this monograph, the historical question of attribution at the Havana embassy is less important than the broader and better-documented

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[1] With traffic-dependent duty cycle and (on the n78 C-band 5G layer) electronic beam steering - see Section 8.1 for the per-operator band picture in N.Z.

[2] ODNI March 2023 - Updated Assessment of Anomalous Health Incidents (unclassified summary). Pierpaoli et al. 2024 - Neuroimaging Findings and Chan et al. 2024 - Clinical and Biomarker Tests in US Government personnel (JAMA).

record - including the Moscow Signal years, the 1976 Lilienfeld study [1], and the modern peer-reviewed RF biology literature. That is, that pulsed and sustained microwave exposure can produce measurable neurological effects under the right conditions.

CIA Whistleblowers on the source of the Havana Signal

Recently, in a CBS 60 Minute interview (8 Mar 26), two CIA whistle blowers stated that "Havana Syndrome" – and subsequent similar events - had more than likely been caused by man-made microwave radiation. Further, that a portable device of such capability (of Russian origin), is now in the possession of the Dept. of Homeland Security. They explained that pulsed microwave energy can cause havoc, including headaches, severe pain, cognitive dysfunction, disorientation, seizures, and loss of consciousness. Further, on medical examination, those who suffered such attacks very often demonstrated structural damage to the brain, heart, nervous system, muscles and bones. [2]

In the same CBS report, Dr David Relman (Stanford University Professor of Medicine) was interviewed. He had been asked by the U.S. Government to lead two investigations into more recent effects on U.S. military personnel and civilians – who had suffered very similar symptomatology. He and his two expert panels found that in a subset of cases, the most plausible explanation was a form of radiofrequency or microwave energy. [ibid]

In summary, thousands of published research studies outlining the very likely damaging effects of man-made microwaves exist. This research has been ongoing since World War 2, but is has burgeoned considerably over the last twenty years. [3]

Besides research on the likely damaging effects of man-made **microwaves** on humans, RF-EMFs that are outside the microwave band have also been researched, as have ELFs. Both these EMF bands appear to fairly consistently show predictable harms linked to exposure [4] – with the Panagopoulus et al. model discussed in detail in **Section 14.1** below. [5]

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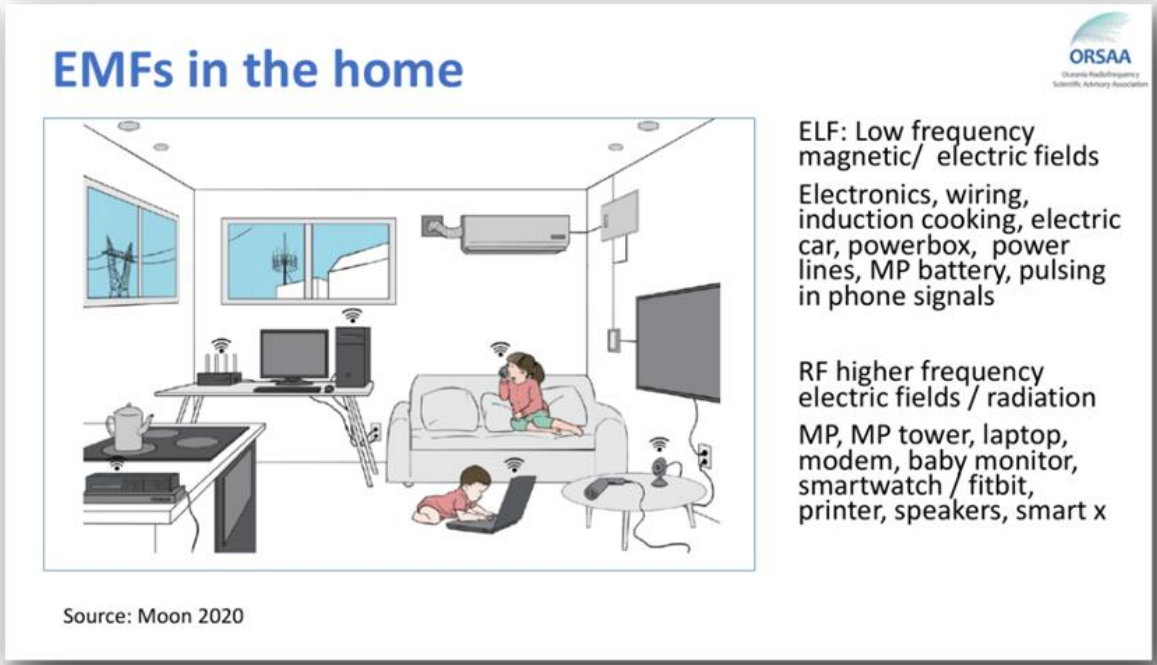
[1] Lilienfeld 1978 Moscow embassy study (Foreign Service Health Status Study, Johns Hopkins

[2] https://www.cbsnews.com/news/us-military-tested-device-that-may-be-tied-to-havana-syndrome-60-minutes-transcript/ and https://www.saferemr.com/2021/11/the-havana-syndrome.html

[3] Belpomme et al. 2018 - Thermal and non-thermal health effects of low intensity non-ionizing radiation (Environmental Pollution); McCredden et al. 2022 - Wireless technology is an environmental stressor (Frontiers in Public Health).

[4] See: Firstenberg A 2017 - The Invisible Rainbow: A History of Electricity and Life. Santa Fe and Sucre: AGB Press. ISBN 978-0-692-68301-9 (HB)

[5] IARC Monograph Vol 102 (2013); Hardell & Carlberg 2020 - Health risks from RF radiation including 5G should be assessed by experts with no conflicts of interest (Oncology Letters); and Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441.



Some common sources of EMF radiation in the home (ORSAA)

Although man-made **non-microwave** frequencies also appear to produce fairly predictable harms, this monograph focuses primarily on damage caused by man-made microwaves. This is because – as above - there are many more relevant studies on arising associated harms, and because these microwaves are ubiquitous in many peoples' daily environments.

Before concluding this Section, it should be acknowledged that some man-made EMF devices (e.g. Pulsed EMF devices aka PEMF devices) appear to enhance tissue and bone healing, improve cellular functioning, boost circulation, promote mobility, lessen pain, etc. [1]

What these devices usually have in common, is that they regularly pulse magnetic fields within the range of sub-Hz up to a few kHz, with this range being far below the microwave range, which begins at 300 MHz. [2]

Any particular device will have a set regularity of pulsing at a set frequency range, without the erratic bursts of data contained in MMMs. These "cleaner" features make such devices much more congruent with body processes and functioning. Certainly, not all devices achieve what they claim to, and before considering purchase, it is necessary to find (unbiased) evidence that short-term improvements continue over the longer-term. [3]

[1] See: Pulsed Electromagnetic Fields (PEMF)-Physiological Response and Its Potential in Trauma Treatment - PMC
[2] See: Understanding the concepts of intensity and frequency PEMF - AOPP)
[3] See: Pulsed Electromagnetic Field Therapy - an overview | ScienceDirect Topics

Example of a PEMF Healing Device: FlexPulse G2 PEMF (flexpulse.com)

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12. Man-Made Microwave Dangers: with thousands of studies, why a seeming absence of interest from Media & from Governments?

Opening note

The intention of this discussion is **not** to impugn individuals or agencies, but to emphasise the importance of governance structures, advisory processes, and regulatory standards that are demonstrably comprehensive, independent, and fully aligned with the protection of public health. Given the massive scale of exposure to man-made microwaves (MMMs) and the genuine possibility of long-term effects, continued scrutiny and transparent reassessment of safety standards remain both reasonable and necessary.

12.1 Governance, expertise, independence and current procedures

Many governments around the world have strong policy support for the telecommunications industry and its rapid infrastructure rollout. One likely reason for this is the competitive nature of many countries when it comes to economic development, with key infrastructure needs for rapid, high-volume communication. [1]

A frequently cited viewpoint in this field, is that advisory committees on technical risk, benefit from breadth of expertise across the disciplines relevant to their remit, from independence of their composition from the industries whose standards they set, and from periodic external review of that composition. [2] A concern arising from this viewpoint is that current advisory bodies may include members drawn directly from industries that the committee's recommendations regulate, that the disciplines required to assess complex bio-electromagnetic health risks may be insufficiently represented on the relevant panels, and that potential conflicts of interest may arise. [3]

12.1.1 Composition of the New Zealand Advisory Committee, ICHEF

In New Zealand, the Committee that advises Health New Zealand – and by extension the Government - on appropriate levels of non-ionising radiation, is the Interagency Committee for Health Effects of Non-Ionising Radiation, or ICHEF. [4]

According to this Committee's Terms of Reference, it reports to the Director General of Health with copies of meeting notes provided to the Chief Executives of the Ministry for the Environment and MBIE. Should there be reasonable suspicion of health hazards, or other issues of significance, these are to be brought to the attention of joint Ministers. Annual and/or occasional reports will also be provided to joint Ministers, Health and relevant Government Ministers. [ibid]

Based on a May 2026 OIA response and publicly available information, ICHEF is comprised of a total of 26 members including 2 observers from ARPANSA, Australia. ARPSANA is the Australian Government's lead authority for radiation protection and nuclear safety. It is charged with safeguarding the public, workers

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[1] See for example: Understanding the public voices and researchers speaking into the 5G narrative (PubMed); Why has there been no public consultation or appropriate risk assessment of 5G before the rollout in NZ? (NZ OIA request to PM Jacinda Ardern); 5G Space Appeal - International Call to Halt 5G Deployment.

[2] See for example: See: https://www.orsaa.org/uploads/6/7/7/9/67791943/arpansa-who_is_misleading_who.pdf

[3] See: https://www.orsaa.org/uploads/6/7/7/9/67791943/arpansa-who_is_misleading_who.pdf

[4] See: https://www.health.govt.nz/system/files/2022-06/interagency-committee-health-effects-non-ionising-fields-report-ministers-2022-jun22.pdf (Appendix G for Terms of Reference)

and environment from the harmful effects of ionising and non-ionising radiation – through regulation, research and public education. [1]

Unfortunately, the writer was unable to discover unambiguous details regarding the professional role and training/expertise of 9 members of the Committee. That is, those details did not appear to be in the public domain.

As best could be determined from the recent OIA, membership on ICHEF is comprised of:

- Two members come from industries that the Committee's recommendations regulate, including telecommunications. (One of these – discussed below in 10.2.2 - does contracting work for both the Government and the telecommunications industry.)
- One member comes from Kordia, a state-owned enterprise providing mission-critical technology, telecommunications and broadcasting services in N.Z.
- The Ministry of Business, Innovation & Employment has five representatives.
- Health New Zealand has four representatives.
- The Ministry of Health has two representatives.
- The Ministry of Education has two representatives. (Both of these members provide technical advice to schools on ICT networks and cyber security.)
- WorkSafe NZ has two representatives.
- The Electricity Engineers' Association (EEA) has one representative.
- The Ministry for the Environment has one representative.
- Local Government has one representative.
- Transpower New Zealand Ltd. has one representative.
- Consumer NZ has one representative – a technology and consumer-product journalist, specialising in testing consumer technology such as computers and mobile phones.
- ARPANSA Australia provides 2 observers.

*(Information obtained under the **Official Information Act**, May 2026 [2])*

Given this Committee's Terms of Reference [3], it is very unclear to the writer why MBIE would need to have **five** representatives on ICHEF. Unfortunately, the high numbers from MBIE could provide the impression that an undue focus of ICHEF work is promoting the promulgation of wireless technologies for business purposes.

12.1.2 Does the current composition of ICHEF provide sufficient expertise to enable it to fulfil the key role of adequate emissions safety standards?

Public health, environmental health and/or epidemiology expertise – possessed by at least three members - while clearly valuable, is typically centred on population-level health surveillance, statistical analysis, health systems, health monitoring, health promotion, disease outbreak management, and policy. [4] While such expertise is helpful, it may not, on its own, be sufficient to assess highly specialised mechanistic and clinical questions in this medical-scientific subdomain.

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[1] See: www.arpansa.gov.au

[2] Although the writer has the exact date and Reference number of the OIA response, this has been withheld from the monograph in order to safeguard the identity of those on the advisory Committee

[3] See: https://www.health.govt.nz/system/files/2022-06/interagency-committee-health-effects-non-ionising-fields-report-ministers-2022-jun22.pdf (Appendix G)

[4] See: 18 Public Health Skills Needed for Upskilling

One member of ICHEF appears to have expertise in radiation safety, ion beam analysis, surface physics and radiation.

Among the Committee members, one individual appears to hold advanced qualifications in physics and medical physics and operates a private consultancy that provides electromagnetic field (EMF) services to government agencies, telecommunications companies, and related infrastructure providers. While this individual has publicly acknowledged the possibility of conflicts of interest and has outlined strategies for managing them, as a generic governance issue, it is reasonable to question whether such arrangements can adequately reassure the public and maintain public confidence. This is particularly when the potential health impacts of chronic microwave exposure appear to be initially subtle, cumulative, and increasingly severe over the longer-term. (See **Section 14** and **Section 15** below.)

The two observers from ARPANSA (Australia) both appear to hold advanced scientific expertise that is pertinent to the tasked duties of ICHEF. This includes expertise in RF-EMFs of mobile phones, Wi-Fi, 5G and broadcast transmitters. However, some researchers – including at ORSAA Australia – have stated that ARPANSA is not a fully independent body, as it apparently receives some of its funding from the wireless industry via the Australian Communications and Media Authority (ACMA) funds. [1] ACMA is tasked with helping to maximise the economic and social benefits of communications infrastructure, services and content in Australia. [2] ARPANSA continues to deny any lack of independence, and any industry influence.

12.1.3 Is ICHEF reviewing the full range of relevant published research?

ICHEF's apparent practice, like that of analogous advisory committees in other jurisdictions, has been to anchor its recommendations on reviews published by major national and international health and scientific bodies, particularly I.C.N.I.R.P. [3] and the W.H.O.'s International EMF Project. [4] However, when considering the extensive body of experimental and observational research reporting apparent biological effects at exposure levels below current standards - including the large curated ORSAA database - a substantial discrepancy appears to exist between prevailing safety standards and the broader, research literature covering the last two decades. [5] This discrepancy is not best understood as a personal-incentives issue; rather, it appears to reflect the methodological choice to ground recommendations in the reviewed-by-major-bodies literature, rather than in the broader peer-reviewed literature. This methodological choice, and whether it is producing recommendations that adequately reflect current evidence – and sufficiently protect the public - is the appropriate subject of review.

Looking further into the apparent discrepancy between current safety standards and the body of published research reporting biological effects at exposure levels below those standards, several non-exclusive possibilities are worth setting out: (1) portions of the relevant research may not be reaching the Committee's current inclusion standards, or is being considered in a form that does not allow full evaluation; (2) the collective expertise of the committee may not fully match the breadth of disciplines the task requires; (3) differing methodological and interpretive frameworks across the literature may be leading to evaluatory confusion, and/or inconsistent weighting of the evidence; or (4) ICHEF may have recommended more stringent standards in some areas but its recommendations may not have been adopted into regulation. In any of these scenarios, the importance of advisory and decision-making bodies

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[1] See: https://www.orsaa.org/uploads/6/7/7/9/67791943/arpansa-who_is_misleading_who.pdf
[2] See: https://www.acma.gov.au
[3] See: PSGR NZ recent Substack article - The EMF Problem: RF Radiation Governance Without Democratic Risk Assessment, https://psgrnz.substack.com/p/the-emf-problem-rf-radiation-governance
[4] See: https://www.who.int/initiatives/the-international-emf-project
[5] Especially research supporting a likely casual link between man-made microwave exposure and subsequent health damage – as presented in this monograph

being - and being seen to be - comprehensive in expertise, independent in composition, and objective and transparent in reasoning, cannot be overstated.

12.1.4 Need for an urgent review of the comprehensiveness of ICHEF expertise and its procedures

As briefly noted in the paragraph above, based on the recent O.I.A. response and review of publicly available information, the collective academic training and professional backgrounds of (ICHEF) Committee members while helpful, may **not be sufficient** to assess more specialised biological, physiological and clinical questions in this dramatically intensifying field of EMR MMM biotechnology.

Based on multiple concerns raised in this Section (and in **Section 14** and **Section 15** below), it would be reassuring for the writer (and others with similar concerns such as Physicians and Scientists for Global Responsibility, NZ [1]) if Government commissioned an independent review of ICHEF's composition against the disciplines directly relevant to its remit. In the author's opinion, disciplines vital to adequate assessment of MMM biological and medical effects include - but are not limited to: human biophysics, medical physics, human biochemistry, human neurology, psychology, RF engineering, dosimetry, occupational health, environmental health, paediatrics, and building biology/EMF remediation. While some of these fields of expertise are already represented on ICHEF, many of these fields of expertise appear to be absent.

So as to avoid the body assessing its own composition the review should be conducted by an independent body - for example, a panel convened by the Royal Society Te Apārangi, or by an analogous independent academy - rather than by ICHEF itself. To add to the prestige and expertise level of such a review body, the writer recommends the inclusion of two or more members from the list of independent experts denoted in Section 9 above. So the review's purpose would be to test whether the disciplines represented are sufficient for the complexity of the Committee's task, and to recommend additions or substitutions on the basis of disciplinary need - rather than on the basis of position pre-selection. (If review outcomes indicate the need for the addition of more areas of expertise, the author recommends appointing two or more of the same independent experts to ICHEF.)

It would be further reassuring for concerned New Zealanders if ICHEF, in consultation with Health New Zealand and relevant Ministers, were to give urgent consideration to the practical initiatives and public-health recommendations outlined in **Section 22:** Recommendations: Immediate, Risk Mitigation Steps by the NZ Government

It is reasonable to expect that a full report to Government will be delivered within a month of each of the consecutive six-monthly ICHEF review meetings, with authorship of this review clearly denoted. [2]

Past, present and future ICHEF advisory reviews need to be readily and fully available to the public.

Progress toward updated emission standards that are explicitly designed to mitigate risks to human and environmental health, where supported by evidence, should be communicated to the public transparently and in a timely manner.

In the opinion of the author, there is clearly an **ongoing duty of care** for this Committee and for Government, with respect to public awareness and education, in this vital and ubiquitous field of public health.

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[1] See: EMF Sensitive? You May Not Be the Outlier You Think You Are

[2] See: PSGR NZ recent Substack article - The EMF Problem: RF Radiation Governance Without Democratic Risk Assessment, https://psgrnz.substack.com/p/the-emf-problem-rf-radiation-governance

Summary of this Sub-Section - Governance, expertise, independence and current procedures

In conclusion to this sub-section, transparency and accessibility of advisory-committee reasoning is an area where ICHEF could substantially strengthen public confidence. A constructive recommendation is for ICHEF to publish readily accessible, plain-language summaries of: the scientific reviews and studies it has considered in arriving at its current recommendations; the reasons for excluding any peer-reviewed published research that has sound methodology and conclusions; the reasoning by which it has weighed considered evidence; the basis for its current exposure-limit recommendations; any updates over time; and its responses to public submissions, scientific challenges, and OIA queries.

This kind of structured public communication, which is increasingly standard for technical advisory bodies in comparable jurisdictions [1] - would shift the framing of public engagement from "why has so little been communicated?" to, "here is the basis for the Committee's recommendations, and here is how to engage further."

The production of a constellation of wise and informed risk mitigation recommendations that adequately reflects current evidence, appears to be an appropriate government and industry objective that would be enhanced by robust independent review that explicitly sought to pre-eminently safeguard public well-being.

As discussed in detail above, there appears to be an urgent need to independently review the comprehensiveness of the expertise on ICHEF, in relationship to its tasked duties. While not wishing to pre-empt the conclusions of such a review, in the writer's opinion, ICHEF needs to be immediately strengthened by representation from internationally recognised experts across this field. Such experts should be widely accepted by fellow researchers (in this field) as fully independent of any ties to the telecommunications industry - or any connections to industries that produce or market devices emitting man-made microwaves.

REVIEW OF RESEARCH BY COUNTRY OF ORIGIN

BALANCE OF EVIDENCE

Leading EMF Effect Countries

Country	Effect Papers	No Effect Papers
CHINA	141	13
TURKEY	131	22
USA	103	61
INDIA	80	5
SWEDEN	66	13
IRAN	50	4
RUSSIA	40	2

Leading No Effect Countries

Country	Effect Papers	No Effect Papers
USA	103	61
DEU	38	51
JPN	33	44
ITA	61	35
FRA	41	35
GBR	22	34
KOR	26	25
AUS	36	23
FIN	20	23

- Some countries finding a large number of "no effects" have corporations significantly investing in wireless technology (i.e. Siemens, Samsung, Nokia, Sony, Motorola ... etc.)
- ICNIRP was founded in Germany (DEU) and receives funding from the German Federal Ministry for the environment. Germany is one of the few countries finding more "no effects" than effects
- Many countries that are finding a significantly higher proportion of effects also typically have the most protective RF exposure limits (excluding USA)

Source: ORSAA database as of 23/05/2017

Table comparing Countries research output regarding "EMF Effect" vs "No Effect". See: Health Freedom Event - Victor Leach (2020)

[1] See: OECD (2021). *Governance of Regulators: Practices and Challenges*. OECD Publishing. https://www.oecd.org/gov/regulatory-policy/

12.2 Repeated warnings from researchers and citizens

Numerous prominent scientists and researchers in this field report that they have repeatedly raised concerns with their own governments and others about potential health risks associated with wireless technologies, but report that these submissions have not resulted in substantive policy change. Examples include researchers affiliated with the Environmental Health Trust, ICBE-EMF, ORSAA, and several universities in North America and Europe. In parallel, large numbers of citizens - including in Australia - have made formal submissions and informational requests, with limited substantive response. [1]

In addition, there are many thousands of signatures to an international appeal calling for a moratorium on the rollout of 5G until potential hazards are fully investigated. Signatories include thousands of scientists, engineers, medical doctors, other health professionals (such as dentists, pharmacists and psychologists) and thousands of related health agencies. [2] They cite research which they state shows harmful effects, including increased cancer risk, infertility, and neurological disorders.

12.3 Research funding asymmetries

Rigorous experimental and epidemiological research in this area is expensive, and researchers report that funding for studies investigating potential harms is difficult to obtain from governments or commercial sources. [3] Conversely, there appears to be comparatively greater availability of funding for research that supports the safety of existing technologies and exposure limits. This pattern is consistent with broader literature on industry influence over research agendas. [ibid]

12.4 Methodological challenges and weight of evidence

Due to acknowledged investigative and methodological challenges, research outcomes in this field vary, and synthesis across studies is complex. Nonetheless, when findings from animal studies, human observational studies, and laboratory research across physics, biology, physiology, medicine, psychology, and occupational health are considered together, a substantial and reasonably coherent body of evidence emerges that supports the legitimacy of major ongoing concern. [4] In the opinion of the writer, this breadth and depth of evidence supporting probable harm, warrants careful, deliberative consideration and effective action that is designed to mitigate all risks to health, rather than dismissal.

12.5 Additional risks for children

It has been long-known that children are more at risk from exposure to MMMs, owing to thinner skulls, more water in their brains, and a higher ion content - in their brains. [5] These differing biological characteristics are estimated to cause twice the radiation absorption in their brains, and 10 times the radiation absorbed by their skulls. [6] Further, as children are likely to be exposed to increasing levels of MMMs and for their entire lives, the accumulating risks they will face go very far beyond risks to someone already in middle-age or adulthood.

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[1] See: Why has there been no public consultation or appropriate risk assessment of 5G before the rollout in NZ? - a Official Information Act request to Jacinda Ardern - FYI ; and FOI 23-140 - Documents.pdf

[2] See: 5G Space Appeal | International Call to Halt 5G Deployment on Earth & in Space

[3] See: Research on Industry Influence on EMF - Environmental Health Trust and The Influence of Industry Sponsorship on the Research Agenda: A Scoping Review - PMC

[4] Belpomme D, Hardell L, Belyaev I, Burgio E, Carpenter DO (2018), 'Thermal and non-thermal health effects of low intensity non-ionizing radiation: an international perspective,' Environmental Pollution 242(Pt A):643–658; McCredden JE et al. (2022), Frontiers in Public Health 10:986315.

[5] See: https://pubmed.ncbi.nlm.nih.gov/23705297/

[6] See: https://pubmed.ncbi.nlm.nih.gov/21999884/

5G cell tower outside residences and about 80 meters from Whau Valley School (Kamo Rd, Whangārei) – photo by author

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13. Why Man-Made Microwaves may be damaging – even at non-heating (non-ionising) levels

Opening note

As well as relevant scientific studies and reviews being referenced, the information presented here is occasionally based on statements made by reputable experts in the field, such as via online webinars and associated materials. [1] In particular, the 2024 YouTube talk by Dr D Panagopoulos (Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube); the 2025 EMF Hazards Summit interview of Dr P Heroux (EMF Hazards Summit - The EMF Guy 48hrs free viewing); and the 2020 YouTube video by radiation health physicist Mr Victor Leach – Health Freedom Event - Victor Leach.

In discussing apparent biophysical and biochemical effects of man-made microwaves (MMMs), it is clear that there are often "effect windows", where specific microwave characteristics will have much greater impact on human physiology. [2] The effect size is a measure of the strength of the relationship between two variables in a population or a sample, and that apparent relationship will depend on the specific frequency, wavelength and power density characteristics of the microwave radiation. [3] Further, just as some specific microwave frequencies can have a large effect size, other specific EMFs (within the microwave spectrum) may have little or no measurable impact on human physiology – at least given current limitations on our measuring ability. [ibid]

Owing to these complexities, this Section and **Sections 12 and 13** below, will **not** attempt to identify exact (man-made) microwave characteristics that appear to create effects – whether physical, emotional, or cognitive. Rather, where there is evidence of any effects at all, regardless of the specific microwave characteristics, these will be discussed. In instances that specific experimental research is referenced, the reader will be able to undertake their own investigation to determine exact features of the microwaves employed as the independent variable.

Much of the below Section is highly technical, with however, some bullet-points being at the level of the lay reader. The writer has endeavoured to list the less technical points first – namely bullet-points 1 to 11.

13.1 Man-made microwaves characteristics appear to be damaging to health – even at non-heating levels

1. MMMs are erratic and chaotic in their pulsing, with predominating natural microwaves (NMs) such as thermal and cosmic, being a continuous, ever-present, regular field. [4] Therefore, in general, MMMs are potentially far more disruptive to human cellular biophysics and biochemistry – that require predictability to function. [5]

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[1] See Section 9 above for details on these established experts

[2] Belyaev 2005 - Non-thermal biological effects of microwaves: current knowledge, further perspective and urgent needs (Electromagnetic Biology and Medicine); Belyaev 2015 - Health Effects of Selected EMF Exposures (EU SCHEER reference report chapter).

[3] View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen

[4] However, some NMs are pulsing or non-regular, such as pulsar stars and solar flares

[5] Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube; and Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity | Scientific Reports

2. MMMs are much higher in power density than natural microwaves and therefore may be expected to exert significantly higher levels of effect on human structure and function. [1] So, Electromagnetic radiation (EMR) consists of vast numbers of photons, with each photon being a packet of energy. For an EMR intensity of 1 milliwatt per square metre at a frequency of 1 GHz - the kind of level that can occur near domestic wireless equipment - approximately 1.5 sextillion (1.5×10^{21}) photons cross each square metre every second. These photons do not act independently. Because they originate from the same transmitter and share a phase relationship, they propagate as a coherent wave that can produce predictable patterns of constructive and destructive interference. [2] The biological consequences of this coherence are discussed further as Mechanism 2 in **Section 14**.

3. MMMs are pulsed and the waves are polarised. This means these waves can constructively interfere with one another, thereby amplifying their intensities at many locations. [3] An RF radiation survey of wireless radiation in an active classroom with computers on desks will detect hot spots as microwaves constructively interfere and add up. [4]

4. MMMs are erratic and chaotic in the intensity of their pulsing, with NMs usually being at a constant level of intensity – except for an event such as a solar flare. Therefore, MMMs are potentially far more disruptive to (human) cellular biophysics and biochemistry which require predictability and consistency to properly function. [5]

5. Predominating NMs (such as thermal and cosmic) are natural sinosoidal in their promulgation, whereas the (usually employed) low frequency modulation carrier waves for MMM's, are able to be more disruptive biologically. [6] This is because the sinusoidal carrier wave of microwave transmissions is continuously modified by the transmitter – which modifies one or more properties of the high-frequency sinusoidal carrier wave. (Modified characteristics can be in amplitude, frequency or phase.) So, owing to these continuous modifications, carrier waves are only sinusoidal over very short intervals, and capable of being biologically disruptive. [ibid]

6. Microwave transmission systems require an information-bearing baseband signal - such as speech (usually 300 Hz–3.4 kHz), music (up to about 20 kHz), or digital data - to modulate a high-frequency microwave carrier. In amplitude modulation, this information is characterised by the signal envelope, while in modern digital modulation schemes (e.g., OFDM, QPSK, QAM), the information is conveyed primarily through controlled changes in the carrier's amplitude, phase, and/or frequency. [7] The apparent systemic biological effects of such waves has been thoroughly investigated by Panagopoulos and colleagues, who have explained in extensive biophysical detail how ion gates at cell walls throughout the body can be readily perturbed and dysregulated by such waves – resulting

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[1] See: 2024 YouTube talk by Dr Panagopoulos - Electromagnetic Fields: Health Effects & Mechanism of Action; Planetary electromagnetic pollution: it is time to assess its impact (Lancet Planetary Health 2018) and View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen

[2] See: *Classical Electrodynamics* by John D Jackson, Wiley & Sons, 1998; and https://www.mdpi.com/2673-592X/2/4/22

[3] See: Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity | Scientific Reports

[4] See: Case Study: Measurements of Radio Frequency Exposure from Wi-Fi Devices; and Health Freedom Event - Victor Leach

[5] Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube and Physical Differences between Man-Made and Cosmic Microwave Electromagnetic Radiation and Their Exposure Limits, and Radiofrequencies as Generators of Biotoxic Free Radicals | MDPI

[6] See Dr P Heroux interview, EMF Hazards Summit - The EMF Guy 48hrs free viewing ; and Panagopoulos et al. 2025, . Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

[7] See: https://www.ee.cuhk.edu.hk/~wkma/eleg2310/handouts/4-AM.pdf

in massive influx of ions into the cells, chaotic cell and organ function, a rapid build-up of reactive oxygen species, early cell death, etc. [1]

7. MMMs have been reported to disrupt and overwhelm the essential micro-current communications within and between cells. [2]

8. Water is the substance most strongly coupled to microwave fields in the human body, and approximately 60% of adult body mass is water (with brain and muscle tissue individually closer to 75%). At thermal exposure levels, this coupling produces dielectric heating - the mechanism that operates in microwave ovens at single-frequency 2.45 GHz exposures many orders of magnitude above ambient wireless levels. The proposed mechanisms by which RF could produce biological effects at the much lower power levels of consumer wireless devices, however, are not thermal. They involve membrane rectification producing small DC voltages and ion fluxes at the cell membrane, perturbation of voltage-sensing protein domains in ion channels (see **Section 14** Mechanism 3 - Pall's voltage-gated calcium channel framing, and the broader voltage-gated channel literature reviewed in Gerhards et al. (2025) [3], and reactive oxygen and nitrogen species production through mitochondrial and membrane perturbations (see Section 14 Mechanism 3 - the ROS/RNS stage of the cascade). The clinical RF-hyperthermia literature provides indirect supporting evidence that RF does something beyond pure bulk heating - cells heated by RF to a given temperature respond differently than cells heated by water bath to the same temperature - but the candidate mechanism for that difference is membrane-electrochemical, not dipole-rotation. So the bullet's underlying point is preserved without invoking a thermal mechanism: at the levels of RF exposure relevant to this document, the mechanisms of concern are non-thermal and operate through membrane biology and the downstream oxidative cascade rather than through water heating. [4]

9. Hydrogen bonds also hold together the two strands of the DNA double helix - a different population of hydrogen bonds from those in bulk water, but functionally analogous. Some researchers have postulated that RF exposure could perturb DNA-strand hydrogen bonding directly, including through coupling to specific vibrational (phonon) modes in DNA, though direct experimental demonstration of such an effect at telecom-frequency RF exposure levels is so far lacking. [5] The best-supported and most extensively replicated route from RF exposure to DNA damage runs indirectly, via reactive oxygen and nitrogen species generated by mitochondrial and membrane perturbations (see **Section 14**, Mechanism 3 - the ROS/RNS stage of the cascade).

10. MMMs have been shown by some investigators to decrease the viscosity and increase the diffusion of water – most likely including water throughout our bodies. This is a major change to the structure of water, and can be expected to cause ongoing stress to cellular function. [6]

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[1] See: Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

[2] See Dr P Heroux interview EMF Hazards Summit - The EMF Guy 48hrs free viewing; and Polarization: A Key Difference between Man-made and Natural Electromagnetic Fields, in regard to Biological Activity | Scientific Reports)

[3] Gerhards L et al. (2025), comprehensive review of voltage-gated channel mechanisms in low-intensity electromagnetic field bioeffects, Chemical Reviews, Vol. 125, Issue 17, pp. 8051–8088. DOI: 10.1021/acs.chemrev.5c00178

[4] See: Impact of 5G Electromagnetic Waves on Water

[5] See: Understanding physical mechanism of low-level microwave radiation effect: International Journal of Radiation Biology: Vol 94 , No 10 - Get Access

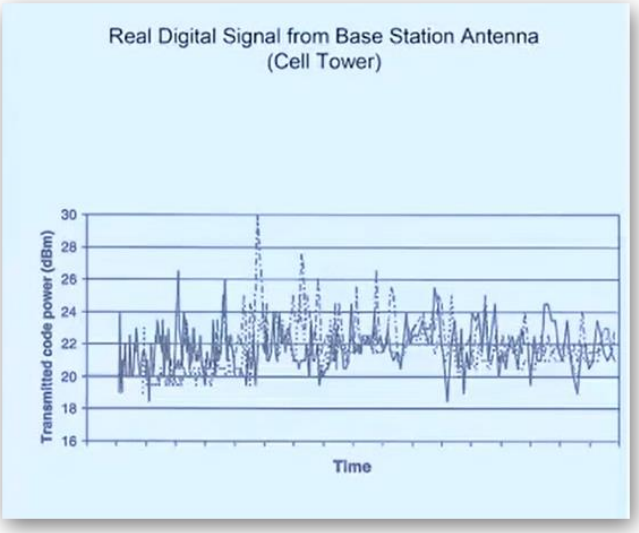
[6] See: Understanding physical mechanism of low-level microwave radiation effect: International Journal of Radiation Biology: Vol 94 , No 10 - Get Access

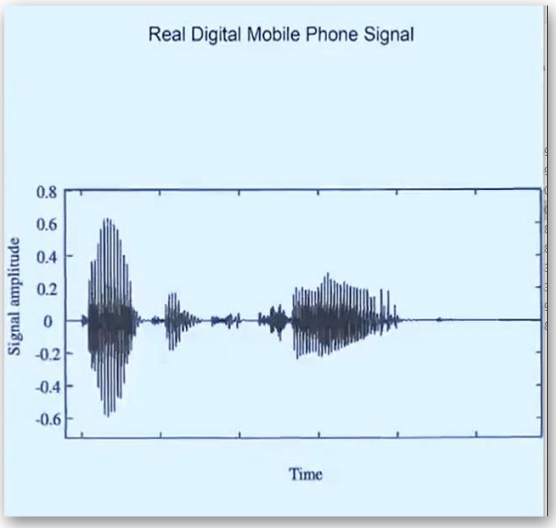
11. Human bodies evolved to be able to tolerate low power density NMs. With MMMs we are continually exposed to more and more frequencies at high power densities, that the human body has never before encountered, and likely has little adaptive capacity to respond. [1]

12. At the same time, it is well known by researchers in this field, that there are anomalous "effect windows", where particular frequencies seem especially harmful to animal and human health. [2] For example, even at the low power level of Wi-Fi routers, we can anticipate that prolonged exposure to these frequencies (2.45GHz and 5GHz) may well be linked to significant health damage. [3]

13. The effects of cell tower EMR are characterised by antenna-pattern geometry as well as by the near-field / far-field distinction. Cell tower antennas are mounted on masts (typically 15–40 m above ground) with the main lobe (panel) of their radiation pattern electrically downtilted by a few degrees (typically 2–8°). Peak ground-level exposure is therefore not directly under the mast but at the point where the main lobe of the antenna pattern intersects the ground - typically tens to a few hundred metres away. The 50–300 m range commonly cited for highest 4G ground-level exposure reflects this geometry across typical N.Z. macro-cell deployments. At these distances, observers are generally in the far-field of typical sector antennas where the electric and magnetic field components are in a fixed ratio and propagate as a plane wave.

14. Near-field intensities close to a source are generally higher than far-field intensities at greater distance - which is why a phone held against the head produces high local exposure. Even at observer positions within the radiating near-field of the largest tower panels, however, the local power density at the observer is roughly two to three orders of magnitude lower than that produced by a phone held against the head. The actual exposure profile around a tower is therefore determined by the antenna gain pattern (main-lobe direction, beamwidth, downtilt) rather than by the inverse-square law alone. [4]





[1] See Dr P Heroux interview EMF Hazards Summit - The EMF Guy 48hrs free viewing; and Man-made-and-Natural-EMF-EMR-Dr.Leendert-Vries.pdf
[2] See: 2015_Belyaev.pdf
[3] Atasoy HI, Gunal MY, Atasoy P, Elgun S, Bugdayci G (2013), 'Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices,' Journal of Pediatric Urology 9(2):223–229, doi:10.1016/j.jpurol.2012.02.015.
[4] See: Near and far field - Wikipedia; and Man-made-and-Natural-EMF-EMR-Dr.Leendert-Vries.pdf

Graphics showing actual wave features of cell tower microwave signals, and mobile phone signals - Dr Dimitris Panagopoulos 2024 [1]

15. Wi-Fi access points emit beacon frames every approximately 100 ms, producing a roughly 10 Hz repetition rate in the signal envelope. (Beacon frames carry identifying information that allows Wi-Fi devices to discover, connect to, and synchronise with the access point.) The radiation itself remains at 2.4 GHz, 5 GHz, or 6 GHz - only the envelope timing repeats at this slower rate. There is a substantial published literature on biological effects of pulse-modulated RF that differ from continuous-wave RF at the same average power: NCRP Commentary 18 (2003) reviewed this literature, and multiple double-blind studies (Vecchio 2007/2010/2012 [2] ; Croft et al. 2013 [3] ; Schmid 2012 [4] ; Lustenberger 2013 [5]) have reported alpha-band EEG effects from GSM-pulse-modulated RF exposure at SAR levels around 0.7–2 W/kg. The mechanism behind these effects is not established and the literature on it is genuinely contested. Croft (2013) in particular compared pulsed RF, continuous-wave RF, and pulsed low-frequency-only fields in parallel, and reported alpha-band suppression from both pulsed and CW RF, with no effect from the LF-only condition; if that result holds in replication, it cautions against simple readings of these EEG findings as "envelope rate matches the cortical rhythm and entrains it." Two further caveats are important for the document's purposes. The relevant studies all use phone-against-head GSM exposure at SAR levels orders of magnitude higher than ambient far-field Wi-Fi at typical room distances, so direct generalisation from those studies to Wi-Fi exposure is not supported. And whether comparable effects extend to far-field Wi-Fi at typical room distances has not been directly tested. The defensible position is that pulse-modulated RF can produce small alpha-band EEG effects in some studies, the mechanism remains under investigation, and as far as the author is aware, Wi-Fi-specific testing has not been done. [6]

16. Modern wireless protocols transmit information not as a smooth wave but as bursts of microwave energy that switch on and off in characteristic patterns. The microwave carrier itself sits in the MHz–GHz range. Within each burst, the microwave is modulated with subcarriers in the kilohertz range (LTE uses 15 kHz subcarriers; 5G New Radio scales from 15 kHz up to 240 kHz; Wi-Fi OFDM uses 312.5 kHz). The boundaries between bursts and frames produce envelope variations at much lower frequencies - millisecond timescales for LTE subframes, hundreds of milliseconds for Wi-Fi beacons. These low-frequency envelope components fall in or near the Extremely Low Frequency (ELF) band, and there is reasonable evidence that ELF-range biological effects can occur from this envelope content even when the GHz carrier is well below thermal damage thresholds. [7]

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[1] See: Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube

[2] Vecchio F et al., series of EEG studies on GSM 217 Hz exposure effects (2007, 2010, 2012). Lustenberger C et al. (2013), "Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent memory consolidation," Brain Stimulation 6(5):805–811.

[3] Croft et al. 2013 - Alpha band of resting EEG under pulsed and continuous RF exposures (IEEE Trans. Biomed. Eng.)

[4] Schmid MR et al. (2012), "Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields," Journal of Sleep Research 21(6):620–629.

[5] Lustenberger C et al. (2013), "Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent memory consolidation," Brain Stimulation 6(5):805–811.

[6] NCRP Commentary 18 (2003) - Biological Effects of Modulated Radiofrequency Fields; Croft et al. 2013 - Alpha band of resting EEG under pulsed and continuous RF exposures (IEEE Trans. Biomed. Eng.); Lustenberger et al. 2013 - RF pulses affect sleep-dependent memory consolidation (Brain Stimulation); Schmid et al. 2012 - Sleep EEG alterations under pulsed RF (J. Sleep Research); and Threshold of radiofrequency electromagnetic field effect on human brain: International Journal of Radiation Biology: Vol 97, No 11

[7] Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube; and Health Freedom Event - Victor Leach ; and Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health

17. It is worth noting that the strength of the low-frequency envelope component varies substantially across mobile generations. The strongest case for prominent low-frequency modulation is 2G/GSM, which uses hard amplitude pulses at 217 Hz from TDMA framing, this is the signal structure that drove most of the original pulse-modulation biological-effects literature. [1] 3G/UMTS uses WCDMA with continuous transmission, and is much closer to continuous-wave from an envelope perspective. 4G LTE and 5G NR use OFDM, with frame-level periodicity at 100 Hz (10 ms radio frames) and 1 kHz (1 ms subframes), but their envelopes are continuously filled by reference signals between data symbols, making the low-frequency content much less prominent than in GSM's hard TDMA bursts. As the older generations are progressively decommissioned worldwide N.Z. completed its 3G shutdown in March 2026, and 2G has been retired earlier, the strongest empirical basis for the "low-frequency modulation matters" argument is moving with them. Whether the subtler envelope features of OFDM-based 4G and 5G produce comparable biological effects to GSM-era exposures is much less well established. [2] However, that said, the argument presented by Panagopoulos and colleagues – relating to the continuing presence of ELFs transmissions and their systemic biological effects – appears to remain valid. [3]

18. One proposed mechanism for biological sensitivity to RF exposure invokes the radical pair mechanism (RPM), in which a magnetic field perturbs the spin chemistry of photo-excited radical pairs on the cryptochrome protein. The same physics underlies how migratory birds sense the Earth's magnetic field. Henshaw and Phillips (2024) [4] have proposed that human cryptochromes acting through this mechanism may underlie sensitivity to man-made microwaves and the development of EHS. Whether RPM operates meaningfully at telecom frequencies, however, is currently a matter of active scientific debate.

    Talbi, Zadeh-Haghighi and Simon (2025) [5] have argued on first-principles grounds that for a radical pair to respond to an applied field, the field needs to be quasi-static on the pair's spin coherence timescale (typically nanoseconds to microseconds), whereas a GHz carrier oscillates thousands of times within that window, and that the resulting time-averaging may significantly reduce, or in their analysis effectively eliminate, the RPM contribution at carrier frequencies above the MHz range. [ibid] This proposition by Henshaw and Phillips is a recent theoretical contribution rather than a settled result, and depends on specific assumptions about spin coherence times in cryptochrome radical pairs in vivo; defenders of the RPM framing point to possible narrow resonance windows, longer

effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

[1] Vecchio F et al., series of EEG studies on GSM 217 Hz exposure effects (2007, 2010, 2012). Lustenberger C et al. (2013), "Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent memory consolidation," Brain Stimulation 6(5):805–811. Schmid MR et al. (2012), "Sleep EEG alterations: effects of pulsed magnetic fields versus pulse-modulated radio frequency electromagnetic fields," Journal of Sleep Research 21(6):620–629.

[2] See: https://www.researchgate.net/publication/366089127_Electromagnetic_Fields_of_Wireless_Communications_Biological_and_Health_Effects and https://ehtrust.org/wp-content/uploads/ADVERSE-EFFECTS-OF-WIRELESS-RADIATION-2.pdf

[3] See: Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

[4] Henshaw and Philips: A mechanistic understanding of human magnetoreception vali dates the phenomenon of electromagnetic hypersensitivity (EHS) - https://pubmed.ncbi.nlm.nih.gov/39652433/

[5] Talbi G, Zadeh-Haghighi H, Simon C (2025), 'Radical pair mechanism contributions to radiofrequency electromagnetic field bioeffects,' Frontiers in Quantum Science and Technology. Gerhards L et al. (2025), comprehensive review of voltage-gated channel mechanisms in low-intensity electromagnetic field bioeffects, Chemical Reviews, Vol. 125, Issue 17, pp. 8051–8088. DOI: 10.1021/acs.chemrev.5c00178

coherence times in protein-stabilised pairs, and downstream biological amplification effects that a simple timescale-averaging argument may not fully capture.

The wider biophysics literature continues to investigate alternative mechanism classes alongside RPM, including direct electric-field coupling to voltage-sensing protein domains (see **Section 14** Mechanism 3, Pall's voltage-gated calcium channel framing, and the broader voltage-gated channel literature reviewed in Gerhards et al. (2025) [1] and dielectric coupling with cellular water and membrane lipids. These may turn out to be complementary rather than competing routes. From the risk mitigation perspective of this monograph, the practical point is that a mechanism does not need to be fully settled for the empirical evidence of biological effects to warrant regulatory caution; and that across the candidate mechanisms now under serious investigation, peak electric field and modulation pattern appear at least as relevant as time-averaged power.

13.2 Differing characteristics of microwave Generations – including 4G and 5G transmission systems

1. **Different generations of mobile technology produce different exposure profiles**, and the changes are not simply a matter of "higher frequency = more harm." At microwave frequencies, the per-photon energy of any individual photon is far below the threshold for ionising chemistry and lacks sufficient photon energy to directly break covalent bonds. Proposed non-thermal mechanisms for non-thermal bioeffects are factors such as time-averaged and peak power density, the time-domain modulation pattern, and beam directionality. With higher carrier frequencies, penetration depth in living tissue actually decreases - sub-6 GHz 5G bands penetrate similarly to 4G, while the millimetre-wave 5G bands (24–40 GHz and above) are absorbed within a few millimetres of the skin surface. [2]

   The exposed organ profile therefore shifts toward skin, cornea, and superficial tissue – including peripheral nerves below the skin - and away from deep organs such as the brain. This is a different concern profile from the 4G profile, and the health-related risks are correspondingly different. For example, possible harmful 5G effects include on the eyes, skin biology, potential feedback effects of affected cutaneous / subcutaneous peripheral nerves on the central nervous system, and the contested sweat-duct antenna effects must be considered for all risks to be understood (and therefore mitigated). [ibid] (See Section 14.4 point 18 for further research study citations.)

2. **Accepting the differing penetration depths of 4G c.f. 5G**, nevertheless, current 5G transmission systems continue to rely on simultaneous transmission of the 4G microwave band, [3] with the 4G link handling all signalling, handover management, and session control. [ibid] So, all the potential health concerns arising from 4G exposure will not go away with the establishment of 5G systems. Further, as far as the author is aware, there have been no quality studies examining the **combined** effects of 4G and 5G microwave radiation on the human body. And, with the recent deployment of 5G technology, it is impossible to know the mid-to-long-term effects on health.

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[1] Gerhards L et al. (2025), comprehensive review of voltage-gated channel mechanisms in low-intensity electromagnetic field bioeffects, Chemical Reviews, Vol. 125, Issue 17, pp. 8051–8088. DOI: 10.1021/acs.chemrev.5c00178

[2] See: https://www.nature.com/articles/s41370-021-00297-6 ; https://pmc.ncbi.nlm.nih.gov/articles/PMC8300848 ; and https://pmc.ncbi.nlm.nih.gov/articles/PMC8300848 and The human skin as a sub-THz receiver – Does 5G pose a danger to it or not? by Noa Betzalel, Paul Ben Ishai and Yuri Feldman

[3] See: *"NR and LTE Coexistence Through Dynamic Spectrum Sharing"* - Microwave Journal, December 2019, https://www.microwavejournal.com/articles/33239-nr-and-lte-coexistence-through-dynamic-spectrum-sharing

3. **The other geophysical change matters more directly to most public exposure:** with higher frequencies, transmission range falls off rapidly, requiring cell towers and small cells to be deployed in closer and closer proximity to one another, and to people's homes. [1]

4. **Modern cellular protocols differ from earlier generations** in two technical respects bearing on exposure profile. **Channel bandwidth**: 4G LTE typically uses 5–20 MHz channels per carrier; 5G NR sub-6 GHz uses up to 100 MHz contiguous channels (with carrier aggregation combining multiple), and 5G mmWave (not deployed in N.Z.) supports channels up to 400 MHz. [2] Wider channels allow higher peak data rates with proportionally less time spent transmitting per bit, so the time-averaged transmit power per unit data delivered can be lower with 5G - this is the basis of the industry argument that 5G is more spectrum-efficient and produces lower average exposure for the same data delivered. [3] Peak transmit power, however, is set by hardware and regulatory limits; wider bandwidth does not reduce peak exposure. **Subcarrier spacing and slot timing**: 4G LTE uses fixed 15 kHz subcarrier spacing with 1 ms subframes and 0.5 ms slots. 5G NR supports flexible numerology with subcarrier spacings from 15 to 240 kHz and correspondingly variable slot lengths down to 0.0625 ms. Both 4G and 5G have envelope features in the 10–1000 Hz range - but the 5G envelope is less periodic than 4G's because of variable slot timing under different numerologies and dynamic time-division duplexing with traffic-dependent uplink/downlink ratios. Specific claims of the form "5G pulses at frequency X" (familiar from older EHS-advocacy literature about specific GSM pulse rates) do not apply to 5G NR in the way they applied to GSM. [4]

5. **N.Z. cellular deployments are not uniform** - band aggregation depends on site type. Dense urban capacity sites may transmit across five to seven distinct bands per operator; suburban sites typically run a smaller mix [5]; rural sites are often coverage-driven with low bands dominating, and the n78 C-band 5G layer is frequently not deployed at all in rural areas because its propagation characteristics are unsuitable for long-range coverage. [6] Urban mobile sites in New Zealand normally employ multiple LTE and 5G frequency layers to provide additional capacity, whereas rural sites remain primarily coverage-driven and must continue to rely heavily on low-band spectrum such as 700 MHz. Therefore, the increase in the number of active frequency bands since 2016 is generally greatest at urban capacity sites and more limited at rural coverage sites. [7] The "modern tower transmits across many more bands than a 2016 tower" framing is therefore true for urban capacity sites, partially true for suburban, and largely false for rural.

   This connects to a different set of risks that must be considered, that run through the rest of this document: people in rural and edge-coverage areas have lower ambient RF exposure than urban residents, but their handsets operate in low-signal conditions much more often, where transmit power is at its highest. Heavy phone use in a rural area can produce higher cumulative personal

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[1] See: The human skin as a sub-THz receiver – Does 5G pose a danger to it or not? by Noa Betzalel, Paul Ben Ishai and Yuri Feldman ; Overview of Millimeter Wave Communications for Fifth-Generation (5G) Wireless Networks-with a focus on Propagation Models by Theodore S. Rappaport et al. ; and Antennas for Body Centric Wireless Communications at Millimeter Waves by Nacer Chahat et al.

[2] See: Dahlman E, Parkvall S, Sköld J. *5G NR: The Next Generation Wireless Access Technology*. 2nd ed. Academic Press; 2020

[3] See: IEEE Journal on Selected Areas in Communications, 32(6), 1065–1082, DOI: 10.1109/JSAC.2014.2328098

[4] See: https://www.3gpp.org/DynaReport/38211.htm; https://www.3gpp.org/DynaReport/36211.htm ; https://www.3gpp.org/DynaReport/38104.htm ; https://www.3gpp.org/DynaReport/36104.htm ; https://www.3gpp.org/DynaReport/38300.htm ; and Joe Wiart et al. "RF Exposure in 5G Networks: Challenges and Assessment." IEEE Access (2019)

[5] See: https://www.rsm.govt.nz/projects-and-auctions/completed-projects/preparing-for-5g-in-new-zealand

[6] See: https://rfessentials.com/resources/rf-glossary/band-78-3-5-ghz/

[7] See: https://cellsites.nz/frequencies.html and https://www.rsm.govt.nz/projects-and-auctions/completed-projects/preparing-for-5g-in-new-zealand

exposure than moderate phone use in a good-signal urban area, despite the rural environment being "less RF-saturated." This shifts how risks and recommendations must be considered in order to protect rural communities: people in rural and edge-coverage areas have particular reason to attend to handset-distance practices, because their personal exposure can be elevated despite the lower ambient-exposure environment. (See Section 8.1 for the per-operator N.Z. band table.) [1]

6. **Mid-band 5G deployments normally use active antenna systems (AAS**) incorporating Massive MIMO antenna arrays and electronic beamforming. This allows radio energy to be dynamically directed (focused) toward users and represents a significant change from the predominantly passive sector antennas employed in earlier generations of mobile networks. [2] Typical New Zealand 5G n78 (3.5 GHz) 64T64R Massive MIMO antenna panels have physical apertures on the order of 0.3–0.5 m in width and 0.7–1.0 m in height, with exact dimensions varying by vendor and model. [3]

7. A consequence for exposure assessment follows: Far-field boundary moves outward. Using $d \approx 2D^2/\lambda$ with $D \approx 50$ cm and $\lambda \approx 8.6$ cm at 3.5 GHz, the far-field boundary sits at approximately 5–6 metres from the panel; larger 256-element arrays push it to tens of metres. **So, more locations near a 5G base station can fall in the radiating near-field**, where simple inverse-square reasoning does not apply. The chief concern with being in the near-field of radiation is that field strengths are much less predictable and can be much higher. [4] This is actively addressed in the dosimetry literature. [5]

8. **Beam concentration vs. duty cycle.** A beam-formed signal can deliver a higher directional peak Equivalent Isotropically Radiated Power (EIRP) toward an individual user than a broadcast antenna of the same total transmit power. [6] (EIRP is the legal ceiling that limits the total power a transmitter and its antenna can radiate in a specific direction.) But that beam is not pointed at any one location most of the time - it is steered between users on a TDMA-like schedule. Whether time-averaged exposure at a fixed point is higher or lower than at a 4G site depends on traffic patterns, deployment density, and the time-averaging window used in the assessment. [7] ICNIRP 2020 and the FCC have grappled with this explicitly: conservative max-EIRP assessments overstate exposure considerably, while time-averaged assessments using actual beam-steering statistics are an active methodological debate.

9. **N.Z. context:** Phased-array equipment is deployed at the n78 C-band sites used by all three N.Z. operators, and at Spark's n40 (2.3 GHz) and n1 (2.1 GHz) layers, and One NZ's n7 (2.6 GHz) layer. The two low-band 5G deployments - Spark n5 (850 MHz) and One NZ n8 (900 MHz) - run on conventional sector antennas using dynamic spectrum sharing alongside 4G traffic, and are not phased-array beam-formed. mmWave phased arrays (which use larger element counts but smaller

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[1] Gati A., et al. "Exposure induced by WCDMA mobile phones in operating networks." *IEEE Transactions on Wireless Communications* (2009) https://ieeexplore.ieee.org/abstract/document/5351684 ; Joseph W., et al. "Comparison of personal radio frequency electromagnetic field exposure in different urban environments." *Environmental Research* (2010) https://www.sciencedirect.com/science/article/abs/pii/S0013935110001015

[2] See: https://www.pmcsa.ac.nz/topics/5g-in-aotearoa-new-zealand ; and https://www.ericsson.com/en/reports-and-papers/ericsson-technology-review/articles/beamforming-in-massive-mimo

[3] See for example: https://www.studocu.com/it/document/istituto-scolastico-superiore-8-marzo-k-lorenz-mirano/informatica/air-6488-b43-technical-specs-for-64t64r-antenna-matrix/137089058

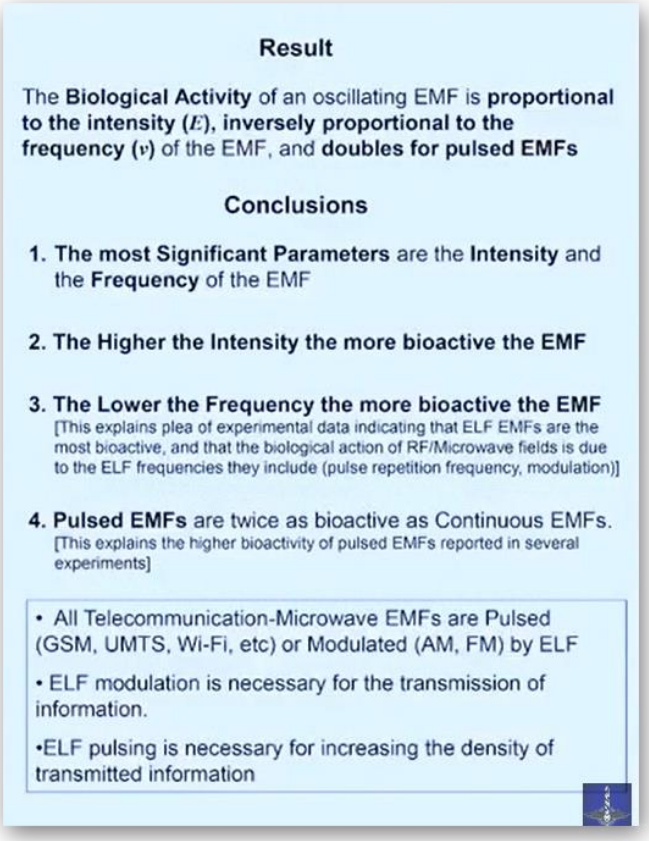
[4] See: International Commission on Non-Ionizing Radiation Protection (2020). *Guidelines for Limiting Exposure to Electromagnetic Fields (100 kHz to 300 GHz)*. *Health Physics*, 118(5), 483–524 ICNIRPrfgdl2020.pdf

[5] See: Thors et al. 2017 - Exposure to RF EMF from array antennas in 5G equipment (IEEE Access); Colombi et al. 2020 - Actual power and EMF exposure from base stations in a commercial 5G network (Applied Sciences); Hardell & Carlberg 2020 Stockholm 5G measurement campaign - Aspects on the ICNIRP 2020 Guidelines on Radiofrequency Radiation (World Academy of Sciences Journal).

[6] See: Recommendation ITU-T K.52 (08/2024) - Guidance on complying with limits for human exposure to electromagnetic fields

[7] See: ICNIRPrfgdl2020.pdf

individual element spacing) are not deployed in N.Z. So the "phased-array technically different" argument applies most strongly to the mid-band C-band and the higher sub-6 GHz layers, and weakens substantially for the low-band 5G layers. (See **Section 8.1**.) [1]



Biological Activity Effects of Oscillating EMFs – key variables. Dr Dimitris Panagopoulos 2024 [2]

Across the discussion above, it is worth being explicit about **a quantitative comparison that has substantial implications for where a key risk mitigation effort should be directed.** For the great majority of individuals, the dominant source of personal RF exposure is the mobile phone held to the head or carried on the body - not the cell tower or the Wi-Fi router - and the magnitudes are not close. Typical ambient ground-level exposure in publicly accessible areas around an N.Z. macro cell tower is generally less than a few percent of the ICNIRP public (thermal heating) limit (median European tower-area measurements are around 1% of ICNIRP, peaks under 8% per the Sagar et al. (2018) [3] systematic review and the British Columbia Centre for Disease Control review of 2019). [4] This translates to localised power densities in the 1–50 μW/cm^2 range. Localised exposure from a phone held against the head produces local SAR of approximately 0.2–1.5 W/kg in brain tissue near the antenna under typical voice-call conditions, with peak values approaching the regulatory limits in worst-case low-signal conditions where the phone transmits at its maximum power.

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[1] See: Niels Kuster et al. "Assessment of Human Exposure to EMR from 5G Massive MIMO Base Stations, https://journals.lww.com/health-physics/fulltext/2018/11000/assessment_of_human_exposure_to_5g_massive_mimo.2.aspx

[2] Electromagnetic Fields: Health Effects & Mechanism of Action - YouTube

[3] Sagar et al. 2018 - RF EMF exposure in everyday microenvironments in Europe: A systematic literature review (J. Exposure Science & Environmental Epidemiology). Median measured exposure around macro cell sites ≈ 1% of the ICNIRP public limit, peaks under 8%.

[4] See: https://westvancouver.ca/sites/default/files/dwv/assets/home-building-property/docs/Planning/cell-towers/Council%20report%20and%20Appendix%20A.pdf

The corresponding local power density in head tissue is on the order of 100–1,000 μW/cm² - two to three orders of magnitude higher than ambient tower exposure for the same individual.

One important technical caveat on this comparison concerns **mobile-phone transmit-power control**. Modern phones use closed-loop power control: the base station tells the phone the minimum transmit power needed to maintain link quality, and the phone adjusts continuously. In good-signal conditions - close to a base station, with clear line-of-sight - a phone can transmit at hundreds to a thousand times below its peak certified power. In poor-signal conditions: rural areas, edge of coverage, basements, lifts, vehicles, urban canyons, the phone transmits at or near its maximum. Therefore, the same phone, in the same hand, used by the same person, produces dramatically different personal RF exposure depending on local signal quality. A user close to a base station with good signal receives slightly higher ambient exposure from the tower but markedly lower personal exposure during phone use; a user in a low-signal rural or edge-coverage area has the opposite profile (lower ambient, much higher personal-use exposure during calls). The 100–1,000× handset-vs.-ambient ratio quoted above is therefore a worst-case figure that applies most strongly in low-signal conditions; in good-signal conditions the ratio is much smaller, though handset-against-head exposure typically still dominates ambient exposure for most users. [1]

13.3 Differing characteristics of microwave Generations: Three implications

First, this is where precautionary, risk mitigation efforts are well-indicated as they are based on established science with little or no disagreement. For example, most laptops/notebooks and cell phones have small-print warnings in their documentation, advising minimum distances between the operational device and the user. That is, the recommendations this monograph already makes (Section 17, Section 20 and Appendix) about handset use distance, speakerphone use, wired headsets, low-signal avoidance, and SAR-distance disclosure, target the dominant individual-dose source.

Second, this puts EHS attributed to far-field tower exposure in context: tower exposure is 100–1,000× lower than handset exposure, yet some individuals report symptoms attributed to tower exposure that they may not report in proportion to their phone use. This implies either non-linear or threshold mechanisms, individual sensitisation, or factors other than raw dose. For example, modulation pattern, exposure duration, contextual or psychological factors could all be explanatory factors. These additional potential factors explain why it is a major oversimplification to state that "all RF is dangerous in proportion to its presence." In addition, in some cases where people report being affected by proximity to mobile cell towers but not by mobile phone use, it may be that their mobile phone use is intentionally highly restricted – a longstanding practice adopted by the author. Or, it may be that such subjectively affected people unwittingly have their Wi-Fi router on all the time at home, unaware of its potentially damaging effects.

Third, recommendations about ambient sources (tower siting, Wi-Fi in schools, smart meters) are defensible on cumulative-population-exposure and child-specific-vulnerability grounds, even though they may total a smaller fraction of individual dose for most adults; these recommendations stand on their own grounds and are not undermined by the handset-dominance comparison. **Section 20.1** (SAR testing vs real-world use) and **Section 22** (recommendations) follow up these implications.

[1] Gati A., et al. "Exposure induced by WCDMA mobile phones in operating networks." *IEEE Transactions on Wireless Communications* (2009) https://ieeexplore.ieee.org/abstract/document/5351684 ; Joseph W., et al. "Comparison of personal radio frequency electromagnetic field exposure in different urban environments." *Environmental Research* (2010) https://www.sciencedirect.com/science/article/abs/pii/S0013935110001015

13.4 German research: Damage to chromosomes from long-term cell tower exposure.

Exacting German research shows damage to chromosomes from long-term cell tower exposure – when living within 160 metres to the closest tower. Despite the somewhat reassuring explanation in the above paragraphs which compared cell tower and cell phone exposure levels, important German-based research (2024) looked at whether or not living close to a cell tower might cause measurable health damage. Researchers meticulously analysed a huge range of health variables based on varying exposure levels to residential base cell towers. The study published in July 2024 compared those who lived in close proximity to mobile base towers (for 5 years or longer) with those who were significantly further away – again for 5 years or more in that area. [1] The Western European scientists conducting this research were all eminent in their fields. [ibid] The subject groups were drawn from neighbouring residential areas in Germany and all subjects reported being in good health.

The study was initiated to assess whether **non-thermal** (non-ionising) exposure levels over a long time period could damage individuals' health. Subjects were matched for possible confounders such as age, sex, nutrition, medical history, medication intake, life-exposure to ionizing radiation (X-Rays, CT scans etc.), occupational RF-EMF exposure, etc. All of the group that lived more distantly from the nearest cell tower were at least 490 metres from that tower and averaged 767 metres. The high exposure group was within at least 160 metres of the nearest tower, with average distance being 125 metres.

[1] See: https://www.sciencedirect.com/science/article/pii/S0147651324005621?via%3Dihub ; and documentary made by these researchers at: https://www.orsaa.org/exposure-mp-tower-video.html

Table 2,
Physical parameters in control and exposed groups. EMF related physical parameters in the sleeping area of the participants living close or distant to the next MPBS. Extremely low frequency fields (16.7 Hz, 50 Hz) were generally low. The group difference to MPBS signal exposure (GSM, LTE) was significant between the groups, while exposure to indoor RF-EMF fields (DECT, WLAN) was not.

Physical parameters	Control-Group N=12 (Mean ± SD)	Exposed-Group N=12 (Mean ± SD)	ANOVA Group difference	
			P	Significance
LFEF; V/m; max	20.4±21.8	27.8±33.4	0.530	n.s.
LFMF 22–6; nT; 16,7 Hz; Max	18.8±16.8	29.2±20.7	0.190	n.s.
LFMF 22–6; nT; 16,7 Hz; AVG	0.8±1.9	3.5±3.2	0.021	*
LFMF 22–6; nT; 50 Hz; Max	61.5±45.2	46.9±22.6	0.326	n.s.
LFMF 22–6; nT; 50 Hz; AVG	18.4±11.5	13.9±9.6	0.312	n.s.
GSM base load RMS, $\mu W/m^2$	1.2±1.6	69.5±108.5	0.040	*
GSM full load RMS, $\mu W/m^2$	4.7±6.4	278.1±434.0	0.040	*
GSM base load PEAK, $\mu W/m^2$	1.5±2.0	87.5±136.6	0.040	*
GSM full load PEAK, $\mu W/m^2$	6.0±8.1	350.1±546.4	0.040	*
LTE base load RMS, $\mu W/m^2$	2.7±2.7	306.7±310.3	0.003	**
LTE full load RMS, $\mu W/m^2$	10.9±10.6	1226.8±1241.1	0.003	**
LTE base load PEAK, $\mu W/m^2$	27.3±26.6	3067.1±3102.7	0.003	**
LTE full load PEAK, $\mu W/m^2$	109.2 ±106.4	122,68.2 ±12,410.7	0.003	**
DECT; PEAK $\mu W/m^2$	61.6±141.7	14.1±27.5	0.266	n.s.
WLAN; PEAK $\mu W/m^2$	98.8±187.4	130.4±239.0	0.722	n.s.

Legend: LFEF - Low frequency electric alternating fields; LFMF – Low frequency magnetic alternating field; GSM, LTE– MPBS signals; DECT – Cordless telephone signals; WLAN – Wireless Local Area Network (WLAN-Router signal), 22–6 – nighttime, PEAK and RMS – detector for RF-spectrum analysis. n.s. – not significant;
*** $p < 0.001$.
* significant, $p < 0.05$;
** significant, $p < 0.01$

See Gulati et al. (2024) https://www.sciencedirect.com/science/article/pii/S0147651324005621?via%3Dihub

Research results showed that the close-proximity group had significantly more chromosomal aberrations such as dicentric chromosomes (p=0.007), chromosomal fragments (p=<0.001) and the total chromosomal aberrations were very significantly higher at p=<0.001. So, the rate of chromosomal damage reflected exposure intensity and "no potential confounder interfered with these findings." **ibid** Further, the level of chromosomal damage in the high-exposure group was nearly double that of the low-exposure group. ibid Researchers concluded that these important differences between the two groups:

> "point to the MPBS [Mobile Phone Base Station] signals (GSM, LTE) as cause of the observed genetic instability. Thus, our findings on chromosomal aberrations may provide a biologically plausible mechanism for the data on significantly increased risk of cancer among persons exposed to MPBS signals." [1]

[1] See Gulati et al. 2024, https://www.sciencedirect.com/science/article/pii/S0147651324005621?via%3Dihub

That is, as a possible result from living much closer to mobile base stations or other RF-EMF transmission sources. [1]

After consultation with the International Atomic Energy Agency (IAEA), researchers were informed that the chromosomal damage that the high-exposure group appeared to experience from non-ionising cell tower microwaves, was identical to chromosomal damage caused by **ionising** radiation – such as from exposure to atomic radiation, or multiple exposures to X-Rays. In other words, contrary to theoretical expectations, the human chromosomes "didn't care" whether the radiation was ionising or non-ionising. [2]

So, despite the supposedly safe levels of cell tower microwave radiation – and the low intensity of such microwave power compared to handset use - those who had lived nearby for 5 years or more, were apparently experiencing significant health damage as a result. While subject numbers were low (12 in each group) the selection progress for each subject was highly rigorous, eliminating all known confounding variables and ensuring that the two groups were as matched as humanly possible. Also, it is a well-accepted fact of statistical analysis that when comparing group outcomes, the smaller the number of subjects, the harder it is to achieve a statistically significant result. So, this makes such large statistical differences even more remarkable and concerning. In the opinion of the writer, given all the methodological constraints of human experimentation in the field of RF-EMFs, this was about as rigorous an outcome as would be scientifically (and pragmatically) possible.

Three key resources for a more in-depth understanding

Beyond all the above likely damaging characteristics of MMMs, for a more in-depth biophysics understanding, please see the excellent book Chapter by Igor Belyaev: 2015_Belyaev.pdf

For the reader wishing to access comprehensive, high-level science on this issue, please refer to the 2021 ORSAA review which is based on the investigations conducted by Prof. Yuri Grigoriev over many decades: *Frequencies used in telecommunications - an integrated radiobiological assessment - ORSAA 2021 EX.pdf* in Papers etc on EHS & Effects of RF-EMFs.

For a scientifically in-depth analysis of why current cell phone technology safety limits appear to be fundamentally outdated and inadequate, the reader is encouraged to peruse the April 2023 journal article by Prof Paul Heroux *et al*. [3]

[1] See: Li et al., 2012, A population-based case–control study of radiofrequency exposure in relation to childhood neoplasm - ScienceDirect ; Eger et al. 2004, "The Influence of being Physically near to a Cell Phone Transmission Mast on the Incidence of cancer, Published in Umwelt-Medizin." https://alliance4mra.org/wp-content/uploads/2021/05/37-increased-incidence-of-cancer-near-a-cell-phone-trasmitter-station.pdf ; Rodrigues et al. 2021, https://www.mdpi.com/1660-4601/18/3/1229

[2] See documentary made by these researchers at: https://www.orsaa.org/exposure-mp-tower-video.html

[3] See: Cell Phone Radiation Exposure Limits and Engineering Solutions | MDPI

Kamo (Whangārei) – large (macro-cell) 4G-5G mobile cell tower less than 40 metres from residential housing – photo by author

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14. Apparent Pathways / Mechanisms of Harm by Man-Made Microwaves – on bodily structure and function

Opening note

All statements in the bullet-points below with casual-sounding language are to be read as the writer's opinion and interpretation, with acknowledgement that this is not settled science and that current Government regulations are not in agreement with at least some of these statements.

As well as relevant scientific studies and reviews being referenced, the information presented is occasionally based on statements made by reputable experts in the field, such as via online webinars and associated materials.

This Section (and the following) attempts to delineate and explain, most of the known or suspected mechanisms by which man-made microwaves may cause harm. As per **Section 13** above, no attempt has been made to isolate specific (man-made) microwave characteristics – such as frequency, wave length and power density – that are apparently involved in producing the documented effects. Rather, **any** apparent effect will be delineated, as long as the microwaves involved were man-made.

In science, statements claiming absolute causal relationships are usually avoided, with reasons for this being discussed at the end of this Section. Therefore, mechanisms of action will be elaborated in terms such as apparent, likely or probable causality.

The mechanisms described in this Section are grouped into four categories. **Direct biophysical mechanisms** (Mechanisms 1–6) describe how man-made microwave (MMMs) interact with biological tissues and processes at the cellular and sub-cellular level. **System-level damage routes** (Mechanisms 7–11) describe pathological pathways downstream of the direct mechanisms. **Functional disruptions** (Mechanisms 12–16) are physiological consequences observed in living systems. **Observed clinical outcomes** (Mechanisms 17–18) are the higher-level health consequences for which observational and epidemiological evidence is most extensive.

14.1 Apparent direct biophysical mechanisms

1. Disruption of electron transfer:

All cells emit low-level photons as part of cell functioning and communication. [1] All cells have micro-electrical currents running within them and between them (due to movement of electrons and protons). MMMs appear to almost immediately disrupt and overwhelm this micro-current and photonic communication. [2] (Also See: Dr P Heroux interview EMF Hazards Summit - The EMF Guy 48hrs free viewing)

2. Coherence (many small forces acting in concert):

Natural background microwaves are diffuse, multi-directional in nature and of very low energy. Therefore, they mostly cancel each other out and cause no damage. In contrast, MMMs operate in a single plane, as determined by the oscillating electric current creating the wave and the direction and shape of the antenna emitting the signal. These waves act together in synchrony (with the same frequency, phase and orientation in the plane of polarisation). It is this synchronous behaviour of millions of small forces from

[1] Mould, R. R., Mackenzie, A. M., Kalampouka, I., Nunn, A. V., Thomas, E. L., Bell, J. D., & Botchway, S. W. (2024). Ultra weak photon emission-a brief review. *Frontiers in Physiology*, *15*, 1348915 https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2024.1348915/full

[2] Héroux, P. (2025). The collision between wireless and biology. *Heliyon*, *11*(10). https://www.cell.com/heliyon/fulltext/S2405-8440(25)00647-4

these individual waves that collectively creates an overall significant force. This force can then cause neural/cellular bioelectric induction, disrupting moving charges in the body. [1]

3. Calcium ion (and other ion) influx into cells, and the oxidative cascade:

The cascade described in this mechanism comprises five connected stages: (1) voltage-gated channel perturbation leading to calcium influx; (2) reactive oxygen and nitrogen species (ROS/RNS) production; (3) peroxynitrite formation; (4) mitochondrial dysfunction and premature cell death; (5) systemic stress response. The cascade is supported empirically at multiple stages; the connecting causal arrows between stages are well-evidenced in the in-vitro and animal literature but less directly established in human in-vivo exposure at ambient RF levels. Each stage is described below with its supporting literature.

Stage 1: Voltage-gated channel perturbation and calcium influx.

All cells rely on exact concentrations of mineral ions being present on the inside and the outside of the cell. This involves maintaining a specific potential difference (PD) between the outside and inside of the cell, for all ionic forms. Departure from normal PD gradients leads to cellular dysregulation, and eventually to disease. For example, the concentration of calcium ions outside of cells is usually at least around 10,000 times more than inside the cell. [2]

Professor Martin Pall (Washington State University) has argued, in a widely cited line of work, that coherent MMMs at non-heating levels can disrupt the cellular potential difference, causing an abnormal influx of calcium ions through voltage-gated calcium channels (VGCCs) in the cell membrane. [3]

Stage 2: Reactive oxygen and nitrogen species production.

MMMs appear to cause a significant increase in oxidative and nitrosative stress. [4] This situation is created through the production of reactive oxygen species (ROS) and reactive nitrogen species (RNS), respectively. [5] Excessive production of ROS, or a deficiency in the body's ability to neutralize them, leads to oxidative stress. Similarly, high levels of RNS such as nitric oxide, can react with ROS to form even more potent reactive species, contributing to nitrosative stress. High levels of ROS (and RNS) cause increasing damage to lipids, proteins and DNA: basically, to any tissue that is exposed to ROS. [6]

Stage 3: Peroxynitrite formation.

A Reactive Oxygen Species called Peroxynitrite (ONOO) is the toxic end-product of irregular calcium ion influx. (See bullet-point 3 above - Irregular gating of ions across membranes.) That is, ONOO,

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[1] Panagopoulos et al. 2002 - Mechanism for action of EMF on cells (Biochem. Biophys. Res. Commun.); Panagopoulos et al. 2010 - Bioeffects of mobile telephony radiation in relation to intensity or distance from the antenna (Int. J. Radiation Biology). Polarisation/coherence mechanism is contested in mainstream biophysics.

[2] See: *EMF*D* [book] by Dr J Mercola, EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books (Chapter 4)

[3] Pall, M. L. (2018). Wi-Fi is an important threat to human health. *Environmental research*, *164*, 405-416. https://www.sciencedirect.com/science/article/pii/S0013935118300355 and 5032457

[4] Evaluation of basal DNA damage and oxidative stress in Wistar rat leukocytes after exposure to microwave radiation. | Semantic ScholarSee: New Report Contradicts Telecom Industry Claim That Wireless Radiation Is Safe (Children's Health Defense); Radiofrequencies as Generators of Biotoxic Free Radicals (MDPI Int. J. Environ. Res. Public Health).

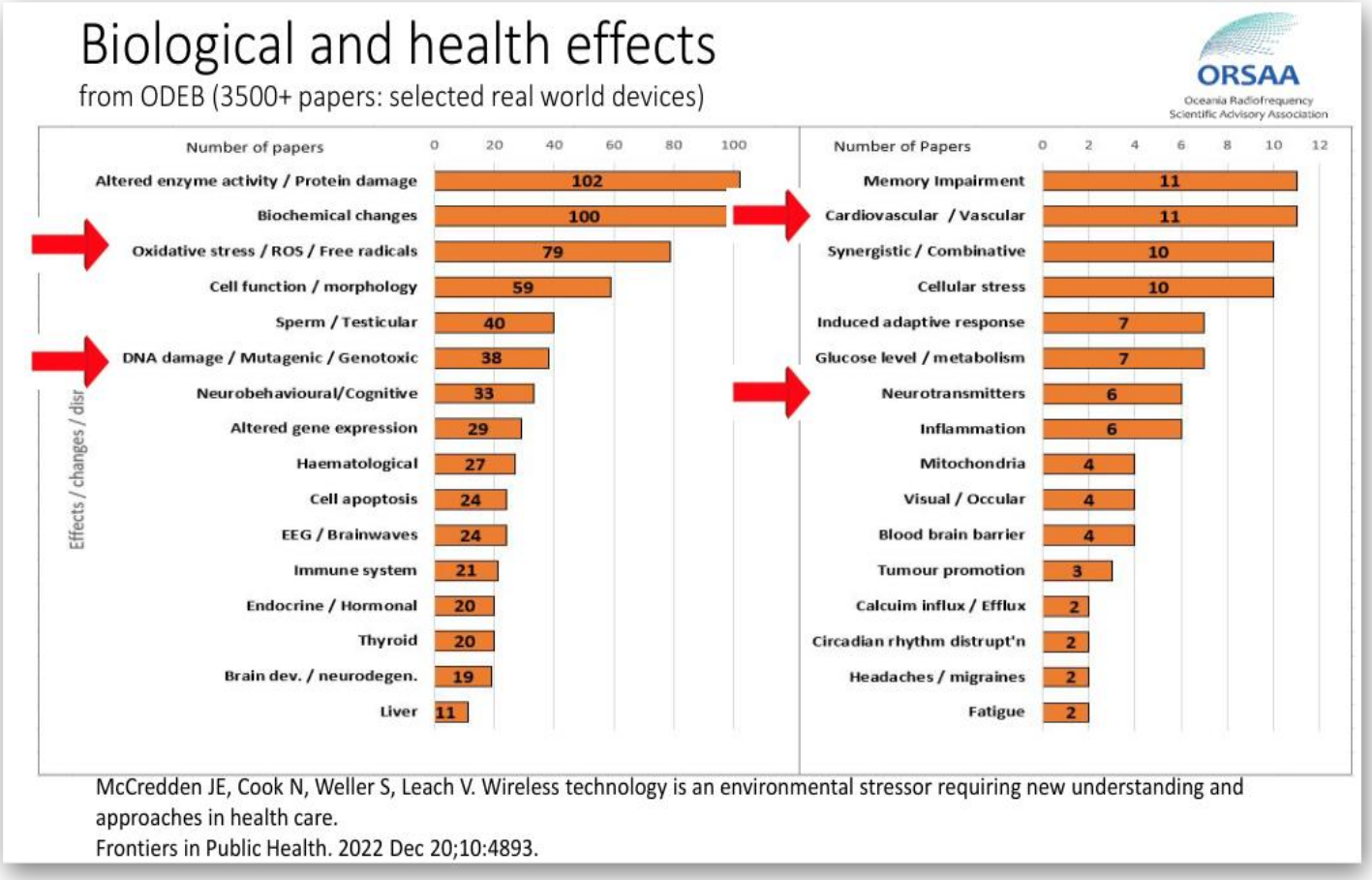
[5] See: Peroxynitrite-induced cytotoxicity: mechanism and opportunities for intervention - PubMed; and DNA damage induced by peroxynitrite: subsequent biological effects - PubMed. and 5032457

[6] Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective - ScienceDirect; and EMF-Portal | [ElektrosmogReport] (p4)

the end product of RF-mediated irregular calcium gating, is the pathway to many serious health effects. [1]

Stage 4: Mitochondrial dysfunction and premature cell death:

Ongoing MMM exposure appears to cause predictable and accruing damage to the very sensitive "power houses" inside every cell, the mitochondria. Many of the obvious symptoms of EHS can be traced back to mounting damage – in the brain and elsewhere - to these critical mitochondria. For example, chronic physical and mental fatigue, brain fog, and emotional flatness and distress. [2] (See also: Biological and health effects slide below)



EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

Once mitochondria are damaged, they initiate the **Cell Danger Response** (Dr R Naviaux), which can become an organ-specific, or even systemic dysfunction in the body, leading to a wide range of chronic health issues and diseases. (The 3 stages of the Cell Danger Response, are attack, repair

[1] See: Peroxynitrite-induced cytotoxicity: mechanism and opportunities for intervention - PubMed; and DNA damage induced by peroxynitrite: subsequent biological effects - PubMed.

[2] See: Non-thermal biological effects of radiofrequency electromagnetic radiation: Mechanistic insights into male reproductive vulnerability in the era of ubiquitous exposure - ScienceDirect; Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.); and 5032457

and reconnect, and the human physiology may become fixed or delayed in any one of these 3 stages – preventing what would normally be complete resolution of the CDR and of the illness.) [1]

MMMs appear to result in early cell death (premature apoptosis) and to dysregulate autophagy – by which unhealthy cells are killed off, and healthy cell components are recycled and utilised for the creation of new cells. (Autophagy and apoptosis are interconnected processes, with autophagy usually preceding apoptosis.) [2]

Stage 5: Systemic stress response:

Significant MMMs exposure appears to cause stress to the entire body – including neurological and emotional distress. This is likely primarily caused by the oxidative and nitrosative stress strongly associated with MMM exposure. [3] Such stress can often be measured in terms of low-grade systemic inflammation. (See study by Belpomme & Irigaray already quoted above.) This stress raises blood cortisol levels and hence blood sugar levels. Over the longer-term, this can lead on to Metabolic Syndrome, Diabetes, candida overgrowth in the gut, and so-called anxiety disorders – caused by fluctuating blood sugar levels and metabolic toxins from candida getting into the blood stream. (See also Biological and health effects slide)

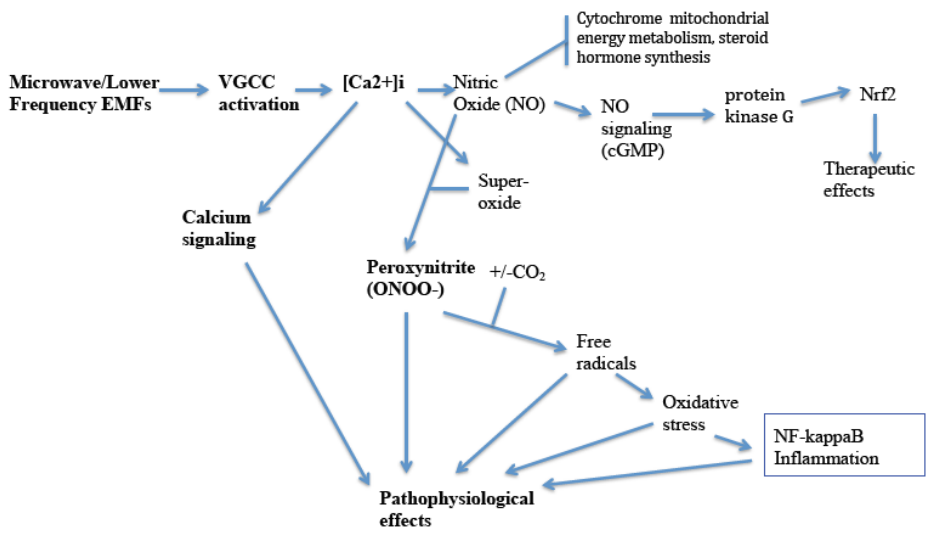


Fig. 1 How EMFs Act via VGCC Activation to Produce Various Effects

Prof. M Pall, 5G Health Risks: Evidence & Mechanisms | PDF | Forms Of Energy | Radiation p 28

Pall's mechanism is among the most prominent hypotheses for non-thermal RF bioeffects, and is supported by a large set of in-vitro and animal experiments showing that VGCC blockers can attenuate observed RF effects. [4] It has however, been challenged on quantitative grounds, in particular, on whether

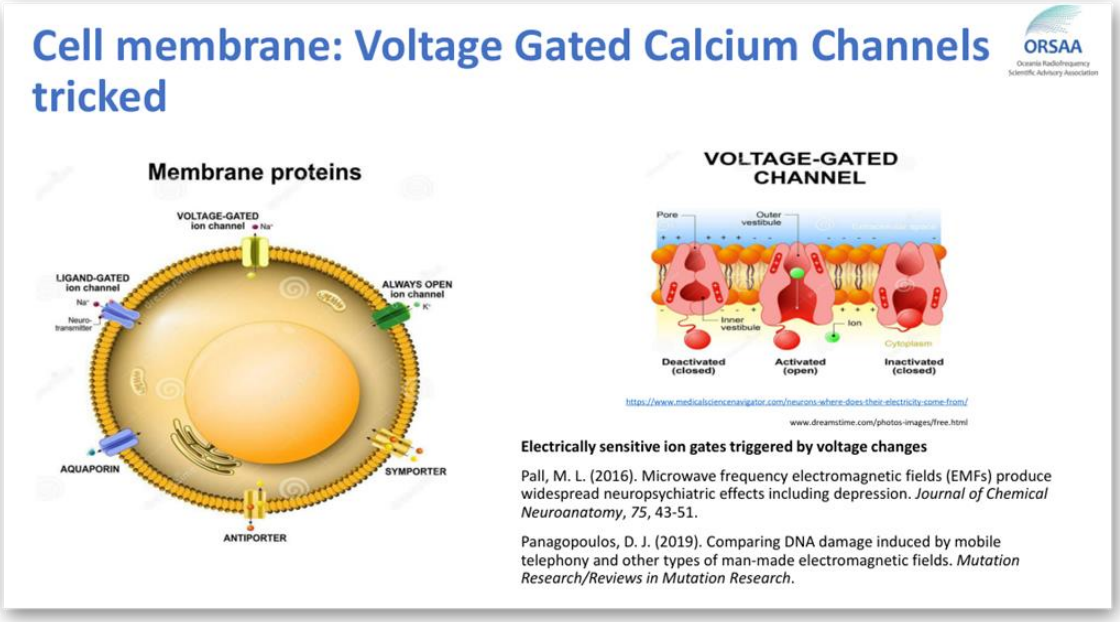
[1] See: Metabolic features of the cell danger response - PubMed
[2] See: Non-thermal biological effects of radiofrequency electromagnetic radiation: Mechanistic insights into male reproductive vulnerability in the era of ubiquitous exposure - ScienceDirect
[3] See: Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective - ScienceDirect; and EMF-Portal | [ElektrosmogReport] (p4)
[4] See: *EMF*D* [book] by Dr J Mercola, EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books

the voltage induced on a channel's voltage-sensing domain by ambient RF is large enough to operate the proposed mechanism, and that debate is not settled. [1] For example, critics have pointed out that Pall's model does not account for the centrality of modulation and pulsation, or explain why pulsed signals are more bioactive then continuous-wave signals at the same power density – one of the most consistently replicated features of the experimental literature. Further, if calcium ion gates/channels are being thus affected, why aren't other ion gates? [2]

In Pall's model, the downstream chain - calcium overload triggering oxidative and nitrosative stress, with peroxynitrite as a particularly damaging end product - is independently well-supported as is the link to many of the secondary mechanisms described later in this Section. Excess intracellular calcium is also directly toxic to the cell. [3]

Regarding peroxynitrite (ONOO), it has been shown to damage almost every tissue in the body. This includes damage to cell membranes, vital internal cell organelles such as mitochondria, proteins throughout the body, stem cells, and DNA. [ibid] Also, peroxynitrite is a relatively stable molecule, so it can travel a significant distance beyond the cell, readily inflicting distal damage. [ibid]

It should also be appreciated that calcium has many other roles in the body, including: forming neuronal connections in the developing brain and neurosculpting of unneeded connections; cell signalling; cell growth; muscle contraction; regulating enzymes and protein functions; triggering hormone release; blood clotting; activating the immune system; nerve function; sperm motility and egg fertilisation; and learning and memory. Therefore, all these key functions can potentially be undermined by MMMs. [ibid]



EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

[1] Foster KR, Moulder JE (2017), 'Wi-Fi and health: review of current status of research,' Health Physics 105(6):561–575 (Pall mechanism critique discussed). See also Pall's responses in the same and subsequent issues. Also, Wood A, Karipidis K. Radiofrequency Fields and Calcium Movements Into and Out of Cells. Radiat Res. 2021 Jan 1;195(1):101-113. doi: 10.1667/RADE-20-00101.1. PMID: 33206197

[2] See: Panagopoulos, DJ.. 'Comments on Pall's "Millimeter (MM) wave and microwave frequency radiation produce deeply penetrating effects: the biology and the physics". Reviews on Environmental Health, vol. 37, no. 2, 2022, pp. 295-297. https://doi.org/10.1515/reveh-2021-0090

[3] See: *EMF*D* [book] by Dr J Mercola, EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books ; and EMF Risk Blindspot: The role of modulation in signal interaction

3.1 The "Ion Forced Oscillation Model" of Panagopoulos and colleagues

To return to discussing the cell membrane, it needs to be understood as an integrated electrical signalling system, regulating all ion levels on the outside and inside of the cell, and thereby regulating and controlling all bodily functions that depend on electrical signalling. [1]

With naturally occurring EMFs, these are a continuous sinusoidal wave at a fixed frequency. These drive free ions on the cell walls into a stable, periodic oscillation, a rhythmic perturbation that the channel's voltage sensor may tolerate within its normal gating range. With man-made EMFs these consist of pulsed or amplitude-modulated fields, which are different in kind, not just degree. Hence, these are viewed by Panagopoulos and colleagues as capable of being bio-electrically disruptive to cell function. [ibid]

Cellular function encompasses not just calcium ion regulation (through the calcium channels/gates), but the wider voltage-gated channel family of sodium, potassium and chloride - and the proton channel Hv1. These all share the same voltage-sensing protein architecture namely the S4 voltage-sensing segment. With the myriad of free mobile ions on the outside of cell walls, as per Coulomb's Law, the irregular oscillating force of the applied electric field will cause these ions to oscillate unnaturally, in harmony with the external EMF. This (ionic) unnatural and erratic oscillation generates forces on the S4 sensing segment, thereby causing the voltage-gated channels to dysregulate and substantially perturb cellular function. [ibid]

So, the S4 voltage-sensing segment is this universal transducer, a single biological mechanism that converts electromagnetic field oscillations into cellular biological effects across many frequencies, intensities, and tissue types. [2] Importantly, Panagopoulos and colleagues found that man-made, polarised, coherent, pulsed electromagnetic fields are readily capable of perturbing ions at **non-thermal** intensities. [ibid] These same researchers showed that it was the slowly varying, polarised, coherent and pulsed modulation of EMFs that achieved this effect on the S4 voltage-sensor on cell walls. And, that in particular, it is the **modulation envelope**, the ELF/ULF variation in the signal that occurs at frequencies and intensities directly comparable to the cell membrane's own electrical activity. Further, it is the signal's irregularity of oscillation, not the energy of the carrier wave that disrupts cell membrane ionic function. [ibid]

So, according to these researchers, it is not the carrier frequency of a wireless signal that matters most. It is the low-frequency pulsations and irregular modulations embedded within it. Further, according to this explanatory model (Ion Forced Oscillation), the carrier frequency of a 4G, 5G, or Wi-Fi signal, in the Gigahertz range, is far too fast to drive meaningful ion displacement at the membrane. Ions simply cannot follow oscillations at those frequencies. [ibid] (That said, this does not imply that other postulated mechanisms in this Section are due solely or primarily to ELFs.)

> *"Panagopoulos landmark 2025 paper in Frontiers in Public Health, co-authored with Yakymenko, De Iuliis, and Chrousos, represented the first comprehensive unification of the IFO-VGIC mechanism with the full downstream biological cascade, tracing the chain from irregular channel gating through ROS overproduction and oxidative stress, to specific disease endpoints, while formally establishing why the*

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[1] See: EMF Risk Blindspot: The role of modulation in signal interaction ; and Panagopoulos et al. 2002 - Mechanism for action of EMF on cells (Biochem. Biophys. Res. Commun.)

[2] See: Panagopoulos et al. 2002 - Mechanism for action of EMF on cells (Biochem. Biophys. Res. Commun.); Panagopoulos et al. 2010 - Bioeffects of mobile telephony radiation in relation to intensity or distance from the antenna (Int. J. Radiation Biology); and Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

intense real-world variability of modern wireless signals, absent from most laboratory exposure systems, is itself the primary determinant of bioactivity." [1]

In terms of the ionic dysregulation, Panagopoulos and colleagues state that all the following channels are collectively affected: sodium channels, which initiate electrical activity; potassium channels, which regulate the timing of the voltage gates; chloride channels, which shape inhibitory tone and membrane stability; and calcium channels. This calcium channel dysregulation is most biologically consequential because calcium is the ion through which electrical activity is translated into cellular action. [ibid]

Evidence status of the Pall cascade and the Panagopoulos et al. Ion Forced Oscillation Model.

Pall's cascade is most strongly supported at Stages 1–3 (calcium influx, ROS/RNS production, peroxynitrite formation), where in-vitro evidence is robust. [2] Stage 4 (mitochondrial dysfunction and apoptosis) is supported by cell-line and animal-model evidence. [ibid] Stage 5 (systemic stress) is supported by observational in-vivo studies and biomarker work in occupationally and chronically exposed subjects (see also *Mechanism 6* on local thermal effects, where Volkow (2011) [3] documents a measurable metabolic response during phone use). As far as the author is aware, this cascade has not been fully demonstrated end-to-end, in controlled human in-vivo exposure studies at ambient RF levels.

The Ion Forced Oscillation Model of Panagopoulos and colleagues appears to provide a comprehensive explanation for non-thermal effects on cellular function, effects that are achievable at a biophysical and biochemical level, at **non-heating** power intensities. Their 2025 paper cites a large body of existing published research which already supports their model. [4] This model clearly invites attention and indeed demands action, by theoreticians in this field, by human and animal researchers in this area, and by agencies and Governments involved in the setting of acceptable safety standards.

4. Haemorheological effects (blood clumping / Rouleaux formation):

Even short exposure to MMMs appear to cause red blood cells (RBCs) in our body to lose their negative charge and become positively charged. [5]

Dr Beverly Rubik (2015) reported a small observational case study in which red blood cell aggregation ("Rouleaux Formation") was visibly increased in dark-field microscopy samples taken from healthy adult

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[1] See: EMF Risk Blindspot: The role of modulation in signal interaction ; and Panagopoulos DJ, Yakymenko I, De Iuliis GN and Chrousos GP (2025) A comprehensive mechanism of biological and health effects of anthropogenic extremely low frequency and wireless communication electromagnetic fields. Front. Public Health 13:1585441. doi: 10.3389/fpubh.2025.1585441

[2] See: EMF Risk Blindspot: The role of modulation in signal interaction; https://pubmed.ncbi.nlm.nih.gov/20649555/ ; https://pmc.ncbi.nlm.nih.gov/articles/PMC2861541/ ; https://pubmed.ncbi.nlm.nih.gov/12033431/ and https://pubmed.ncbi.nlm.nih.gov/12676457/

[3] Volkow ND, Tomasi D, Wang G-J, Vaska P, Fowler JS, Telang F, Alexoff D, Logan J, Wong C (2011), "Effects of cell phone radiofrequency signal exposure on brain glucose metabolism," JAMA 305(8):808–813. doi:10.1001/jama.2011.186.

[4] See: file:///C:/Users/hp/Downloads/fpubh-13-1585441.pdf

[5] Brown, R. R., & Biebrich, B. (2025). Hypothesis: ultrasonography can document dynamic in vivo rouleaux formation due to mobile phone exposure. *Frontiers in Cardiovascular Medicine*, *12*, 1499499 ; https://pubmed.ncbi.nlm.nih.gov/16241488/ ; https://www.frontiersin.org/journals/cardiovascular-medicine/articles/10.3389/fcvm.2025.1499499/full ; Havas, M. (2013). Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system. *Reviews on environmental health*, *28*(2-3), 75-84. https://alliance4mra.org/wp-content/uploads/2021/05/53-havas-wifi-affects-blood-heart.pdf ; and Cellphone Radiation Causes Abnormal Blood Clumping in Just 5 Minutes, Study Finds

Havas, M. (2013). Radiation from wireless technology affects the blood, the heart, and the autonomic nervous system. *Reviews on environmental health*, *28*(2-3), 75-84. https://alliance4mra.org/wp-content/uploads/2021/05/53-havas-wifi-affects-blood-heart.pdf ; and Cellphone Radiation Causes Abnormal Blood Clumping in Just 5 Minutes, Study Finds

subjects after periods of cell phone exposure. [1] The published images are striking - baseline samples versus samples taken after 20 and 45 minutes of phone use show visibly different aggregation patterns.

However, it is worth being explicit about the methodological status of this finding. The study involves a small number of subjects, no blinding, no randomisation, and no controls for sample handling between the baseline and post-exposure blood draws. Dark-field live-blood analysis as a clinical assay does not have established diagnostic validity for assessing acute physiological effects, and the Rouleaux phenomenon itself can be affected by many handling variables including sample temperature, time between draw and slide preparation, and slide pressure.

While the figures are an interesting illustrative observation, they should not be read as established evidence for cellular damage from phone use. Rouleaux formation has separately been documented in a range of clinical conditions (acute-phase inflammation, elevated fibrinogen, certain blood disorders); whether a small dose of cell phone exposure produces meaningful Rouleaux in well-controlled study designs has not been established – as far as the author is aware.

Fig 5 = Baseline (pre-exposure) blood sample

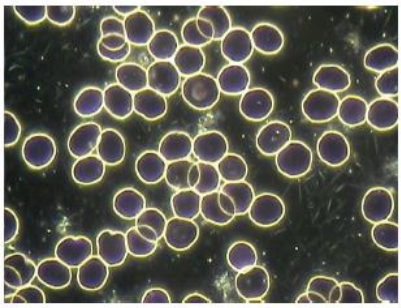


Figure 5: Baseline condition of male, age 55, showing normal, healthy blood.

Fig 6 = phone in backpack active for 20mins – but no data usage

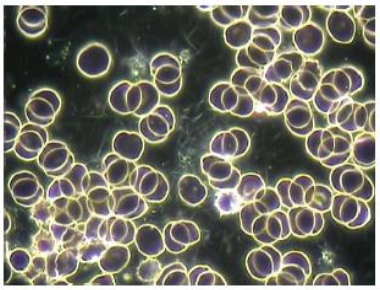


Figure 6: Carrying condition of same male showing aggregated cells and a few misshapen RBCs.

Fig 7 = phone active for 45mins, with 2 calls of no more than 5mins each

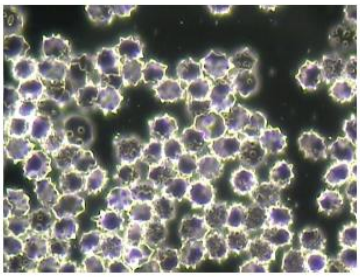


Figure 7: Active use condition of same male subject showing all RBCs are misshapen.

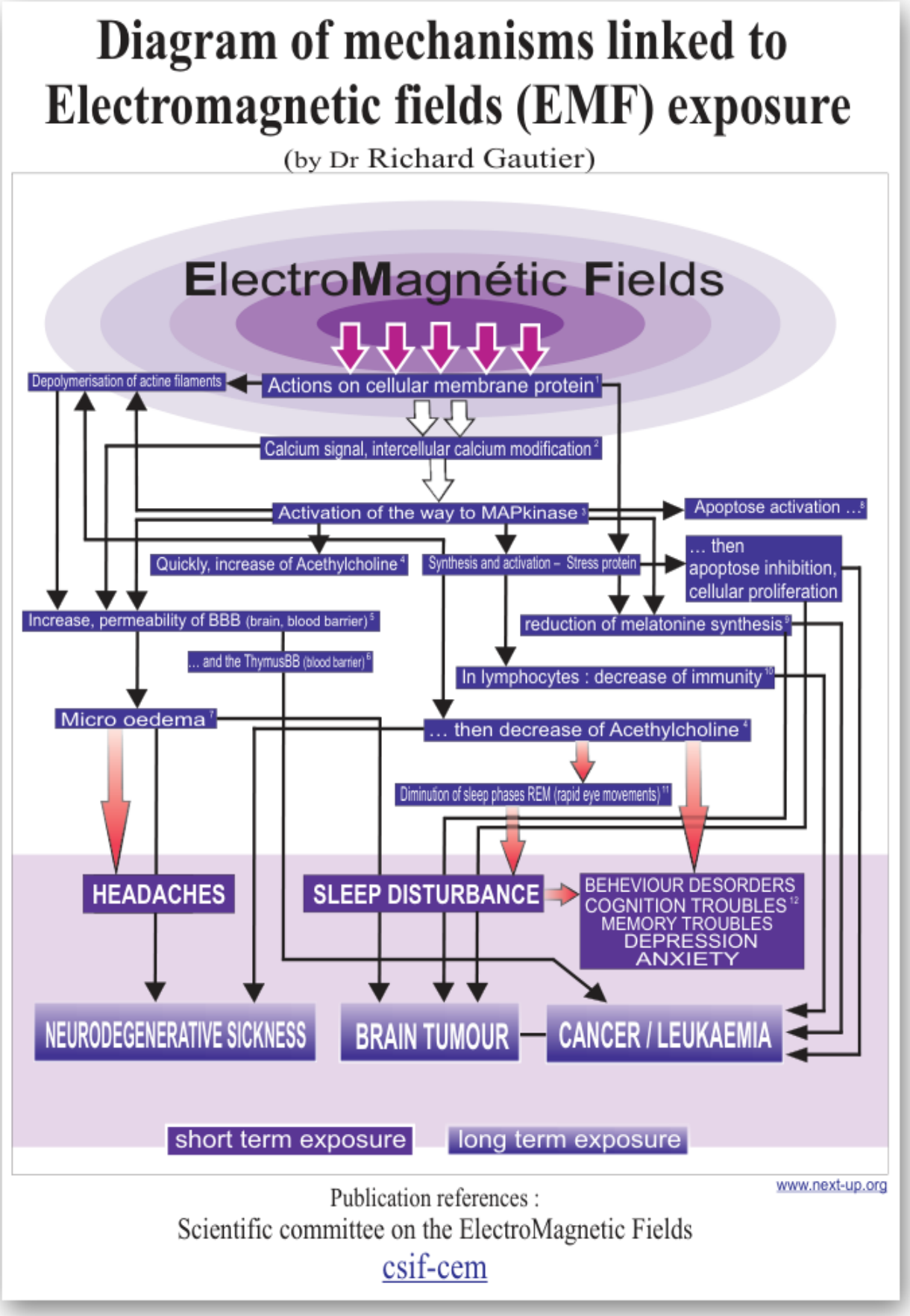
Subjects selected were all healthy adults. Subjects were tested in a room insulated from any other possible microwave radiation. First blood sample was taken after no cell phone use for at least 4 hours. Second blood sample was after the phone was carried in a backpack (45mins) on the subject's back, in active

[1] Rubik, B., & Brown, R. R. (2021). Evidence for a connection between coronavirus disease-19 and exposure to radiofrequency radiation from wireless communications including 5G. *Journal of clinical and translational research*, *7*(5), 666. https://pmc.ncbi.nlm.nih.gov/articles/PMC8580522/pdf/jclintranslres-2021-7-5-666.pdf

mode, but with no cell phone use. Third blood sample was after active use for 45mins – on the Internet or making phone calls – with a maximum of 2 phone calls of no more than 5mins each.

Public-domain picture from Pixabay.com

According to the **Scientific Committee on The Electromagnetic Fields**, the apparent disruption of function at the cellular level by MMMs can cause a wide range of damaging flow-on effects. (See diagram below).



5. Protein misfolding and conformational disruption:

Mobile-phone-frequency RF exposure may interfere with intracellular protein folding. In vitro work by Mancinelli and colleagues (2004) [1] showed that 1.95 GHz RF (a typical mobile-phone carrier frequency) perturbs the conformational refolding of myoglobin, with the authors concluding their findings represent "a potential risk for protein 'misfolding'." Subsequent work (Lian et al., 2018) [2] reported elevated generation of yeast prion [URE3], a non-pathogenic prion model, under both 50 Hz ELF and 2.0 GHz RF exposure. Whether these in-vitro and model-organism findings translate to demonstrable misfolded protein burden in human cells remains an open research question; the mechanistic significance is that protein misfolding and pathological aggregation are central features of several neurodegenerative diseases.

6. Local thermal effects in direct-contact exposure:

When a mobile phone is held against the head during a voice call, or carried against the body in a shirt or trouser pocket, there is a localised region of tissue at the antenna-side surface where RF energy deposition produces measurable thermal and metabolic responses. [3]

Volkow et al. (2011, JAMA) [4] used positron-emission tomography to measure brain glucose metabolism in 47 healthy adults during 50-minute mobile-phone exposures, in a within-subject controlled design with the phone deactivated as the control. They reported a statistically significant increase in glucose metabolism in the orbitofrontal cortex and temporal pole regions closest to the phone antenna during exposure - approximately 7% higher than control. The study did not assess clinical consequences, and the metabolic effect could be either a marker of cellular stress or a benign physiological response to local thermal load. What it demonstrates is that a measurable physiological change occurs in the brain region adjacent to the antenna during typical phone use, in an experimental design that is hard to challenge methodologically.

Several measurement studies have also documented small but consistent increases in skin temperature in the region of the head closest to a phone antenna during voice calls - typically a fraction of a degree Celsius, well below any threshold for acute tissue damage but consistent with the presence of local power absorption that the regulatory SAR framework already acknowledges.

Local thermal effects of this scale are not contested in the scientific literature. They are the physical basis on which the SAR framework was constructed (see Section 20.1), and they are consistent with the manufacturer-specified body-separation distance documented in every smartphone's RF-exposure section. The contested literature concerns whether non-local, non-thermal effects exist at the cellular level at ambient (away-from-source) RF exposure levels - that is the literature that the remaining mechanisms in this Section address. The two questions are distinct: local thermal effects during direct-contact use are real and documented; the non-thermal mechanism case applies to ambient-exposure scenarios and is the subject of the rest of this Section.

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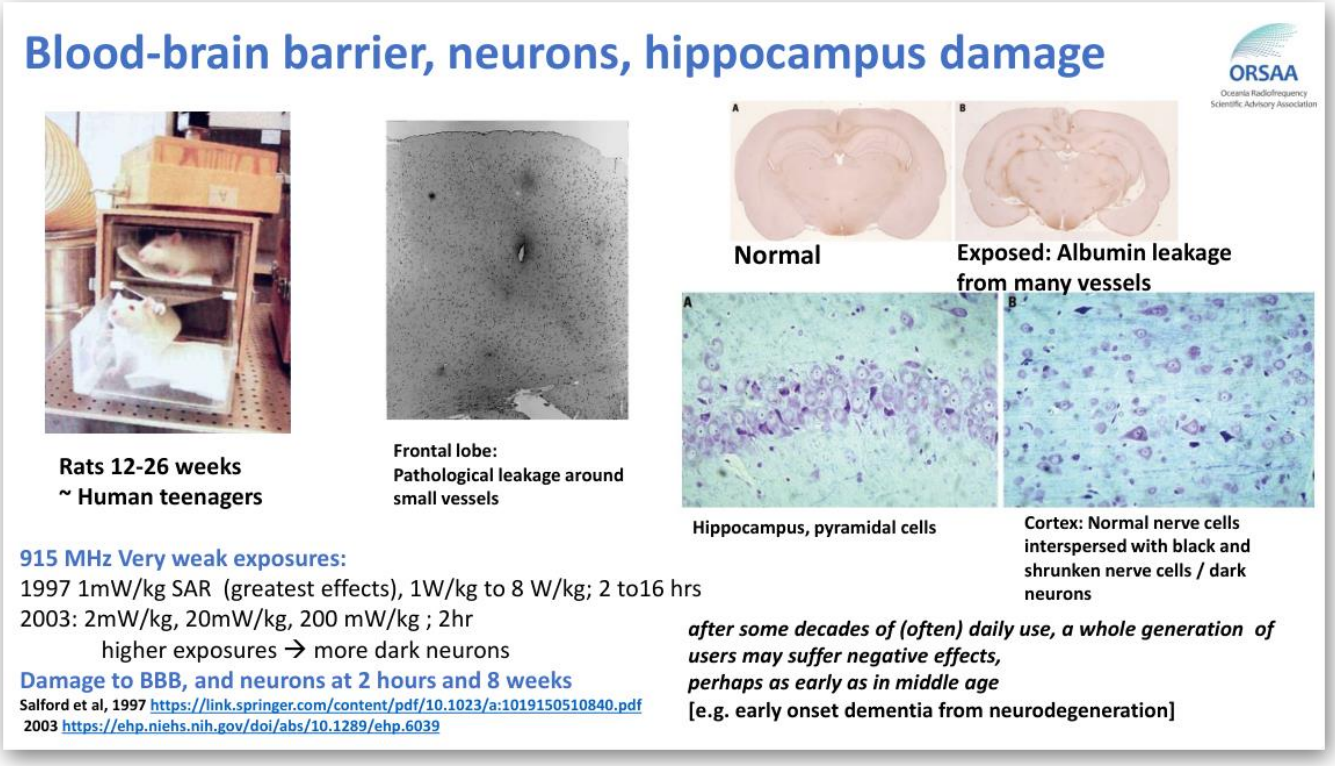
[1] Mancinelli et al. 2004 - Non-thermal effects of EMF on protein refolding (myoglobin) (J. Cellular Biochemistry)
[2] Lian et al. 2018 - Yeast prion [URE3] generation elevated under EMF (Cell Stress and Chaperones).
[3] Mancinelli et al. 2004 - Non-thermal effects of EMF on protein refolding (myoglobin) (J. Cellular Biochemistry); Lian et al. 2018 - Yeast prion [URE3] generation elevated under EMF (Cell Stress and Chaperones).
[4] Volkow ND, Tomasi D, Wang G-J, Vaska P, Fowler JS, Telang F, Alexoff D, Logan J, Wong C (2011), "Effects of cell phone radiofrequency signal exposure on brain glucose metabolism," JAMA 305(8):808–813. doi:10.1001/jama.2011.186.

14.2 Apparent system-level damage routes

7. Blood-brain barrier disruption:

MMMs appear to create blood-brain-barrier (BBB) leakage, allowing blood-borne pathogens, toxins, heavy metals, and even parasites, ready access to the brain. [1] This is very inflammatory to the brain, which may develop a chronic inflammatory response. Such a response unfortunately causes very significant early cell death (apoptosis) of neurons in the brain. [2] (See below; and Biological and health effects slide.)



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8. Brain-gut axis disruption:

There is constant gut-brain communication via the vagus nerve and via communication molecules in the cardiovascular system. The mainstream gastroenterology literature recognises increased intestinal permeability ("leaky gut") as a measurable phenomenon in conditions such as inflammatory bowel disease, coeliac disease, and alcoholic liver disease, with validated biomarkers including zonulin and lactulose-mannitol ratios. The specific chain proposed here - that disruption of the blood-brain barrier by RF exposure leads in turn to disruption of the gut barrier and to systemic leakage of inflammatory molecules such as lipopolysaccharide (LPS) [3] - extends from the broader gut-brain-axis literature and is biologically plausible, but direct experimental demonstration of the BBB→leaky-gut chain in humans following RF exposure remains limited. Independent of that chain, with chronic leaky gut from any cause, foreign food proteins can leak into the bloodstream and act as antigens to the immune system. Any tissue in the body

[1] See: "Permeability of the blood-brain barrier induced by 915 MHz electromagnetic radiation, continuous wave and modulated at 8, 16, 50 and 200 Hz" by Leif G. Salford, Arne Brun, Jacob L. Eberhardt and Bertil R.R. Persson (Bioelectrochemistry and Bioenergetics 30 1993 293-301)

[2] See: "Permeability of the blood-brain barrier induced by 915 MHz electromagnetic radiation, continuous wave and modulated at 8, 16, 50 and 200 Hz" by Leif G. Salford, Arne Brun, Jacob L. Eberhardt and Bertil R.R. Persson (Bioelectrochemistry and Bioenergetics 30 1993 293-301)

[3] See: Traumatic Brain Injury and Gut Microbiome: The Role of the Gut-Brain Axis in Neurodegenerative Processes - PubMed

that has a protein structure similar to a foreign food protein will potentially undergo an autoimmune attack: "molecular mimicry". [1]

9. Microbiome disruption:

A small but growing body of research has examined whether RF exposure perturbs the balance and health of the intestinal microbiome. [2] Altered gut microbiota and metabolic profiles have been reported following 4.9 GHz radiofrequency exposure, [3] a frequency that sits immediately below the 5 GHz Wi-Fi band (which operates approximately 5.15–5.85 GHz) and within the broad frequency range now used across various 5G mid-band telecommunications deployments - making the finding directly relevant to common modern consumer exposure. Greater antibiotic resistance has been found in microbes near telecommunications base stations, [4] and RF-EMF exposures from mobile phones have been shown to disrupt human skin microbiota. [5] Microbiome health is essential for the adequate functioning of the digestive, immune, neurological, and hormonal systems. [6] The specific evidence base on RF effects on the human microbiome is at present small, with heterogeneous exposure conditions across studies; the case for risk mitigation strategies here, rests on the combination of biological plausibility, a handful of suggestive primary studies, and the broader pattern of RF effects on microbial communities in soil and skin, rather than on a large coherent body of evidence.

10. Myelin and central nervous system structural damage:

Ongoing MMM exposure appears to cause the breakdown of the indispensable myelin sheath that coats many of the brain's neurons. [7] This sheath is essential for nerve cells to function adequately. (Accruing damage to the myelin sheath is accepted as a core feature of **Multiple Sclerosis** (MS) and ongoing exposure to MMMs could therefore exacerbate symptoms in MS.) See below and Biological and health effects slide.

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[1] See: Leaky Gut, Leaky Brain? - PubMed; Molecular mimicry as a mechanism for food immune reactivities and autoimmunity - PubMed; and Diet-Induced Gut Dysbiosis and Leaky Gut Syndrome - PubMed

[2] Luo, X., Huang, X., Luo, Z., Wang, Z., He, G., Tan, Y., ... & Yang, X. (2021). Electromagnetic field exposure-induced depression features could be alleviated by heat acclimation based on remodeling the gut microbiota. *Ecotoxicology and Environmental Safety*, *228*, 112980. https://pubmed.ncbi.nlm.nih.gov/34794024/

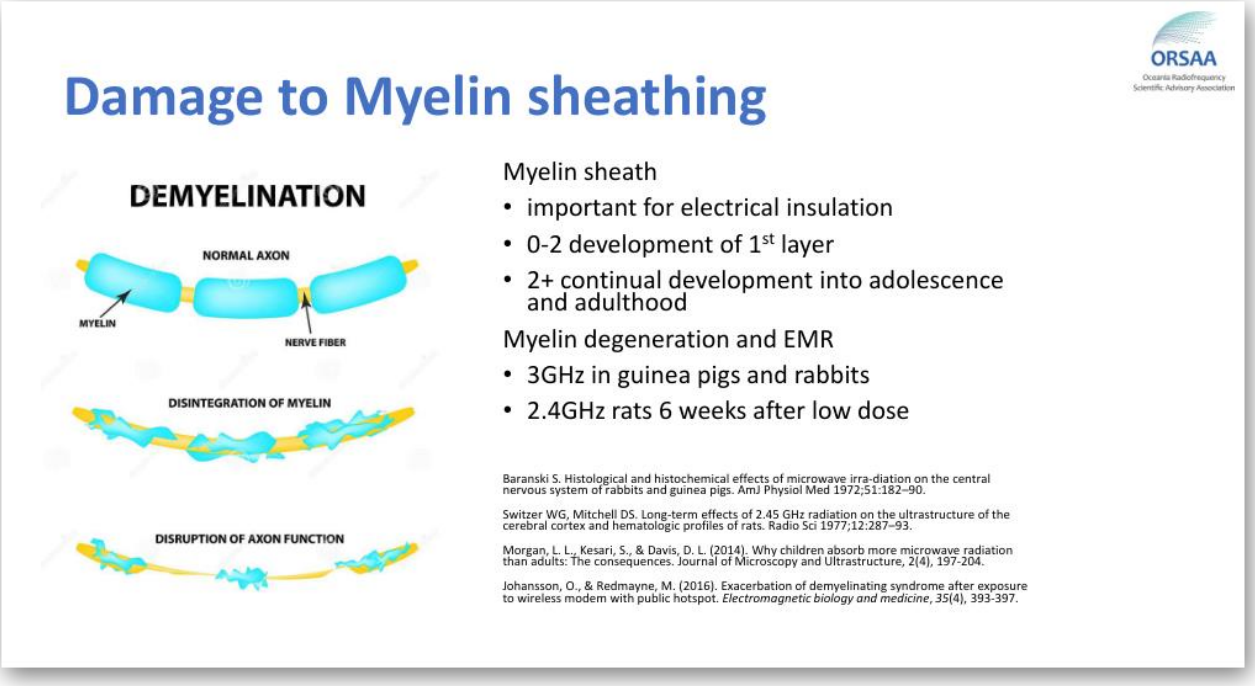
[3] Wang, X., Zhou, G., Lin, J., Qin, T., Du, J., Guo, L., ... & Ding, G. (2024). Effects of radiofrequency field from 5G communication on fecal microbiome and metabolome profiles in mice. *Scientific Reports*, *14*(1), 3571. https://www.nature.com/articles/s41598-024-53842-2.pdf

[4] Sharma, A. B., Lamba, O. S., Sharma, L., & Sharma, A. (2018, April). Effect of mobile tower radiation on microbial diversity in soil and antibiotic resistance. In *2018 International Conference on Power Energy, Environment and Intelligent Control (PEEIC)* (pp. 311-314). IEEE. https://www.researchgate.net/profile/Antim-Sharma/publication/331749510_Effect_of_Mobile_Tower_Radiation_on_Microbial_Diversity_in_Soil_and_Antibiotic_Resistance/links/5df9fab54585159aa4850719/Effect-of-Mobile-Tower-Radiation-on-Microbial-Diversity-in-Soil-and-Antibiotic-Resistance.pdf

[5] Crabtree, D. P., Herrera, B. J., & Kang, S. (2017). The response of human bacteria to static magnetic field and radiofrequency electromagnetic field. *Journal of microbiology*, *55*(10), 809-815. https://www.jmicrobiol.or.kr/upload/pdf/jm-55-10-809.pdf

[6] See: Electromagnetic field exposure-induced depression features could be alleviated by heat acclimation based on remodeling the gut microbiota - PubMed

[7] Johansson, O., & Redmayne, M. (2016). Exacerbation of demyelinating syndrome after exposure to wireless modem with public hotspot. *Electromagnetic Biology and Medicine*, *35*(4), 393-397. http://www.iso.ro/documente/radiatii/Demielinizare.pdf



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11. Genetic damage and routes to offspring effects:

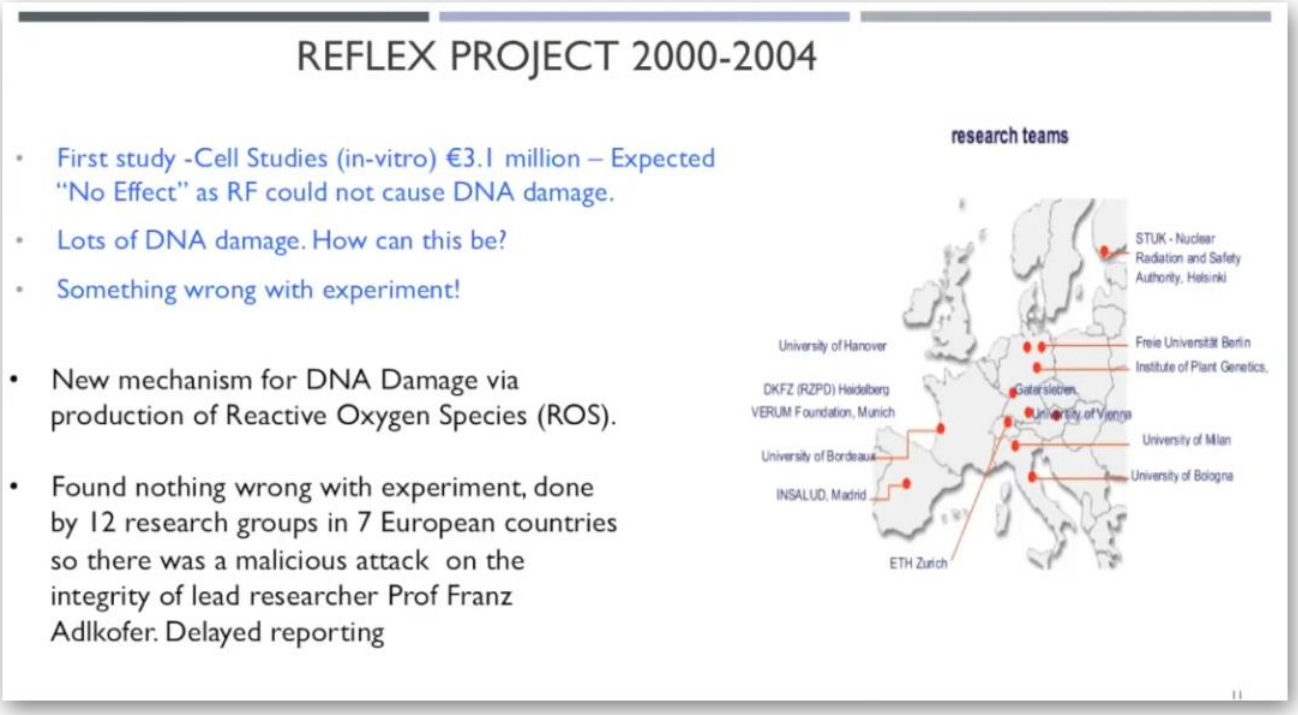
MMMs appear to cause single-strand and double-strand DNA breaks, oxidative DNA damage, and chromosomal abnormalities - in both animal studies and in cultured human cells. The most extensively replicated single line of evidence is the comet-assay literature, where Lai's 2022 [1] tally of the published RFR comet-assay studies found 78 of 125 studies (65%) reported significant DNA damage effects. Cellular DNA-repair pathways correct a fraction of this damage, but under chronic or repeated exposure the rate of new lesions can outstrip repair capacity, leading to accumulating somatic mutations, genomic instability, and downstream consequences for cell function and cancer risk.

Two routes can plausibly carry these effects from the exposed individual to their offspring. The first is *sperm-mediated*: RF exposure has been shown to cause DNA fragmentation, reduced motility, and oxidative damage in human sperm (De Iuliis et al. 2009; Agarwal et al. 2009; Adams et al. 2014 systematic review). [2] By the same mechanism that makes paternal age an established risk factor for *de novo* mutations in children (older sperm carries more accumulated DNA damage, which can be mis-repaired or unrepaired after fertilisation and transmit as new mutations), RF-induced sperm damage is biologically plausible as a route to heritable mutations in offspring. The component links are well-supported; the direct end-to-end epidemiological demonstration in humans (RF-exposed fathers → measurably elevated *de novo* mutation rates in their children) has not been carried out at scale, though some animal studies have shown fertility and developmental effects in the F1 offspring of RF-exposed parents.

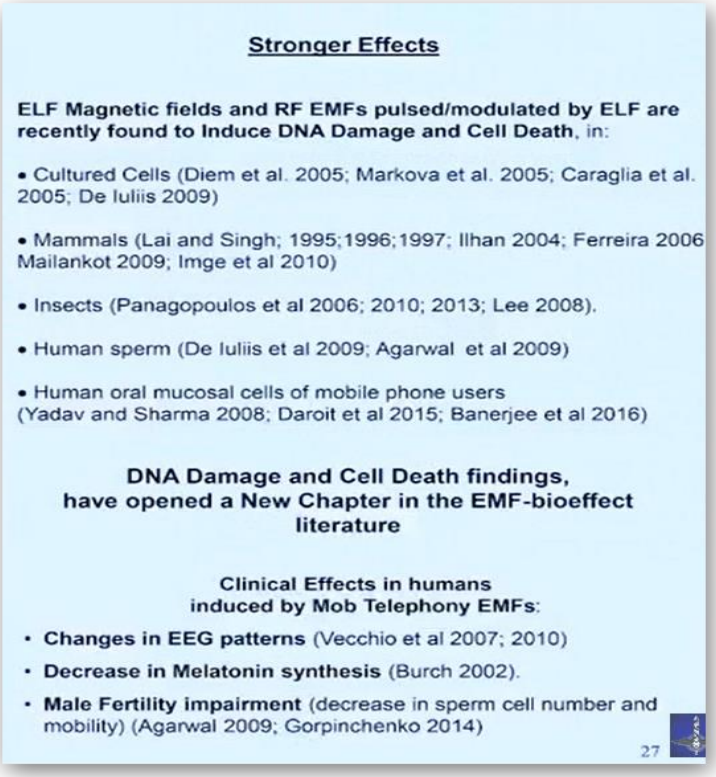
[1] BioInitiative 2022 - Lai tally (74% of 391 RFR neurology papers report effects)
[2] De Iuliis et al. 2009 - Mobile phone radiation induces ROS and DNA damage in human spermatozoa in vitro (PLOS ONE); Agarwal et al. 2008 - Effect of cell phone usage on semen analysis (Fertility & Sterility); Adams et al. 2014 - Effect of mobile telephones on sperm quality: systematic review (Environment International).

The second route is direct *in utero* exposure of the developing foetus, which can produce developmental and behavioural effects in offspring without needing to transmit through gametes. Aldad et al. (2012) in mice and Divan et al. (2008) in humans are the canonical references. [1]

(See the 3 slides below and refer back to the 2025 W.H.O. study in Section 6.)

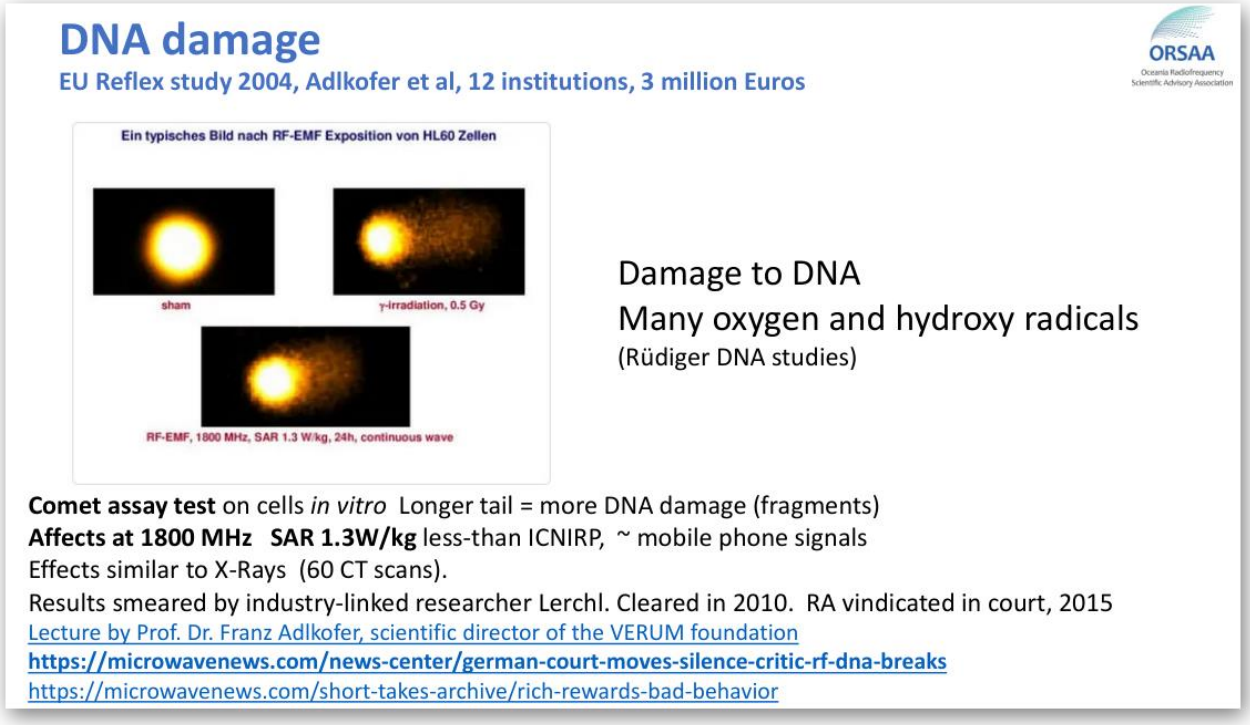


See: Health Freedom Event - Victor Leach



Dr Dimitris Panagopoulos YouTube presentation 2024
https://www.youtube.com/watch?v=wQrxwNTxAhE

[1] Aldad et al. 2012 - Fetal RF radiation exposure affects neurodevelopment and behavior in mice (Scientific Reports); Divan et al. 2008 - Prenatal and postnatal exposure to cell phone use and behavioral problems in children (Epidemiology).



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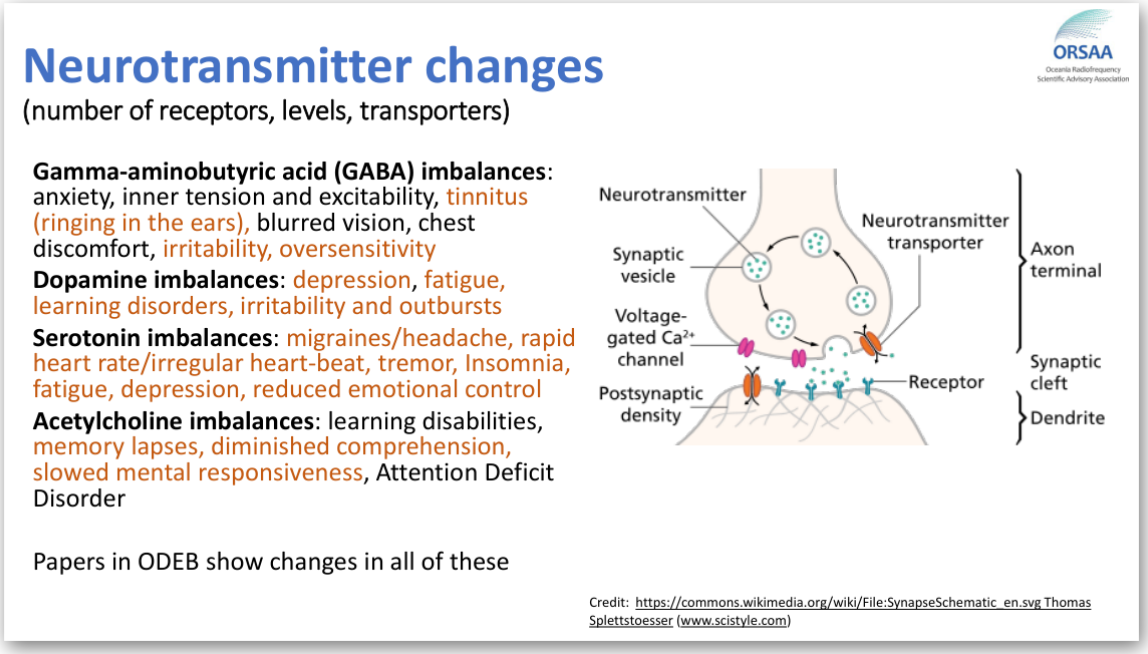
14.3 Apparent functional disruptions

12. Neurotransmitter, brain-wave, and cerebral blood-flow effects:

MMMs appear to alter the very delicate balance of neurotransmitters in the brain - in animal and human studies. Such an alteration can readily cause many adverse psycho-neurological effects. [1] See also the ORSAA slide below.



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[1] See: Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc. and 5032457

MMMs, including short exposures, appear to cause abnormal changes in brain wave (EEG) characteristics in human and animal studies. However, it is unclear how long these effects last, and what chronicity of exposure is required to create lasting effects. [1]

MMM exposure in humans appears to significantly reduce the flow of blood to the brain: neurovascular impairment. This appears so for even quite short exposure times. Again, it is unclear how long these effects last, and what chronicity of exposure is required to create lasting effects. However, in animal studies, chronic exposures appear to lead to neuronal lesions, especially in the area of the temporal lobes. [2] (See also: Biological and health effects slide)

These three findings: neurotransmitter changes, EEG changes, and cerebral blood-flow changes - are observationally distinct but appear mechanistically interconnected through the calcium-influx and oxidative cascade described in Mechanism 3, and through the BBB and structural-CNS effects described in Mechanisms 7 and 10. The supplementary measurements of local brain glucose metabolism and skin temperature during direct phone use are described separately in Mechanisms 6 and 13. (See also Section 15 on the EEG / cognitive-impact reading of these findings.)

13. Endocrine and metabolic perturbation:

Ongoing MMM exposure appears to perturb the functioning of the endocrine system and adversely affect thyroid function. Elevated levels of hormones such as insulin and cortisol are known to consistently cause inflammation, with chronic elevated levels of inflammation leading to many chronic diseases. [3] (See also Biological and health effects slide above.)

Longer-term MMM exposure appears to reduce heart rate variability (HRV) in humans – especially if mobile phones are carried near the heart, and/or with long-term substantial exposure to MMM (such as from nearby mobile towers). HRV is a key indicator of autonomic nervous system regulation, metabolic and immune system health, heart health, cognitive function, general health and psychological health. [4] (The **HeartMath Institute** has produced age-based norms for HRV.) It is currently unclear how long-lasting these negative effects are, and what length of exposure would be needed to create permanent effects. [5]

Medium-term exposure to MMMs from cell towers appears to consistently raise blood sugar levels – in high correlation with exposure level to the cell tower radiation. [6] Chronically raised blood sugar levels are inflammatory at a systemic level, usually leading to a range of serious chronic diseases. This can include diabetes, cardiovascular disease, neurodegenerative disorders and cancer. [7] (See also Biological and health effects slide above; and Behavioral and Health Impacts slide below)

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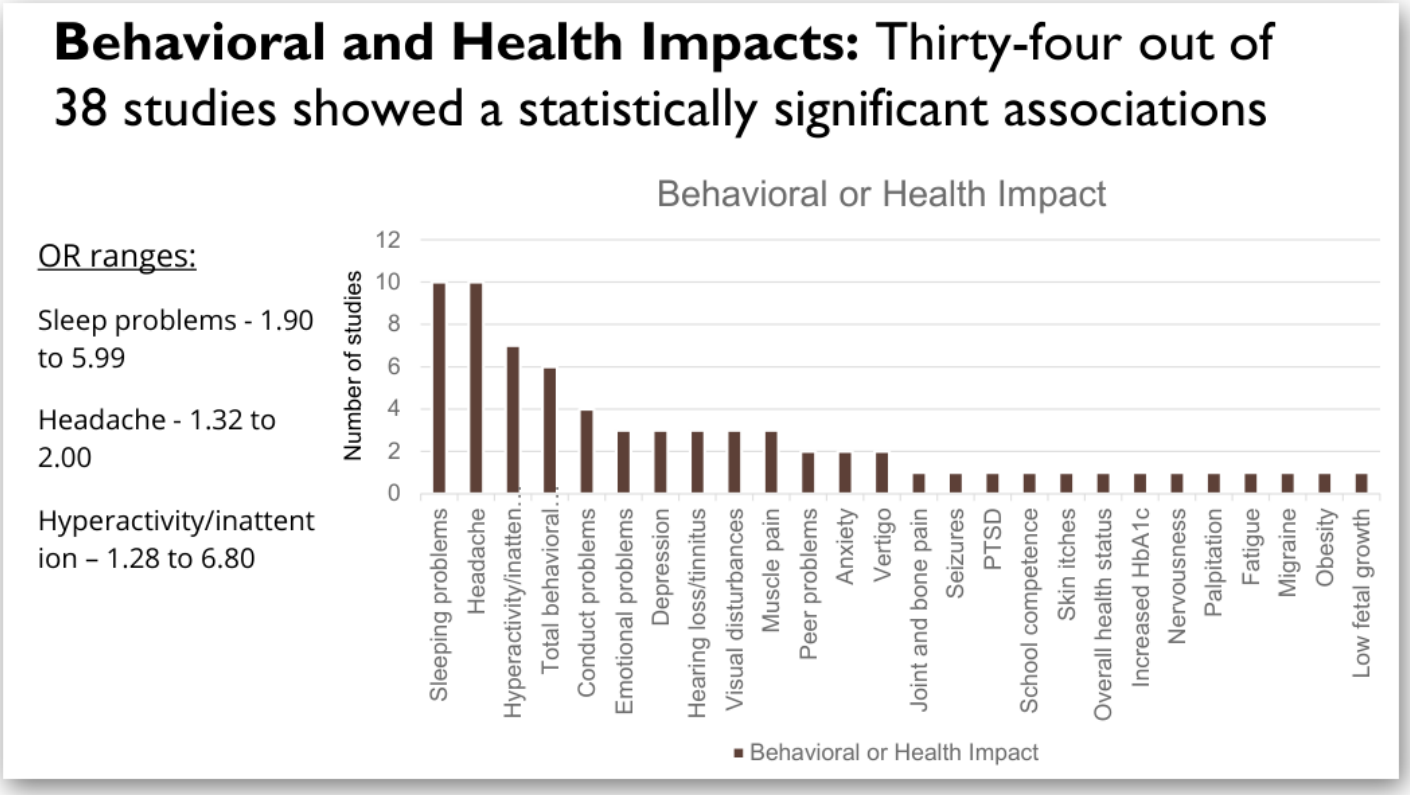
[1] See: Biological and health effects slide: and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.
[2] See: Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.
[3] Non-thermal biological effects of radiofrequency electromagnetic radiation: Mechanistic insights into male reproductive vulnerability in the era of ubiquitous exposure - ScienceDirect; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.)
[4] Bellieni CV, Tei M, Iacoponi F, Tataranno ML, Negro S, Proietti F, Longini M, Perrone S, Buonocore G (2012), 'Is fetal autonomic function influenced by mobile phone use during pregnancy?', Acta Paediatrica 101(1):e30–34, doi:10.1111/j.1651-2227.2011.02465.x.
[5] See: pdf-2236-2166; View of The Mobile Phone Electromagnetic Radiation Effects on Heart Rate Variability Function); and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.
[6] See: Power Systems, Telecommunications, and Diabetes | 6 | The Impact of An; and, EMR Radiation From Cell Towers, Wireless Devices Linked to Diabetes Epidemic
[7] See: Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.

14. Pineal Gland impairment & melatonin reduction:

Some studies have reported that ongoing MMM exposure may disrupt melatonin production by the pineal gland (Burch et al. 2002 [1]; Davis et al. 2006 [2] for related ELF findings); other studies have failed to replicate the effect. The current evidence base for an RF→melatonin link in humans is mixed rather than settled. The pineal gland sits below the blood-brain barrier and produces melatonin, which has well-established roles in circadian rhythm regulation, restorative sleep, and inflammation suppression. Melatonin also has documented anti-cancer effects in vitro (particularly on hormone-responsive cancers such as some breast cancers), and observational epidemiology shows shift workers - who have disrupted circadian rhythms and reduced overnight melatonin - at modestly elevated cancer risk for several cancer types.

Putting these elements into a single causal chain RF→reduced melatonin→increased cancer risk in humans is biologically plausible, but each link is contested and the chain has not been demonstrated end-to-end in human studies. The defensible point this monograph makes is the risk mitigation one: where RF exposure during sleep can be reduced at low cost - keeping Wi-Fi routers and mobile phones away from the bedroom, switching to wired Ethernet, turning routers off at night - doing so removes a candidate disruptor of overnight melatonin without requiring resolution of the upstream causal-chain question.



EMF Hazards Summit April 2025, Bonnie Tucker presentation

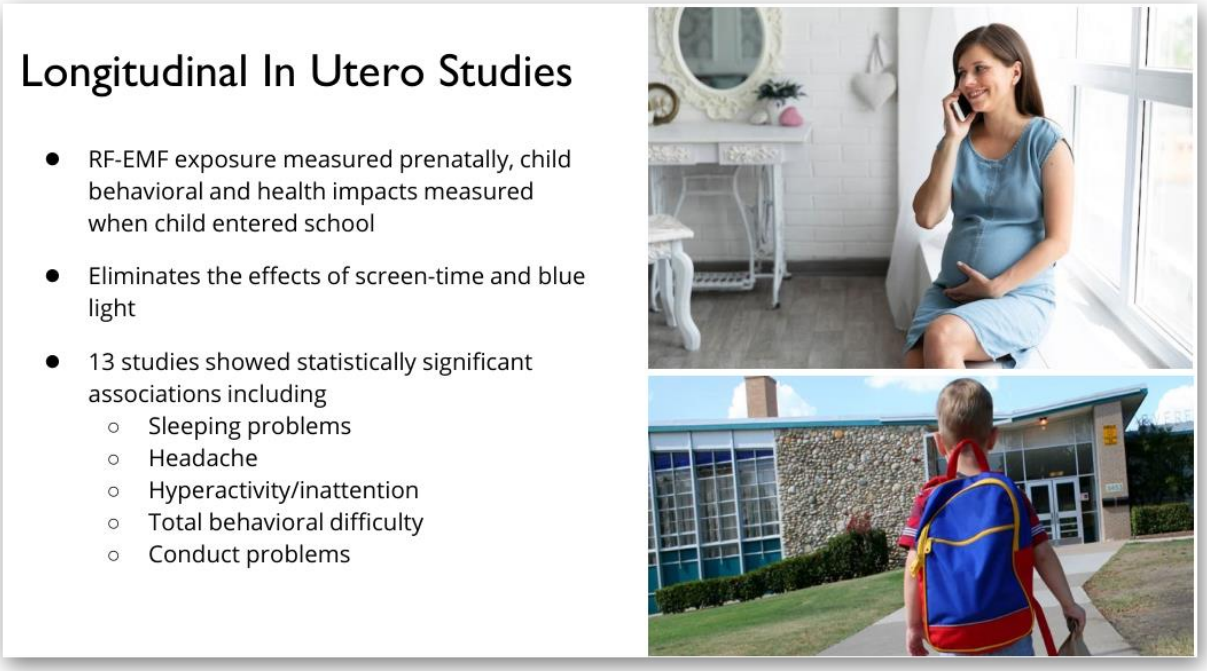
[1] Burch et al. 2002: Melatonin metabolite excretion among cellular telephone users https://pubmed.ncbi.nlm.nih.gov/12456290/

[2] Davis et al. 2006: Effects of 60-Hz magnetic field exposure on nocturnal 6-sulfatoxymelatonin, estrogens, luteinizing hormone, and follicle-stimulating hormone in healthy reproductive-age women: results of a crossover trial - https://pubmed.ncbi.nlm.nih.gov/16458540/

15. Reproductive and developmental effects:

Chronic exposure to MMMs appears to have a very noticeable negative effect on fertility – in both animal and human studies. [1 and 2] Male testes appear to be especially vulnerable to the effect of MMMs, with impaired structure and function, including lowering of male testosterone levels in animal studies. [3] Pathways of damage are believed to be via oxidative stress, lipid peroxidation and DNA damage. [4]

During development in the womb, high levels of exposure to MMMs appear to result in a significantly higher incidence of neurodevelopmental disorders such as Autism/ASD and ADHD. [5] For pregnant mothers with high levels of EMF exposure, this was associated with a trebling of miscarriage risk – compared to the low-level exposure group. [ibid] In human and animal studies, chronic exposure to MMMs is clearly linked with disruptions in brain structure, decreased brain (synaptic) plasticity, and deceased cognitive function. This is especially so during early developmental stages. [6] (See slide below)



EMF Hazards Summit April 2025, Bonnie Tucker presentation

16. Immune-system effects:

MMMs appear to compromise the functioning of the immune system. [7] (See also: Biological and health effects slide) In particular, Chronic EMF exposure appears to **reduce natural killer (NK) cell activity**,

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[3] Jangid et al. 2025 - Non-thermal biological effects of RF EMR: Mechanistic insights into male reproductive vulnerability (Reproductive Toxicology).

[2] See: Non-thermal biological effects of radiofrequency electromagnetic radiation: Mechanistic insights into male reproductive vulnerability in the era of ubiquitous exposure - ScienceDirect and 5032457

[3] View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen

[4] See: 5032457 and The Impacts of Wireless Communication Electromagnetic Fields on Human

[1] Aldad et al. 2012 - Fetal RF radiation exposure affects neurodevelopment and behavior in mice (Scientific Reports); Divan et al. 2008 - Prenatal and postnatal exposure to cell phone use and behavioral problems in children (Epidemiology).

[2] Salford et al. 2003 - Nerve cell damage in mammalian brain after exposure to GSM microwaves (Environmental Health Perspectives); Aldad et al. 2012 - Fetal RF and neurodevelopment in mice (Scientific Reports); ORSAA ODEB database - Effects Categories.

[7] See: Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.; and, People Living Near Cell Towers at Greater Risk of Chronic Immune Stress • Children's Health Defense

weakening cancer surveillance. [1] As was glaringly self-evident over the last few (pandemic) years, possessing a superbly functioning immune system (both innate and acquired) is critical to maintaining short-term and long-term human health. Further, as the immune, endocrinal and neurological systems are closely and dynamically intertwined, deleterious effects on immune function will rapidly undermine healthy function of the neurological and endocrinal systems. Owing to the integrated nature of all bodily systems, negative health effects will eventually become systemic.

14.4 Apparent observed clinical outcomes

17. Cancers and tumours:

Long-term MMM exposure appears to cause rare cancers or tumours in animal and human studies - including brain gliomas and meningiomas in human studies. [2] The Interphone Study published in 2010 [3] reported an elevated risk of brain glioma in the heaviest mobile phone users - an odds ratio of 1.40 (95% CI 1.03–1.89) for those whose cumulative call time exceeded 1,640 hours, approximately equivalent to 30 minutes of daily phone use sustained over a decade. The signal was stronger when the analysis was restricted to gliomas appearing on the same side of the head as the phone was usually held: an odds ratio of 1.96 (95% CI 1.22–3.16). The study authors cautioned that methodological limitations preclude firm causal conclusions from any single number, but the elevated risk in the heaviest-use subgroup, and the asymmetry favouring same-side-of-head tumours, both point in the same direction. The Hardell group's independent body of work reports higher odds ratios in similar long-term, high-use cohorts. [4]

With the significant increase in breast cancer in the Western world, it is hypothesized that as MMMs appear to lower melatonin production [5], the reduced level in the body then allows cancers such as breast cancers, to proliferate. That is, melatonin is one of the body's chief anticancer (endogenous) biochemicals. [6] (See: slide below, *Epidemiological Studies of Note.*) Gliomas in the brain are usually fast-acting and untreatable, and in humans are usually on the side of the brain most exposed to cell phone radiation. As already discussed in Section 6.2, the W.H.O. study in 2025 concluded there is "moderate certainty" evidence of an increased risk of some rare tumours in animal studies - such as pheochromocytomas in the adrenal glands and hepatoblastomas in the liver. [7] There is also a known link between females who carry their phones in their bras, and subsequent breast cancers in this exact area of high exposure. [8] (See also: Biological and health effects slide)

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[1] See: https://greenmedinfo.com/blog/emfs-linked-cancer-autoimmunity-immune-dysfunction
[2] See: 5032457
[3] Interphone Study. Results update. 2008. *http://www.next-up.org/pdf/Interphone_IARC_Results_update.pdf*
[4] Hardell & Carlberg 2020 Stockholm 5G measurement campaign - Aspects on the ICNIRP 2020 Guidelines on Radiofrequency Radiation (World Academy of Sciences Journal).
[5] Pineal melatonin level disruption in humans due to electromagnetic fields and ICNIRP limits - PubMed/; and Research_Review_V4 (a037613)
[6] View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen
[7] 'High Certainty' Cellphone Radiation Linked to Cancer in Animals, WHO Study Finds • Children's Health Defense and 5032457
[8] Health Freedom Event - Victor Leach; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.

EPIDEMIOLOGICAL STUDIES OF NOTE

- Interphone (2000-2004) → glioma in the group with the heavy users (cummulative hrs ≥1640 h) 30 mins/day Delayed reporting 2010. Higher risk for ispsilateral use and temporal tumours.

Patients interviewed	Tumour	Organ
2708	Glioma	Brain
2409	Meningioma	Brain
1100	Acoustic Neuroma (Vestibular Schwannoma)	Acoustic nerve
400	Parotid gland	Salivary gland

- **CERENAT** multicenter French case-control study 2004–2006.
- Among heaviest users (cumulative duration ≥896 h), time since first use was occasionally less than 5 years (11%) but mostly 5– 9 years (49%) and 10 years and more (40%). 54 mins / day
  - 33 % commercial agents, lawyers or sales people
  - 22% chief operating officers, production & operation managers
  - 62% reported occupational mobile phone use.
- **COSMOS** Study (75,993) (2011-2015) Finland, UK Sweden
- – Self reported *vs* Telco usage figures - 14% reported health effect following use

12

See: Health Freedom Event - Victor Leach

18. End-organ symptom presentations:

This entry collects four end-organ effect categories reported in association with MMM exposure. They are included here as observed presentations rather than as proposed mechanisms; their underlying mechanistic literature is less developed than the preceding mechanisms in this Section.

Visual effects.

MMMs (especially 5G waves) may heat the liquid inside the eyes (aqueous humour), potentially causing damage to the eyes and to vision. Also, visual perception disturbances are reported, and a sensation of "burning eyes" is common. [1] (See also Biological and health effects slide)

Hearing effects.

More recent studies have identified damage apparently accruing from cell phone radiation. [2]

Musculoskeletal effects.

Even shorter-term MMM exposure may cause joint and muscle pains, likely owing to inflammation and mitochondrial damage. [3] (See also Biological and health effects slide)

Dermatological effects.

MMMs (especially 5G) may cause skin abnormalities, itching, burning sensations, and even lesions. [ibid] (See also: Behavioral and Health Impacts slide)

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[1] See: Behavioral and Health Impacts slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.

[2] View of Biological effects of electromagnetic waves with emphasis on radio and microwave: An environmental carcinogen

[3] See: Behavioral and Health Impacts slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.

For further investigation of the above mechanisms, see the ORSAA website (www.orsaa.org), and the work of Dr M Pall, Dr D Panagopoulos, Dr P Heroux, & Dr D Belpomme. See also the early, prescient *Lancet Planetary Health* 2018 article titled, *Planetary electromagnetic pollution: it is time to assess its impact*. [1]

14.5 Authoritative research reviews conducted by established scientific experts

14.5.1 Oceania Radiofrequency Advisory Association (ORSAA) review of effects of use of real-world devices, and of living near to mobile phone base stations

ORSAA is a fully independent, not-for-profit Australian organisation that has zero ties to industry or government. One of its main purposes is to collate and disseminate quality, peer-reviewed scientific studies on the effects on humans from exposure to electromagnetic radiation – including the full spectrum of man-made microwaves. Scientists and researchers at ORSAA have made multiple submissions to the Australian Governments of the day, regarding concerns that current RF-EMF safety levels (including MMMs) are inadequate to protect public health. ORSAA scientists frequently publish studies and reviews in the scientific literature. [2]

In December 2022, McCredden (ORSAA) *et al.* wrote in a published review:

> *… experiments investigating exposures from real-world devices and the epidemiology studies examining the effects of living near mobile phone base stations were extracted from ODEB [ORSAA database] and the number of papers showing effects was compared with the number 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 protein damage, biochemical changes and oxidative stress.* [3]

14.5.2 International Commission on the Biological Effects of Electromagnetic Fields (ICBE-EMF) Research (2022)

The ICBE-EMF is a non-governmental, not-for-profit organization, formally recognized by the W.H.O. [4] (However, based on a current W.H.O. Web page, the W.H.O. clearly does not concur with many of the key findings determined by ICBE-EMF. [ibid]) ICBE-EMF is comprised of a multidisciplinary consortium of scientists and doctors (and related professionals) involved with research related to the biological and health effects of electromagnetic frequencies. Their investigations into EMF frequencies covers all the microwave frequencies [5] ICBE-EMF's mission is to protect public and environmental health, and is focused on ensuring the protection of humans from the harmful effects of non-ionizing radiation. Its primary approach is to make global exposure recommendations, based on the best, peer-reviewed, scientific research publications. [ibid]

> *In this paper, we show how the past 25 years of extensive research on RFR [radio frequency radiation] demonstrates that the assumptions underlying the FCC's and ICNIRP's [U.S. regulatory agencies] exposure limits are invalid and continue to present a public health harm. Adverse effects observed at exposures below the assumed threshold SAR include non-thermal induction of reactive oxygen species, DNA damage, cardiomyopathy, carcinogenicity, sperm damage, and neurological effects, including*

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[1] See: Planetary electromagnetic pollution: it is time to assess its impact - The Lancet Planetary Health
[2] https://www.orsaa.org/about-us.html
[3] See: https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2022.986315/full ; and Antennas for Body Centric Wireless Communications at Millimeter Waves by Nacer Chahat et al.
[4] Radiation and health
[5] Who We Are - International Commission on the Biological Effects of Electromagnetic Fields

electromagnetic hypersensitivity… Thus, urgently needed are health protective exposure limits for humans and the environment. These limits must be based on scientific evidence rather than on erroneous assumptions, especially given the increasing worldwide exposures of people and the environment to RFR, including novel forms of radiation from 5G telecommunications for which there are no adequate health effects studies. [1]

14.5.3 Authors (March 2026) argue that wireless radiation limits are 15-900 times too high to protect against cancer risks

According to a recent analysis (March 2026), [2] safety limits for radiofrequency (RF) radiation emitted by cell phones, Wi-Fi routers, cell towers and other wireless devices are at least 15-900 times too high to protect people from cancer risk. The authors were scientists with the International Commission on the Biological Effects of Electromagnetic Fields [3] (ICBE-EMF). The press release stated:

> *Current FCC and ICNIRP public exposure limits need to be reduced by at least 200 times to maintain an acceptable environmental cancer risk of 1 in 100,000.* [4]

The authors also concluded that current safety limits are 8 to 24 times too high to protect against male reproductive harm, including decreased sperm count, sperm vitality and testosterone levels.

The researchers explained that the Federal Communications Commission (FCC) and the International Commission on Non-Ionizing Radiation Protection [5] (ICNIRP) set their wireless radiation safety limits based on a handful of studies from the 1980s. The studies, which had small sample sizes, measured only the short-term impact of RF radiation at levels high enough to heat human tissue.

Ronald Melnick, Ph.D., a retired toxicologist from the National Institute of Environmental Health Sciences and the study's lead author, said in the ICBE-EMF press release [ibid] that governments need to "step up, abandon these obsolete guidelines, and conduct rigorous risk assessments using modern toxicological data."

Joel Moskowitz, Ph.D., director of the Center for Family and Community Health at the University of California, Berkeley, and one of the study's authors, said, "We are constantly surrounded by devices emitting wireless radiation; yet government regulations do not account for the chronic, low-level exposures they create."

For their report, Melnick and Moskowitz applied standard risk-assessment methods developed by the U.S. Environmental Protection Agency (EPA) to review experimental (animal) research on RF radiation conducted during the last 30 years. Their recommended exposure limits were based on an average human daily exposure level of 8 hours to wireless radiation.

The study comes as the FCC continues to fail to comply with a 2021 Court order to provide a satisfactory explanation for how its current limits - which haven't been updated since 1996 - adequately protect human health. The Court order directed the FCC to review **11,000 pages of evidence** supporting claims that wireless radiation at levels currently allowed by the FCC, harms people - especially children.

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[1] Scientific evidence invalidates health assumptions underlying the FCC and ICNIRP exposure limit determinations for radiofrequency radiation: implications for 5G - PubMed

[2] See: Exposure limits to radiofrequency EMF do not account for cancer risk or reproductive toxicity assessed from data in experimental animals | Environmental Health | Springer Nature Link

[3] See: Who We Are - International Commission on the Biological Effects of Electromagnetic Fields

[4] See: **press release**

[5] **ICNIRP** is a self-selecting group with "longstanding industry ties that is accountable to no one," according to the **Environmental Health Trust**. Many other countries base their limits on ICNIRP's recommendations.

For an extremely in-depth and comprehensive review of alleged health impacts of MMMs, the reader is encouraged to access the 1,000+ page monograph (2020) by Dr RN Kostoff, an eminent U.S. scientist (*Who's Who in Science & Engineering 2006*, and *Outstanding Intellectuals of the 21st Century 2006*). [1]

14.6 Why the above mechanisms appear to be inadequately addressed in science and public policy

Multiple explanations for why research outcomes in the area of MMMs are so varied and for why definitive statements of causal health damage remain contested, have already been discussed in Section 9 and Section 12 above.

In addition, according to accepted scientific research protocols, establishing a direct causal relationship between one variable and another, is a complex, ongoing endeavour in research and experimentation. For example, one key requirement is successful replication of study outcomes, which rarely occurs as funding in this area is usually not available for replication studies. Furthermore, it is always difficult to rule out unknown or unmeasured variables which may be at least partly affecting outcome measures.

Owing to the above (and additional) challenges, it is common practice for the outcomes of scientific investigations to be cautiously worded, even when it appears highly likely that a direct causal relationship has been established. (Examples of common cautious phrasing include: "there appears to be a strong link between X and Y"; and, "there appears to be a strong association (or relationship) between X and Y.")

Accordingly, in this monograph the writer has avoided any absolute statements on a causal link between MMMs and resulting health damage, instead using "**appears** to cause", or a similarly phrased caveat. This choice of wording by the writer is intended to signal the writer's grave-level concern, and to catalyse and indeed require, urgent Government-funded research.

As previously acknowledged above, with the current state of the research literature, many of the mechanisms discussed in this monograph remain contested, and not accepted as settled by all regulatory or medical authorities.

Supporters of an unbridled rollout of 4G and 5G cell towers and other MMMs seem highly inclined to reference the set of studies where no apparent deleterious health harms from MMM exposures were found. Such referencing is usually made without any understanding of specific experimental methodology, without specific critique of why methods have been deemed to be problematic in papers that didn't show health effects, and without clarity on the potential conflicts of interest of the researchers. In addition, proponents of MMMs being **safe** for humans are usually at a loss to produce (exact) replication studies, where the initial study **harmful outcomes** were subsequently **unable** to be replicated.

Despite all the challenges and limitations discussed immediately above, the epidemiological precepts that establish causality are well known [2] and in the opinion of the writer, the case for the **elevated probability that MMMs can cause multiple health harms**, has been reasonably established in this Section – and in the preceding **Section 13**.

[1] See: https://stop5g.lu/wp-content/uploads/2020/06/LARGEST_UNETHICAL_MEDICAL_EXPERIMENT_FINAL.pdf
[2] See: https://pmc.ncbi.nlm.nih.gov/articles/PMC1898525/

The firm opinion of the writer is that the accumulative weight of evidence presented in this Section lies far beyond sufficient to invoke the **Precautionary Principle**, requiring an immediate embargo on increasing MMM exposures in New Zealand. This embargo must be in place until health risks for the entire population have been urgently, independently and critically assessed. In addition, there will be real urgency for relevant Health and Safety Legislation, to become coherent with the resulting hazard identification and risk analysis.

AI-generated picture

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15. Man-Made Microwaves: Some apparent Neuropsychological and Behavioural Effects on Humans

Opening note

All statements in the bullet-points below with casual-sounding language are to be read as the writer's opinion and interpretation, with acknowledgement that this is not settled science and that current Government regulations are not in agreement with at least some of these statements.

A note on the citations in this list

Many of the symptom claims below are anchored on the ORSAA database categorisation page ("Effects Categories"), which is a useful aggregator but is not itself a peer-reviewed primary source. That said, ORSAA states that it only curates quality research that is published and peer-reviewed. The ORSAA database is sufficient evidence to flag a topic as deserving risk mitigation consideration; it is not sufficient evidence to claim that any specific symptom is established as RF-caused. Where strong peer-reviewed primary or meta-analytic citations are available - such as for tinnitus, cognitive effects, sleep / EEG effects, and headaches - those have been added below in addition to the ORSAA references. For the remaining symptoms, the ORSAA-database reference is preserved, but the reader is asked to read the claim with the same weight as the original ORSAA categorisation supports.

Some apparent neuropsychological effects on humans

A range of cognitive, mood and other brain-related effects on humans, apparently resulting from exposure to man-made microwaves, have been reported [1]:

1. **Poor short-term and long-term memory.** [2] (See: Cognitive function effects slide; Location of EMF Exposure and Type of Memory Decline slide; Biological and health effects slide; Mood, mental health and behavioral effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: Foerster et al. (2018) reported a dose-response association between cumulative RF brain dose from mobile-phone use and figural-memory performance decrement in 700 Swiss adolescents over one year. [ibid]

2. **"Brain fog", with slower cognitive processing, poor ability to focus and concentrate, poor ability to follow conversations, poor ability to think rationally and sequentially, poor planning ability,** etc. [ibid] (See: "Brain effects" slide below; EMF Exposure and Cognitive Decline slide; Cognitive function effects slide; Biological and health effects slide; Mood, mental health and behavioural effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Note on citation strength: subjective cognitive complaints of this kind ("brain fog") are commonly reported in EHS symptom surveys but the specific peer-reviewed primary literature on RF and subjective cognitive impairment is thin. The closest objective-measure study is the Foerster et al. (2018) figural-memory dose-response finding in Swiss adolescents already cited in the Memory bullet above.

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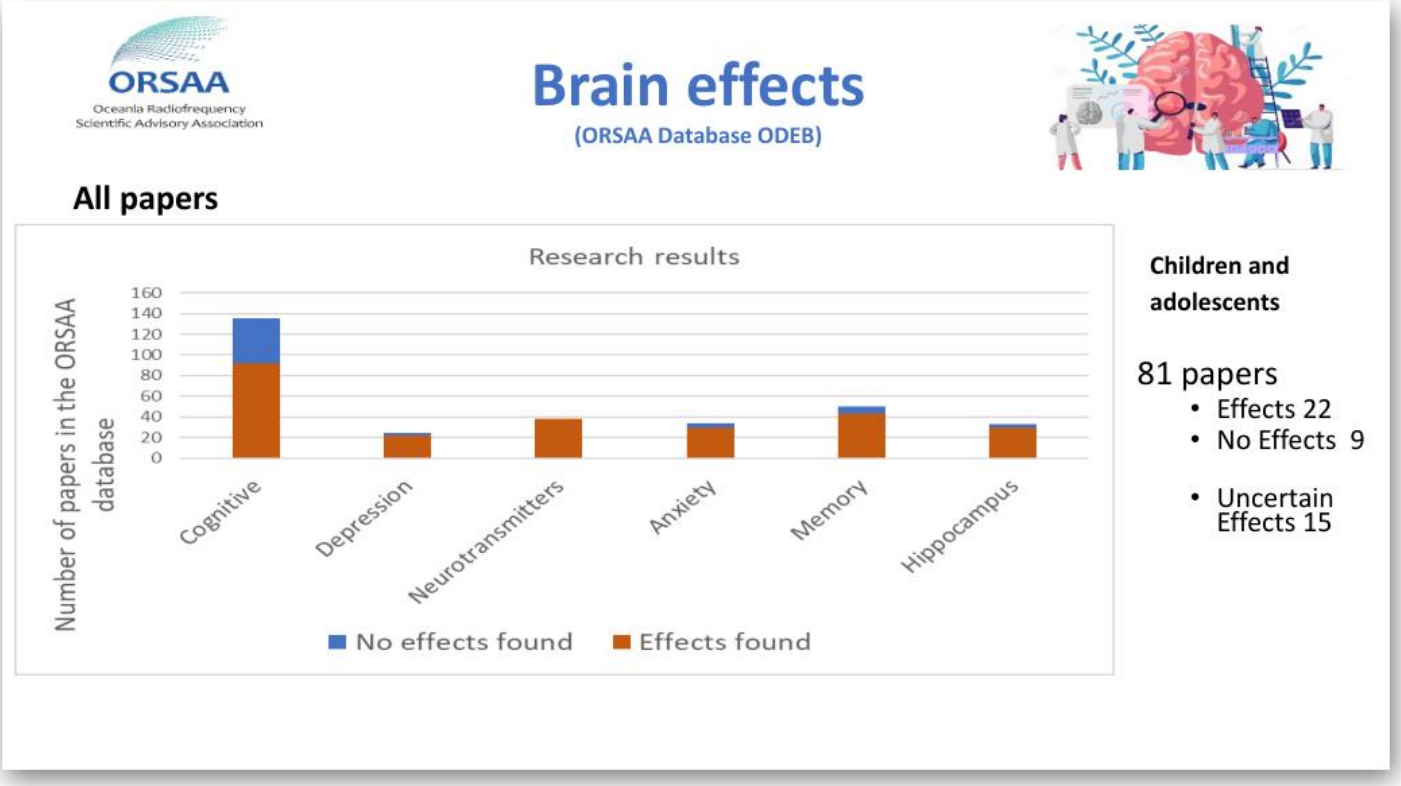
[1] Note: As per **Sections 13 and 14**, no attempt has been made to isolate specific (man-made) microwave characteristics – such as frequency, wave length and power density – that are apparently involved in producing the documented effects. Rather, any apparent effect will be delineated, as long as the microwaves involved were man-made.

[2] Foerster et al. 2018 - Adolescents' memory performance and individual brain dose of microwave radiation from wireless communication (Environmental Health Perspectives); BioInitiative 2022 - Lai tally (74% of 391 RFR neurology papers report effects).



EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

3. **Chronic mental and physical fatigue** [ibid and 1] (See: Sleep and well-being effects slide; Cognitive function effects slide; Behavioral & Health Impacts slide; Biological and health effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: Hutter et al. (2006), Occupational and Environmental Medicine, surveyed 365 adults living within 600 m of mobile-phone base stations in three Austrian rural and urban areas. Fatigue, headache, and concentration difficulties were the most frequently reported symptoms, with prevalence correlating with measured RF field strength at the residence. The study is cross-sectional and self-report and does not establish causality, but it remains the most-cited single observational study on base-station residence and fatigue. [2]

4. **Dizziness** [3] (See: Behavioral & Health Impacts slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Note on citation strength: dizziness is reported in symptom surveys of populations living near mobile-phone base stations (see Hutter et al. 2006 cited at the Chronic Fatigue bullet above) and is one of the symptoms most commonly reported by individuals self-identifying as EHS-affected. Specific peer-reviewed primary literature on RF and dizziness as a standalone symptom is thin; the broader case rests on the symptom-survey aggregation and on the plausible mechanistic connections to cerebral blood-flow changes (Section 14 Mechanisms 4 and 12) and vestibular system perturbations.

5. **Headaches** [ibid] (See: Sleep and well-being effects slide; Behavioral & Health Impacts slide; Biological and health effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: Schreier et al. (2006), Swiss cross-sectional survey

[1] See: Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7
[2] Hutter et al. 2006 - Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations (Occupational and Environmental Medicine).
[3] See: Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7

of 2,048 adults, reported headaches as the most frequent symptom attributed to mobile-phone use among self-reported EHS-affected individuals; Frey (1998) reviewed the historical microwave-headache literature.[1]

6. **Constant "ringing in the ears" (tinnitus)** [2] (See: Sleep and well-being effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: Hutter et al. (2010), surveyed 412 mobile-phone users and reported an association between higher-intensity phone use and increased tinnitus prevalence; replicated in Medeiros & Sanchez (2016) systematic review.[3]

7. **Agitation, aggression, hyperactivity and conduct difficulties** [4] (See: Behavioral & Health Impacts slide; Mood, mental health and behavioral effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: this is one of the better-evidenced developmental-behavioural endpoints in the literature. Divan et al. (2008), Epidemiology, analysed data on 13,159 children from the Danish National Birth Cohort and reported a significantly increased risk of behavioural problems (hyperactivity, emotional problems, conduct difficulties) in children whose mothers regularly used cell phones during pregnancy and who themselves used cell phones in early childhood. The 2012 follow-up by the same group, with 28,745 children, confirmed and strengthened the association. Sudan et al. (2016) extended the cohort's follow-up to age 11 and reported that children whose cellphone exposures began prenatally or at age 7 had increased odds of emotional and behavioural difficulties at age 11 (OR 1.36–1.58 depending on exposure window), after socio-economic adjustment. [5] See also Section 14 Mechanism 15 (Reproductive and developmental effects) for the *in utero* exposure pathway.

8. **Anxiety, nervousness, obsession-compulsion, post-trauma stress** (See: Behavioral & Health Impacts slide; Brain effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Note on citation strength: anxiety and related affective symptoms are commonly reported in EHS symptom surveys (see Hutter et al. 2006 at the **Chronic Fatigue** bullet) but the peer-reviewed primary literature on RF-EMF and clinically-defined anxiety disorders is thin. The most-cited synthesis arguing for an RF→neuropsychiatric-effects link is Pall (2016), Journal of Chemical Neuroanatomy, which reviews mechanistic and observational studies on EMF and depression / anxiety / sleep disorders. Pall's specific VGCC mechanism, while generally accepted by experts in this field [6], is not fully accepted in the mainstream literature (see Section 14 Mechanism 3); the review's literature collation remains a useful aggregator but is not itself a methodological replacement for the missing primary RCT-level evidence. [7]

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[1] Schreier et al. 2006 - Prevalence of symptoms attributed to EMF exposure: Swiss cross-sectional survey (Sozial- und Präventivmedizin); Frey 1998 - Headaches from cellular telephones: are they real and what are the implications? (Environmental Health Perspectives).

[2] See: Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7

3 Hutter et al. 2006 - Subjective symptoms, sleeping problems, and cognitive performance near base stations (Occupational and Environmental Medicine) ; Medeiros & Sanchez 2016 - Tinnitus and cell phones: role of RF radiation (systematic review) (Brazilian J. Otorhinolaryngology).

[4] https://childrenshealthdefense.org/defender/adolescents-cellphones-mind-health-well-being/ and 5032457

[5] Divan et al. 2008 - Prenatal and postnatal cell phone exposure and behavioural problems in children (Epidemiology); Divan et al. 2012 - Cell phone use and behavioural problems in young children (J. Epidemiology and Community Health); Sudan et al. 2016 - Prospective cohort analysis: cellphone use and emotional/behavioural difficulties at age 11 (J. Epidemiology and Community Health).

[6] See: *EMF*D* [book] by Dr J Mercola, EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books

[7] Pall 2016 - Microwave frequency EMFs produce widespread neuropsychiatric effects including depression (J. Chemical Neuroanatomy). Review article; contested mechanism (see Section 14 Mechanism 3).

9. **Low mood or depression** [1] (See: Brain effects slide; Behavioral & Health Impacts slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Note on citation strength: as with anxiety (see above), depression is widely reported in EHS symptom surveys but the peer-reviewed primary literature on RF-EMF and clinically-defined depression is thin. The Pall (2016) review cited at the Anxiety bullet covers both endpoints. Observational support comes from cross-sectional symptom surveys (Hutter 2006) [2] and from the broader literature on RF effects on neurotransmitter systems (**Section 14** Mechanism 11).

10. **Poor sleep** [3] (See: Sleep and well-being effects slide; Behavioral & Health Impacts slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: this is one of the better-evidenced symptoms in the literature. Mohler et al. (2010), Bioelectromagnetics, used personal RF dosimetry in a cohort of 1,375 adults and reported a small but statistically significant association between higher measured RF exposure (particularly from mobile-phone base stations) and self-reported sleep-quality impairment. Altpeter et al. (2006), Environmental Health Perspectives, reported substantial sleep-quality improvements among residents of Schwarzenburg, Switzerland, following the 1998 shutdown of a nearby shortwave broadcast transmitter - a natural-experiment design that is rare and methodologically informative in this literature. [4] At the polysomnography level, see also the EEG / sleep-spindle changes described at the **Cortical effects** bullet below and the broader pulse-modulated-RF sleep-architecture literature (Lustenberger et al. 2013 [5]).

11. **Cortical effects, such as EEG changes in alpha waves and slow-wave sleep spindles.** These are among the more consistent and replicated effects in the human pulse-modulated-RF EEG literature (see review by Regel and Achermann, 2011 [6], and the broader literature cited at **Section 13** above). The EEG changes are typically small in magnitude (a few percent in alpha-band power; small shifts in spindle frequency) and have not been consistently accompanied by measurable cognitive changes on standard cognitive testing in the same subjects. Two readings of this pattern are defensible and the document leaves both on the table for the reader. The first reading is that detectable physiological response without functional cognitive impact suggests the body responds to RF in measurable ways but the responses do not necessarily translate to measurable harm at the exposure levels tested. The second reading is that small but reproducible EEG changes are an early-warning signal of cellular or neural stress that may precede measurable cognitive effects, particularly under longer-term exposure or in vulnerable populations not yet tested. Neither reading is conclusively supported; they reflect a genuine open question about the relationship between detected physiological change and clinical relevance. The document's precautionary / risk mitigation case does not depend on resolving this - it depends on the broader body of mechanism

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[1] See: Kids Who Get Cellphones Before Age 12 at Higher Risk of Obesity, Depression, Poor Sleep and Genotoxic Effects of Wireless Communication Electromagnetic Fields | 7

[2] Hutter et al. 2006 - Subjective symptoms, sleeping problems, and cognitive performance in subjects living near mobile phone base stations (Occupational and Environmental Medicine).

[3] See: Kids Who Get Cellphones Before Age 12 at Higher Risk of Obesity, Depression, Poor Sleep and, Kids' Sleeping Problems Linked to Wireless Radiation, Screens ; and https://www.researchgate.net/publication/6124296_Regel_SJ_Tinguely_G_Schuderer_J_Adam_M_Kuster_N_Landolt_H-P_et_alPulsed_radio-frequency_electromagnetic_fields_dose-dependent_effects_on_sleep_the_sleep_EEG_and_cognitive_performance_J_Sleep_Res_16253

[5] Mohler et al. 2010 - Effects of everyday RF EMF exposure on sleep quality: cross-sectional study (Bioelectromagnetics); Altpeter et al. 2006 - Short-wave magnetic fields on sleep quality and melatonin cycle: Schwarzenburg shut-down study (Bioelectromagnetics).

[5] Lustenberger C et al. (2013), "Stimulation of the brain with radiofrequency electromagnetic field pulses affects sleep-dependent memory consolidation," Brain Stimulation 6(5):805–811.

[6] See: https://link.springer.com/article/10.1186/1476-069x-10-10 ; https://pubmed.ncbi.nlm.nih.gov/21266038/ ;

and outcome evidence presented in **Sections 11 and 12** - but readers should know that the EEG-effect literature, while consistent, has not yet shown the cognitive-impact bridge it would need to demonstrate harm directly.

Sleep and well-being effects

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Effects Summary	Study	Place	N	Ages
Headache/Migraine MP use was associated with a significantly increased adjusted odds ratio for headaches and migraine	Chiu et al 2014 Telephone interview	Taiwan	2042	11-15
Fatigue association between fatigue and MP usage	Zheng et al 2015 questionnaire	China	781	School age
Sleep and well-being Wireless MP and CP use: increased risk of headaches, feeling down/depressed, waking in the night, sleepiness at school, tinnitus (wired headsets)	Redmayne et al 2013	New Zealand	373	High school students
Sleep disturbances MP use after lights out: short sleep duration, subjective poor sleep quality, excessive daytime sleepiness, and insomnia	Munezawa et al 2011	Japan	94,777	High school students

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12. **Reduced verbal expression and comprehension in children** (See: Mood, mental health and behavioral effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.) Specific peer-reviewed support: Birks et al. (2017), Environment International, pooled prenatal-cellphone-use data and child behavioural-problem outcomes from five European birth cohorts (Denmark, Korea, Netherlands, Norway, Spain), totalling 83,884 mother-child pairs, and reported a clinical-range odds ratio of 1.28 (95% CI 1.12, 1.48) for hyperactivity/inattention problems at age 5–7 among children whose mothers reported high prenatal cell phone use. [1]

    Hyperactivity/inattention at this developmental window is associated with reduced expressive and receptive language performance. The effect persisted after adjustment for socio-economic and other potential confounders. See also **Section 14** Mechanism 15 (Reproductive and developmental effects) for the broader prenatal exposure literature. [ibid]

[1] Birks et al. 2017 - Maternal cell phone use during pregnancy and child behavioural problems in five birth cohorts (Environment International).

Cognitive function effects

Effects Summary	Study	Place	N	Ages
Reaction time, attention, focused attention, memory * RT longer for 9-12 yrs Memory capacity smaller boys and girls Motor reaction time greater for girls RT greater for girls	Kolodynski et al 1996 Exposure to pulsed radar vs non exposed vs control	Skrunda, Latvia	996	9-18
Perception (audio and visual), Neuromuscular and Cognitive functions 1. Increase in reaction time to sound and light 2. more errors in phonemic perception and recognition; 3. deterioration in arbitrary attention and semantic memory; 4. increased fatigue and decreased working capacity of muscle 5. safe mode of use devices statistically significantly improve ALL indicators	Grigoriev et al 2019 longitudinal use of MT over time 6 to 17 years	Moskow region	161 users 370 controls	6-17
Memory cumulative duration and of wireless phone use and RF-EMF dose negatively associated with memory (stronger for figural than verbal memory)	Schoeni 2015 questionnaire (recall last 6 months) + operators recorded use	Central Switzerland rural and urban	439	grade 7-9
Memory Decreased figural memory scores in association with an increase in RF-EMF brain dose scores for both CP and MP use	Foerster 2017	Switzerland	669	grade 7-9
EEG and memory task modulation of brain oscillatory responses in children in the approximately 4 - 8 Hz and approximately 15 Hz EEG frequencies during cognitive processing of auditory memory and memory search task	Krause et al 2009 Exposure or not to GPS pulsed 217Hz effects on 1 – 20 Hz event related brain oscillatory EEG	Finland	15	10-14

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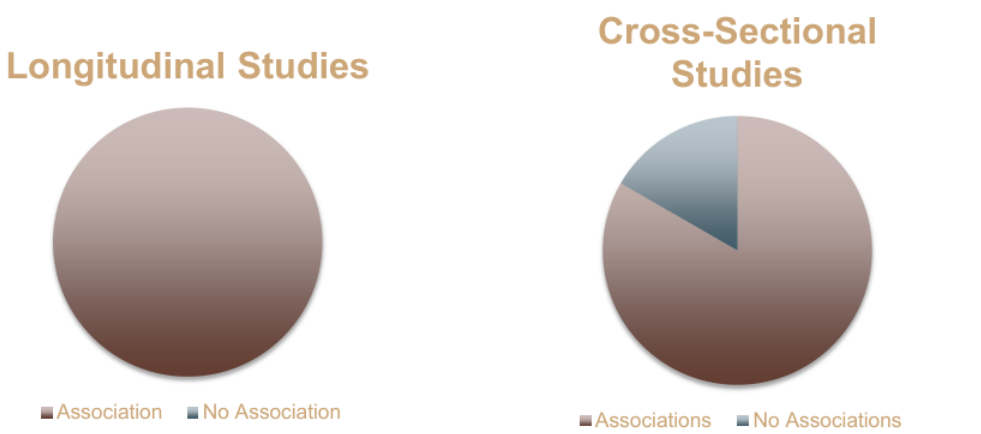
EMF Exposure and Cognitive Decline: Ten out of 11 studies showed a statistically significant association



5 out of 5 studies showed an association

5 out of 6 studies showed an association

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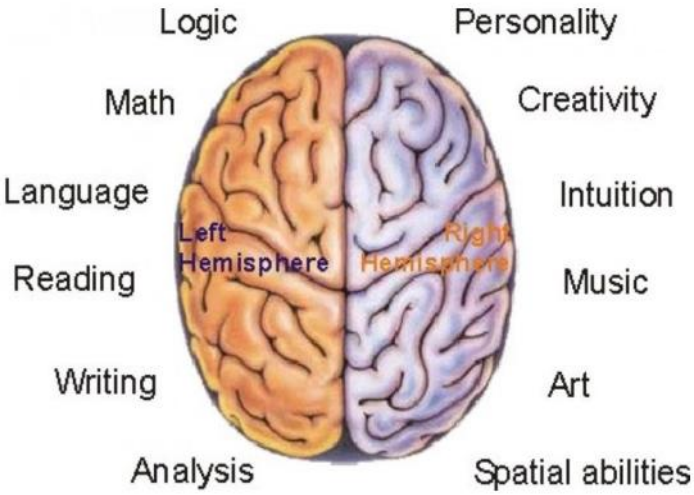
Location of EMF Exposure and Type of Memory Decline

- Decrease in figural memory for students with right-side preference but no decrease in verbal memory
- Ride-side preference - holding phone in right hand up to right ear
- Spatial and figural memory functions concentrated on right side of brain



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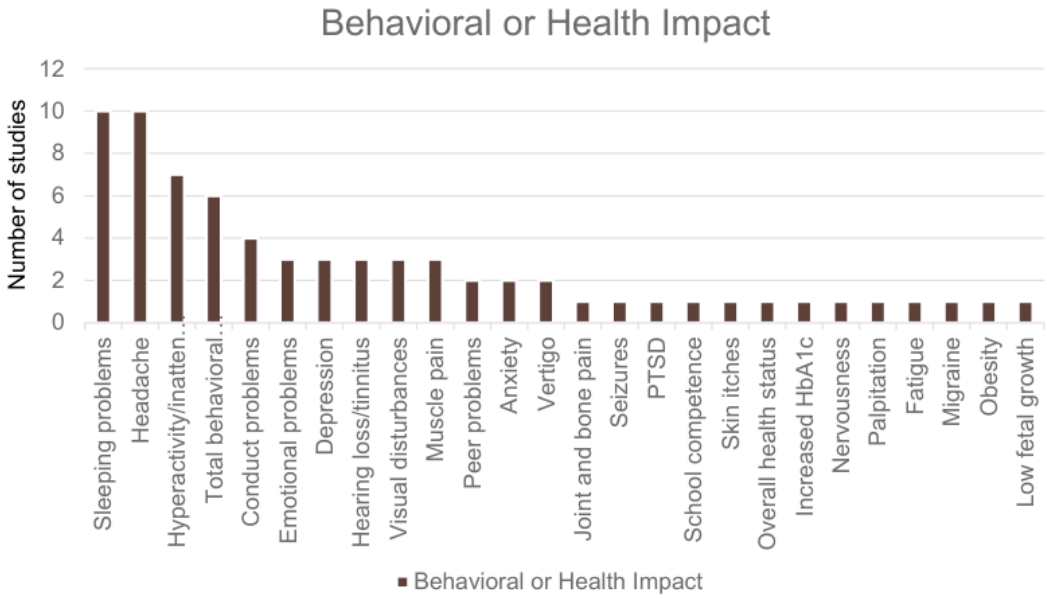
Behavioral and Health Impacts: Thirty-four out of 38 studies showed a statistically significant associations

OR ranges:

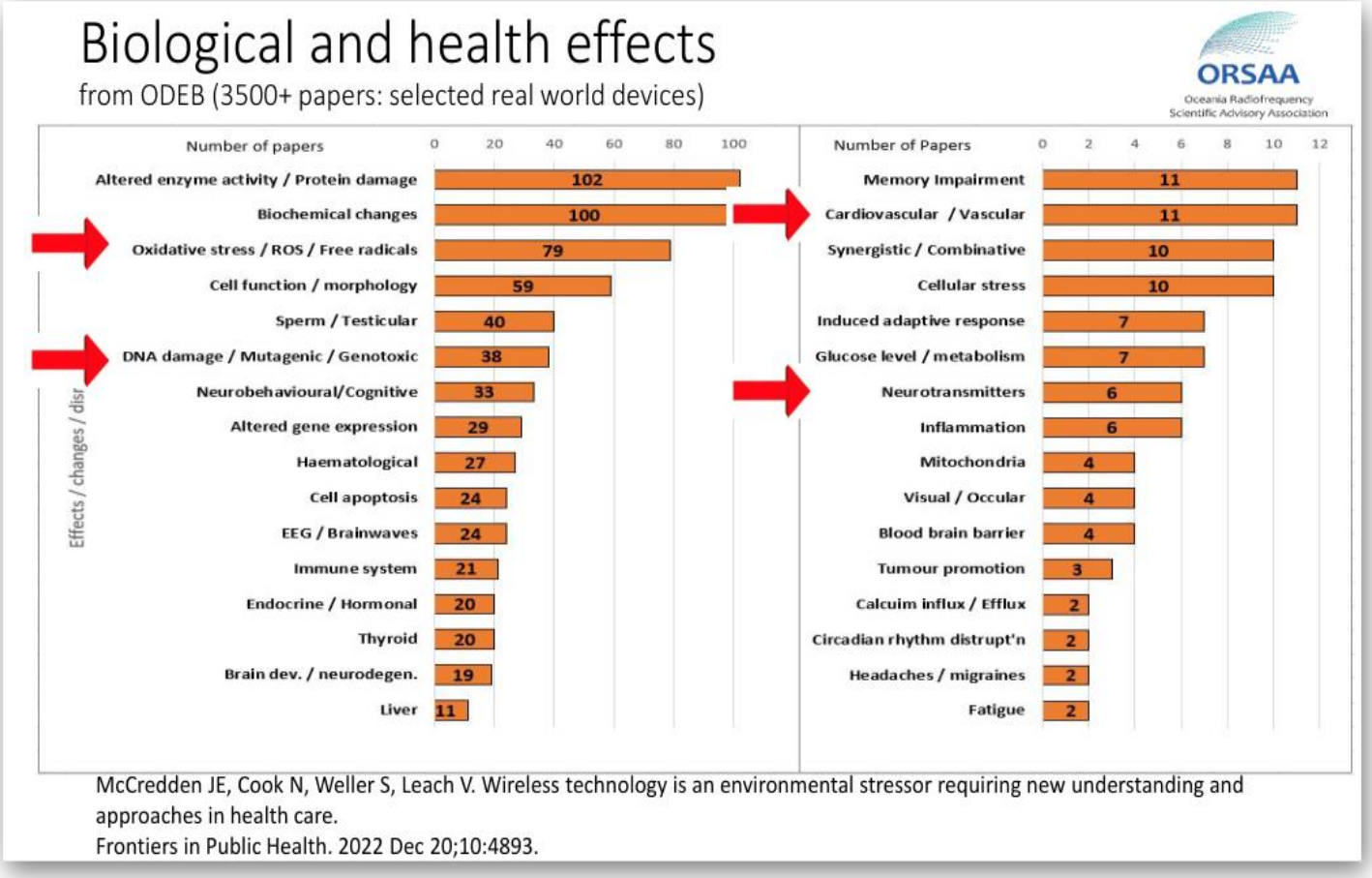
Sleep problems - 1.90 to 5.99

Headache - 1.32 to 2.00

Hyperactivity/inattention – 1.28 to 6.80



EMF Hazards Summit April 2025, Bonnie Tucker presentation



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Mood, mental health and behavioural effects

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Effects Summary	Study	Place	N	Ages
Mental Health Issues An association between exposure and conduct problems for adolescents and children	Thomas et al 2010 personal dosimeter and Strengths and Difficulties Questionnaire (SDQ): emotional symptoms, conduct problems, hyperactivity-inattention, peer problems, prosocial behaviour	Bavaria	1 498 1 524	Children Adolescents
Behavioural Issues Exposure to cell phones both prenatal and postnatal was associated with more behavioural difficulties.	Divan et al 2008, 2010 questionnaire re MP use, (SDQ): hyperactivity-inattention, emotional symptoms, peer problems, conduct problems, and prosocial behaviour.	Denmark (Danish National Birth Cohort)	28 745	Mothers
ADHD (mice) Young exposed mice hyperactive, memory impairments and decreased anxiety neuropathololgy (dose-responsive impaired glutamatergic synaptic transmission onto layer V pyramidal neurons of the prefrontal cortex) Behaviours similar to ADHD in children	Aldad, Gan, Gao, & Taylor, 2012	Yale	82 79	Exposed *in utero* Control
Verbal and Behavioural Issues young boys who live near RF transmitters showed reduced verbal expression/comprehension and had higher scores for total problems, obsessive-compulsive and post-traumatic stress disorders than controls	Calvente et al., 2016	Spain	123 boys	9-11yrs

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Concluding comments for this Section

Many apparent cognitive and behavioural effects have been found in animal studies (mostly with rats and mice), where structural and biochemical changes in the brain can be directly investigated. Most of the studies have shown many changes to the morphology and function of the brain. [1] Effects on the hippocampus in particular, are associated with reduced memory and spatial performance (see reviews by Lai et al., Narayanan et al.) [2] These multiple results give substantive support to the effects that have been shown in humans – though it is acknowledged that brain structure and function in animals does not always totally reflect human structure and function.

The further accumulation of evidence presented in this Section adds to the necessity for an **immediate embargo on increasing MMM exposures**. As per Section 14 above, this embargo needs to be in place until health risks for the entire population have been urgently, independently and critically assessed. Relevant Health and Safety Legislation must become coherent with the resulting hazard identification and risk analysis. In addition, Government needs to consider immediately (and in good faith) beginning to implement the range of key strategies outlined in **Section 22** below: Recommendations: Immediate, Risk Mitigation Steps for the NZ Government to Consider.

In the writer's opinion, in light of the combined evidence presented in this Section, **Section 13** and **Section 14**, **the case for the high probability that MMMs cause multiple health harms,** has been firmly established.

In the research review by Coskun & Demirel (2025) they concluded that, "Many biological mechanisms have been proposed for the effects of man-made EMFs on health, and thousands of studies have been published showing the non-thermal effects of low-intensity microwaves. However, these findings are mostly ignored." [3]

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[1] https://childrenshealthdefense.org/wp-content/uploads/rf-2018-neurological-lai-book-chapter.pdf
[2] https://childrenshealthdefense.org/wp-content/uploads/rf-2018-neurological-lai-book-chapter.pdf and https://link.springer.com/article/10.1007/s11356-019-06278-5#citeas
[3] See: 5032457

16. The Onset and Progression of my Presumed EHS, & Relevant Medical Assessments: A Commentary and Person Experience Narrative

Introductory Note

As previously acknowledged in this monograph, the author is a registered psychologist and not a medical practitioner. He is not legally (or ethically) entitled to diagnose or treat any disease or to provide health recommendations based on his opinions. As before, information presented in this Section is for informational purposes only, and any health decisions made by the reader need to be only after consultation with a qualified health practitioner.

16.1 Chronological account of my health deterioration

Apart from that initial serious health challenge 20 years ago, up until 2018 I enjoyed excellent health, being extremely health-conscious. This was thanks to (almost exclusive) organic food, a specialised diet to cope with some food sensitivities, and an excellent lifestyle - with regular exercise, good stress management and regular meditation. In addition, my work environment remained enjoyable and satisfying, and my interpersonal relations at work and home remained nourishing and rewarding. Further, there were no sudden major stressors that had invaded my life.

Then, in 2018 I went to work for a Government Ministry, after having worked for 10 years with survivors of trauma and torture, at the National Refugee Reception Centre in Auckland.

I initially remained in excellent health, working 9-10 hours per day, 4 days per week at the Ministry Office. However, after the first few months there, I became aware that I was more tired than normal, and that my cognitive function had deteriorated substantially. I was suffering from noticeable memory challenges, problems drowning out background noise in the Office or at schools, reduced ability to remain on task for long periods at the computer, poor ability to recall names and faces, diminished ability to plan and problem-solve, slowed cognitive processing speed, and word retrieval challenges. I was also frequently anxious and irritable, had low emotional energy and diminished enthusiasm for my work and life.

I had never previously suffered from any of these cognitive issues and it was highly concerning for me, with no apparent reason for this major deterioration in functioning.

In addition, I developed worrying neurobiological symptoms that I had also never experienced before in my life. These included, non-stop ringing in my ears (tinnitus), frequent and painful daily headaches (front and back of my head), some vertigo and clumsiness when tired, non-refreshing sleep, and sore eyes.

As noted, all these symptoms came “out of the blue”. That is, there was no known infection or other physical insult to explain them, my family and social life remained of good quality, and I had no significant or abnormal stressors in my life.

Prior to the onset of all these symptoms, I always looked forward to long (10kms or more), moderately challenging walks in nature each weekend. This was effortless for me. Besides the long walks, I would go for fast walks at the local Botanic Gardens, usually 3-4 times per week, for half an hour or more each time.

So, given the complete mystery as to what had caused my sudden health decline, I was very concerned and worried, especially as my symptoms continued to worsen over that year.

By Christmas 2018, I was so exhausted physically and mentally, that I could barely function adequately at work, and needed to “crash” as soon as I got home. At Cooks Beach (Christmas holiday), I was only able to

walk slowly for 20 minutes on the flat upper-shore, before needing to stop and rest for 30 minutes, and then returning - even more slowly - back to our holiday home to recover.

I still had no idea as to what might be causing such a drastic health decline, and had not yet done any research into possible health effects of microwave radiation. However, at home, I already intuitively used Ethernet cables for Internet connectivity, and usually had the Wi-Fi disabled on our router. Also, the local 4G mobile base station was quite far away, with only a 1 or 2-bar signal.

In April 2019, my wife and I travelled to Boston (USA) for the then-recent birth of our grandson. We stayed in a large, multi-storey apartment on the top floor. After the first night's sleep, I woke up significantly more fatigued than usual, and my physical and cognitive functioning had both suddenly declined further. I still had no idea as to what was going on, but told my wife how concerned I was.

After several night's sleep in the apartment, my condition had further worsened, and I suddenly thought that maybe it had something to do with all the Wi-Fi signals in the apartment. So, I used my mobile phone to check for Wi-Fi signals and there were 21 of them, with all being either at maximum strength, or one bar below.

As a result of this possible insight, I tried to move out of the building, but the owner wouldn't give any refund, and other accommodation was extremely expensive.

After more than 2 weeks in this building at night, I was forgetting or misplacing many of my large and small objects, including walking away from my suitcase at a local train station. Scarily, I had attained genuine zombie status for the first time in my life. My wife had noticed my major decline and mentioned it a number of times, with much concern.

By the time I got back to NZ, I still wasn't sure what had caused my major decline, but I now had a theory to go on. At the same time, I was very concerned that returning to my normal life, would not bring any mitigation of my severe symptoms.

On getting back to my Government Office, I asked admin staff if we had any Wi-Fi routers in the building. I was shown 3 of them on the ceiling, all within about 20 metres of my workstation. (I had previously occasionally noticed these fairly inconspicuous brown boxes on the ceiling, but never stopped to think what they might be.) When I asked IT staff about the Wi-Fi networks in the Office, I was informed (October 2019) that there were 6 different networks, employing 20 plus routers in total!

I then immediately embarked on ongoing, in-depth research into the possible damaging effects of Wi-Fi and other microwave radiation. This was during 2019.

During this year (2019), I worked at home as much as possible, and did whatever I could to protect myself from the multiple Wi-Fi signals from neighbours. There were usually 12 of these signals, with 2 that were strong, and others of decreasing strength. To protect myself at night, I erected (thick) aluminium foil barriers along the lengths of all 4 walls in my bedroom. As a result, Wi-Fi signals fell to just one weak one on my phone. After some months of doing whatever possible to shield myself from MMMs, many of my symptoms stabilised, and a few decreased – such as the daily painful headaches. However, I was still left with substantial physical and cognitive fatigue and decline, and a dull, aching head that did not resolve until very recently – when I discovered a medical compound that has reduced my chronic brain inflammation and headaches.

As an outcome of my extensive research, I was becoming quite convinced that all my symptoms fitted readily into known symptoms of those suffering from EHS. However, when I went to my local GP he knew nothing about such a condition, and had no suggestions on what might help. When I showed him a

printout of the ICD-10 with EHS as a diagnosis (W90), he seemed surprised, but dismissed this, saying that NZ doesn't use the ICD-10 and that our disease categorisation system has no such diagnosis.

Happily, this same GP did agree to run a huge range of blood tests to try to uncover any biomarkers that were outside the normal reference ranges. This was in October 2019. My serum glucose and HbA1c were at the top end of the normal reference range. Given that my diet was nearly always low in simple carbs and sugar, and my stress levels were being actively managed each day, microwaves became a possible explanation for these elevations. (As per Section 14 above, elevation of blood sugar levels by ongoing exposure to microwaves is a well-established and consistent research finding.)

The only other elevated results were that my morning blood cortisol was at the high end of the normal reference range, as was my LDL cholesterol. Microwaves appear to increase blood sugar levels and psycho-neurological stress. So, this could have been a reason for the elevated cortisol as well. (See Section 14 above.)

Over 2020 and 2021 I undertook an extensive battery of functional medicine and direct-to-consumer genetic testing, ordered through a Naturopath / Functional Medicine Practitioner with an account with FxMed in Napier. The detailed results, and my interpretation of how each may relate to my health decline, are summarised in the Personal Experience Appendix **(Section 1)** at the end of this document. Several of the tests in that battery - DTC SNP panels, hair-element analysis, organic-acids profiling, and live-blood analysis - are functional-medicine tests rather than mainstream clinical chemistry. The findings are presented as personal medical history rather than as part of this document's substantive case.

16.2 My unofficial "Diagnosis" of EHS

By mid-2020, I already knew several people with good knowledge in the area of EHS and one of these recommended a GP in Auckland who knew other people with similar symptoms and a similar exposure history.

I saw this GP in September, 2020. He took a detailed medical history, and looked at a summary of all my NZ Lab tests results, and USA Functional Lab test outcomes. He agreed that I appeared to have no other health condition that could explain my symptoms, and was aware of no other underlying pathogenic processes that could be identified, except for the ones discussed in **14.1** above and the Personal Experience Appendix below.

Very thankfully, this GP agreed to write a letter to my employer, explaining that he had undertaken a detailed review of my medical history, current presentation, and recent lab test results. As a result, he concluded that it was important for health and safety reasons to limit my exposure to such [Wi-Fi] radiation. He requested that I limit my exposure to 2 hours a week of office work. He added (in the letter) that clinically it made sense, so he supported that approach.

16.3 Recent evidence: my health is again adversely affected by Wi-Fi microwaves

In early April 2026 I decided to change my Internet provider in order to enjoy cheaper monthly fees. I had not made such a change for many years. On the day that I switched ISPs, the technician on the phone advised that I would need to do a complete reset of my modem, to update settings to the new provider.

This was done without any hitch and I continued to spend numerous hours most days of the week, working in my Office. Where I stand or sit at my computer is just one metre from the modem and Wi-Fi transmission by the modem has always been off over the last 7 years or more.

Over the following 3 weeks, I continued with my normal daily routine, and became very concerned when many of my EHS-like symptoms gradually worsened, and regular daily headaches began again. So by the end of 3 weeks, for no apparent reason, I was feeling high-level mental and physical fatigue, cognitive blunting and slowing, stress, low mood and motivation, etc. This level of ill-health had not been present for about 4 years and there had been no changes at all in my diet, life style, relationships, finances and overall life status.

While trying to understand what could be causing this substantial decline, I suddenly remembered that on resetting a modem, there is a chance that Wi-Fi can be reactivated by this. I immediately looked at my modem on the floor and noted that green lights were showing for both Wi-Fi frequencies (2.45 GHz and 5 GHz). As I hadn't been near my modem since the reset 3 weeks prior, I had clearly been exposed to Wi-Fi radiation over that entire period, with intense radiation whenever working in my office.

On disabling both Wi-Fi frequencies, over the next 2-3 weeks, as best as I could assess, my health gradually returned to pre-Wi-Fi exposure levels.

I realise that this is purely anecdotal evidence with a subject number of just one. However, in single subject or small group studies, there is a recognised, valid experimental procedure simply called "ABA", or the "reversal design". [1] That is, there is first a baseline (non-exposure) condition (A), then the intervention procedure (B), followed by returning to a non-exposure phase (A). If there is some causality involved with the independent variable during stage "B", then a there should be a change in subject condition during this phase. With a return to pre-exposure subject conditions – in my case with the removal of close-proximity Wi-Fi radiation – the condition of the subject should gradually revert to normal (pre-exposure) levels of phase A. (This assumes that permanent changes haven't occurred to the subject during Phase "B".)

16.4 YouTube video by former "Tech Guru" explaining EHS issues – and his mitigation strategies

This 2025 YouTube video is very clear and well-explained, and can quickly increase understanding of potential microwave dangers (and other EMFs) with their likely effects on functioning: EMF Poisoning: WiFi, Cell Phones, Smart Homes, Influenza, and Dirty Electricity | Keith Cutter - YouTube

For the full personal account of the protective measures I have adopted, and for the detailed functional-medicine test results that complement the clinical chronology above, see the Personal Experience Appendix at the end of this document.

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[1] See: https://opentextbc.ca/researchmethods/chapter/single-subject-research-designs/

17. Practical Measures I Apply in My Own Household

Introductory Note

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What I do in practice

This Section describes the small set of measures I apply in my own household whose underlying rationale is well supported by mainstream risk mitigation guidance from national health bodies (including ANSES, the French National agency for environmental and animal health, etc.[1]) and by the regulatory framework's own treatment of phone-against-body separation distance - see **Section 20.1** on SAR testing. A wider set of measures I personally use that go beyond these mainstream-supported practices, including silver-mesh shielding, smart-meter chip removal, dirty-electricity remediation, and choice of vehicle, are described separately in the **Personal Experience Appendix** as personal experience rather than as part of the document's substantive case.

I live in a semi-rural environment that is at least a kilometre from the nearest 4G tower. This was not initially a deliberate choice for EMF reasons, but distance from the nearest sector antenna's main-lobe ground intercept (see Section 13) is the most direct way to reduce ambient base-station RF exposure at home.

With my mobile phone at home, I nearly always have it in Flight Mode and away from my person, checking it a couple of times a day for voice messages and texts. My wife has agreed to the same arrangement. If I answer or make a brief call I almost always have the phone on speaker, holding it well away from my head. The manufacturer-specified separation distance documented in every smartphone's RF-exposure section already implicitly recommends this - at zero or near-zero separation, in-body SAR can considerably exceed the certified-compliance reading (see Section 20.1). We have a landline so friends and family can still contact us reliably.

Our home uses wired Ethernet for Internet connectivity, and the Wi-Fi function on the router is disabled. When travelling I ask friends or relatives if their Wi-Fi router can be turned off at night. This aligns with mainstream risk mitigation advice from ANSES and other national health bodies that wired connections are preferable to Wi-Fi for fixed-location use, particularly for children.

Owing to the combined effect of these and the further measures described in the Personal Experience Appendix at the end of this document, my EHS-like symptoms over the last few years have fallen from the severe level of late 2018 / early 2019 to mild-to-moderate today.

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[1] ANSES: This French governmental agency is responsible for food, environmental, occupational, animal, and plant health safety, https://www.anses.fr/en

18. Who May be More at Risk for EHS, or the Potential Damaging Effects of Man-Made Microwaves?

Introductory Note

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Based on the findings of Dr J Mercola [1], along with the author's research and personal findings elaborated above, it is suggested that any of the following health issues or profiles may increase vulnerability to MMMs:

1. **Children in general,** and the younger they are, the more at risk – due to their brains still developing, thinner skulls, smaller brains, and higher levels of water and ions in their brains. [2]

2. Anyone with **metal concentrations in the mouth or on the head** - especially children with their developing brains. For example, those with orthodontic braces, with amalgam (mercury-based) fillings, and those with metal-framed glasses. That is, metal objects such as amalgam fillings, braces and metal-framed glasses can interact with RF/microwave fields and may increase local field distributions or localized energy absorption. [3] More specifically, regarding amalgam fillings, mobile phone EMFs have been linked to an increased rate of mercury release; microwaves acting on metal braces appear to increase the release of metals such as nickel; and metal-framed spectacles and metallic implants have been linked to slightly increased localized specific absorption rate (SAR) in nearby tissue. [ibid]

3. Spending **a lot of time beside conductive metal objects** - depending on the specific characteristics of that object - can perturb RF electromagnetic fields, creating areas of **local field enhancement**, shielding, or redistribution. [4] So, depending on the conductive properties of an object, sitting at a metal-framed desk, beside a metal filing cabinet, sleeping on a metal-framed bed or metal-sprung mattress, could enhance the concentration of the microwaves in that area. [ibid]

4. Anyone with **one or multiple head injuries** – even when the person didn't become unconscious. [5]

5. Anyone with **significant levels of heavy metals and/or metals in the brain** - such as mercury and aluminium. Unlike ferromagnetic particles such as magnetite (discussed below), these metals do not have an electromagnetic coupling mechanism that lets them amplify RF energy locally. In their biologically relevant ionic forms (Hg^{2+} and Al^{3+}), both are diamagnetic, so neither supports magnetic resonance, and at micromolar tissue concentrations they have no antenna-like geometry. Their effect on EHS vulnerability is independent toxicity that compounds with RF damage on overlapping

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[1] See: *EMF*D* [book] by Dr J Mercola, EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books (chapter 5)
[2] See: See: https://pubmed.ncbi.nlm.nih.gov/23705297/
[3] See: https://www.rfsafe.com/research/ViewStudyExpert.php ; https://www.sciencedirect.com/science/article/abs/pii/S1761722718300962; https://pmc.ncbi.nlm.nih.gov/articles/PMC5928305 and https://search.ieice.org/bin/summary.php?id=j104-b_6_500&category=-B&year=2021&lang=J&abst=
[4] See: https://onlinelibrary.wiley.com/doi/abs/10.1002/mop.21261
[5] See: https://esmed.org/MRA/mra/article/view/6253

molecular targets: chronic neuroinflammation, mitochondrial dysfunction, glutathione depletion, impaired oxidative-stress defence, and (for mercury) blood-brain-barrier disruption. Where the brain is already carrying a heavy-metal burden, RF exposure adding further oxidative and nitrosative stress will produce greater net damage than either insult alone. Iron and copper accumulation, a separate concern relevant to ageing and to some neurodegenerative conditions, can additionally amplify RF-induced oxidative damage through Fenton-type catalysis - a chemical rather than electromagnetic effect. **ibid**

6. Anyone with **high, ongoing exposure to microwaves** – regardless of reasonable pre-exposure health status **ibid**

7. Anyone with a **chronic inflammatory condition** – such as an autoimmune disease, or **Chronic Inflammatory Response Syndrome**, CIRS. CIRS is known to very often be caused by exposure to mould mycotoxins. [1] Such mycotoxin exposure and chronic inflammation may then predispose one to being more badly affected by MMMs. [2] People in this chronic inflammatory group would include anyone with **Mast Cell Activation Syndrome** (MCAS), chronic histamine elevation, or **Multiple Chemical Sensitivities** (MCS).

8. Anyone with a **genetic disadvantage when it comes to detox pathways** and detox functionality **ibid**

9. Anyone with **poor functioning of key detox organs** such as the skin, kidneys and liver

10. Anyone with **poor general health status**, likely owing to consumption of too many toxins in water, food, air, medications, etc. **ibid** Also, likely owing to poor lifestyle factors such as chronic high stress, little exercise, and poor quality of sleep.

11. Anyone with **pre-existing poor cardiovascular status** – with compromised circulation, and/or compromised heart function. [3]

12. Anyone with **poor metabolic flexibility** who gets most of their energy from burning carbohydrates **ibid**

13. Anyone with already **compromised mitochondrial function** – which always happens with aging, or owing to impacts of accruing endotoxins and/or exotoxins. **ibid**

14. Anyone with an **existing neurodevelopmental disorder** such as ADHD and Autism/ASD. (As discussed above, these conditions very often exist with diagnosable inflammation of the gut and/or the brain.)

15. Anyone with **chronic gut inflammation and gut dysbiosis**. (Food sensitivities or intolerances will usually cause inflammation.) With chronic gut inflammation, this usually leads to a leaky gut membrane, which then causes over-activation of the immune system – owing to foreign proteins appearing in the blood that shouldn't be there. This in turn may lead to a leaky blood-brain barrier, with consequent increasing levels of brain inflammation and brain dysfunction.

16. As discussed (**Section 14**) oxidative and nitrosative stress are closely linked through the production of reactive oxygen species (ROS) and reactive nitrogen species (RNS), respectively. Excessive production of ROS, or a deficiency in the body's ability to neutralize them, leads to oxidative stress.

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[1] See: Mold, Mycotoxins and a Dysregulated Immune System: A Combination of Concern? - PubMed; and Understanding Mycotoxin-induced Illness: Part 1 - PubMed

[2] See: https://esmed.org/MRA/mra/article/view/6253

[3] See: *EMF*D* [book] by Dr J Mercola, EMF*D: 5G, Wifi & Cell Phones-Hidden Harms and How to Protect Yourself : Mercola, Joseph: Amazon.com.au: Books (Chapter 4)

Similarly, high levels of RNS, like nitric oxide, can react with ROS to form even more potent reactive species, contributing to nitrosative stress. Those **people with already high levels of ROS or RNS** (for whatever reason), will likely be more affected by MMMs, which – in a vicious cycle - usually adds to ROS and RNS levels. High levels of ROS (and RNS) cause increasing damage to lipids, proteins and DNA: basically, to any tissue that is exposed to ROS.

17. Anyone with a significant **issue breaking down oxalates** in foods – thereby causing systemic inflammation and a range of symptoms very similar to EHS

18. Anyone with a significant issue with **exposure to mycotoxins** – either endogenously created or from an external (mould) source.

19. **Magnetite particles in human brain tissue** may have a more direct relationship with microwave exposure than the heavy-metal bullet above, because magnetite (Fe_3O_4) is genuinely ferromagnetic. Ferromagnetic particles in an alternating magnetic field can resonantly absorb electromagnetic energy by *ferromagnetic resonance* (FMR), at frequencies determined by particle size, shape, and the local magnetic field. For magnetite nanoparticles in tissue, FMR frequencies fall within the GHz range - directly overlapping the frequencies used for mobile telecommunications. Whether this resonant absorption couples to local cellular damage in living tissue is an open question, but the underlying physics is well-established and the magnetite–RF coupling is genuinely real, not metaphorical.

20. **Three populations of magnetite are now recognised in human brain tissue** (Maher et al. 2016, *PNAS*; Giere 2016, *PNAS* commentary): (i) biogenic magnetite, produced by the body itself in small numbers as crystallographically pure octahedral or hexagonal crystals; (ii) pollution-derived magnetite nanoparticles - combustion-derived spherules typically 10–150 nm in diameter, often associated with other metals such as platinum, nickel, and cobalt, and abundant in the brains of people living in urban environments with diesel exhaust and brake-wear pollution; and (iii) other exogenous magnetite, including occupational sources. The pollution-derived population is the most policy-relevant of the three: it identifies a specific exposure pathway (combustion air pollution) that loads the human brain with ferromagnetic particles capable of RF coupling. People in high-air-pollution environments may carry a greater magnetite burden, and to whatever extent FMR with telecommunications-frequency RF couples to cellular damage, this population may be more susceptible to MMM-related effects. [1]

[1] Maher et al. 2016 - Magnetite pollution nanoparticles in the human brain (PNAS); Giere 2016 - Magnetite in the human body: Biogenic vs. anthropogenic (PNAS commentary).

Young boy with braces (AI generated) www.magnific.com

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19. How Qualified Medical Professionals might consider going about Diagnosing EHS

Introductory Note

Except for the carefully qualified suggestion at bullet-point 6, the author has entirely avoided introducing any of his ideas in this Section. That is, all other bullet-points are direct summaries of the source documents noted below, or drawn from the preceding discussion.

As previously acknowledged, the writer is not a medical practitioner and the below information is intended solely as a possible basis for discussion between a concerned reader and their qualified health practitioner – with expertise in this field.

Source documents:

EHS Questionnaire – SaferTech.NZ.pdf; *Electrosensitivity Science – Physicians for Safe Technology (Sept 2019).docx*; *Electrohypersensitivity - Patient Questionnaire (mdsafetech.org).docx*; *EUROPAEM EMF Guideline 2016 for prevention, Dx & treatment of EMF-related health problems.pdf*; *Diagnosis & Treatment of EHS – EUROPAEM Guidelines – DL summary (2019).pdf*; and *EHS as Newly Identified & Characterized Neurologic Pathological Disorder - How to Dx, Treat & Prevent - Belpomme Mar 20.pdf*. All these documents are in the author's OneDrive folder EHS Diagnosis.

1. There are established patient questionnaires – for example the SaferTech.NZ one at Survey, which is an adapted and updated version of the EUROPAEM EMF guidelines 2016 noted above. In these questionnaires, a person can self-report what characteristic symptoms are being noticed, and with what level of frequency and severity. This is then discussed with one's qualified health practitioner. However, a problem with successfully diagnosing EHS is that other conditions or diseases can produce overlapping symptoms. So, for the contested-literature biomarker work that has been proposed in this area, please see the EUROPAEM guidelines, this writer's summary of those Guidelines, and the March 2020 article by Belpomme, all in EHS Diagnosis.) Additional notes on these contested biomarkers are in **Section 9** of the **Personal Experience Appendix**.

2. A related problem with diagnosis, is that people that are apparently being badly affected by MMMs, do not necessarily present with the exact same symptom profile, or blood-based biomarkers. Rather, they present with variation within the overall symptom set, and within the full range of biomarker indicators. Heterogeneous clinical presentation is well-documented across many other syndromes whose underlying mechanisms involve individual variation in genetic, immune, and inflammatory factors, and is not in itself evidence for or against a discrete underlying condition. [1]

3. A very extensive medical history needs to be taken, looking for any health issues that could be causing or compounding the current symptom profile. This should include:

    - Overall state of health
    - Electrical trauma: multiple shocks, electrocution, struck by lightning
    - Chemical trauma: exposure to pesticides, metals, chlorinated hydrocarbons (PCBs, DDT, etc.)
    - Biological trauma in the form of a large load of parasites, fungal infections, viral infections, etc.
    - Physical trauma to the central nervous system in the form of TBIs, whiplash, other accidents, spinal problems

[1] See: slide 14 in Microsoft PowerPoint - AODA Functional Medicine 101 - Copy

- Emotional trauma
- Autoimmune disorders
- Genetic factors

4. Investigators including Havas (Trent University, Canada) have proposed that a prior history of traumatic brain injury (TBI), and elevated body burdens of heavy metals such as mercury, may increase individual susceptibility to developing EHS-like symptom patterns. The proposal is plausible mechanistically - both TBI and chronic heavy-metal exposure are independently associated with disrupted blood-brain-barrier integrity and chronic neuroinflammation - but it has not been confirmed in prospective cohort studies and is not part of any standard clinical-vulnerability assessment for EHS.

5. Extensive medical testing is needed to rule out any other disease or condition that could be producing similar symptoms. Separately, a contested-literature programme led by Belpomme and Irigaray [1] has investigated whether a panel of biomarkers - autoantibodies against myelin, S100B, and nitrotyrosine among others - might support a biological / clinical case for EHS as a discrete condition. Their reported findings (and the prevalences they report within their own patient series) are summarised in Section 9 of the Personal Experience Appendix. While mainstream rheumatology, immunology, and neurology do not currently recognise this biomarker panel as diagnostic of any condition, Belpomme and Irigaray have nevertheless come up with biomarkers that appear helpful in distinguishing between affected individuals and those who are unaffected. [2]

Int. J. Mol. Sci. **2020**, *21*, 1915 6 of 20

Table 4. Increase in low-grade inflammation-related biomarker mean blood level values in the peripheral blood of patients with EHS and/or MCS, according to References [9,10]. SE—standard error; hs-CRP—hypersensitive C reactive protein; IgE—immunoglobulin E; Hsp—heat-shock protein.

	Patient Groups							
Marker Normal Values	EHS Mean ± SE	Above Normal (%)	MCS Mean ± SE	Above Normal (%)	p *	EHS/MCS Mean ± SE	Above Normal (%)	p **
hs-CRP < 3 mg/L	10.3 ± 1.9	15	5.3 ± 1.7	12	0.50	6.9 ± 1.7	14.3	0.36
Histamine < 10 nmol/L	13.6 ± 0.2	37	23.5 ± 4.5	33	0.91	13.6 ± 0.4	41.5	0.52
IgE < 100 UI/mL	329.5 ± 43.9	22	150.9 ± 18.3	20	0.23	385 ± 70	24.7	0.53
Hsp 70 < 5 ng/mL	8.2 ± 0.2	18.7	5.9 ± 0.5	12	0.03	8 ± 0.3	25.4	0.72
Hsp 27 < 5 ng/mL	7.3 ± 0.2	25.8	6.8 ± 0.1	6 ***	0.59	7.2 ± 0.3	31.8	0.56

* Comparison between the EHS and MCS groups of patients for marker mean level values was done using the two-tailed t-test. Except for Hsp 70, there is no statistically significant difference between EHS and MCS patients for increased mean level values of the different biomarkers analyzed, suggesting that EHS and MCS share a common physiopathological mechanism for genesis. ** Comparison between the EHS and EHS/MCS groups of patients by using the two-tailed t-test. There is no statistically significant difference between EHS and EHS/MCS patients for increased mean level values of the different biomarkers analyzed. *** With the exception of MCS, for which there is a statistically significantly lower frequency percentage value for Hsp 27, the frequency percentage values obtained in EHS and EHS/MCS for all the other investigated parameters do not differ significantly on the basis of the chi-square independence test.

Table from the Belpomme & Irigaray paper of March 2020, showing some distinguishing biomarkers [3]

[1] See: (*Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment.* Belpomme & Irigaray September 2022. PMID: 35537497 DOI: 10.1016/j.envres.2022.113374)
[2] See for example: The Critical Importance of Molecular ,Biomarkers and Imaging in the Study of Electrohypersensitivity. A Scientific Consensus International Report and the 2 key – already quoted - papers by Belpomme (Mar 2020 and Sep 2022)
[3] See: Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It - PubMed

Regarding 3 key biomarkers of oxidative stress that they assessed EHS sufferers for (Thiobarbituric acid, oxidised glutathione and Nitrotyrosine), 80 per cent showed at least one of these biomarkers in peripheral blood supply, compared to 0 per cent in the group of normal subjects. [1] The most commonly elevated biomarker was histamine. (The full range of biomarkers they assessed was: hs-CRP, Hsp, Histamine, IgE, Nitrotyrosine (NTT), "O-myelin" (anti-MAG?), oxidised glutathione, TBARS (thiobarbituric acid reactive substances.) [ibid]

6. Belpomme and Irigary (2020) have also established a **hierarchy of presenting symptoms** for 150 EHS sufferers (with elevated biomarkers), when compared to 50 normal subjects (with no symptoms of EHS and no elevated biomarkers). Many of those presenting with EHS also suffered from Multiple Chemical Sensitivities (MCS). [2] However, it should be noted that this symptom-frequency table is based on their own clinical cohort rather than on a randomized population-based study. Also, the diagnoses were based on patients who self-reported EHS and/or MCS and were then evaluated in the authors' clinical programme – using six major clinical criteria. [3]

Clinical Symptoms	EHS (%)	Normal Controls (%)	p **	MCS (%)	p ***	EHS/MCS (%)	p ****
Headache	88	0	<0.0001	80	0.122	96	0.065
Dysesthesia	82	0	<0.0001	67	0.0149	96	0.002
Myalgia	48	6	<0.0001	48	1	76	<0.0001
Arthralgia	30	18	0.067	24	0.611	56	<0.001
Ear heat/otalgia	70	0	<0.0001	16	<0.0001	90	<0.001
Tinnitus	60	6	<0.0001	35	<0.001	88	<0.0001
Hyperacusis	40	6	<0.0001	20	<0.001	52	0.118
Dizziness	70	0	<0.0001	52	0.0137	68	0.878
Balance disorder	42	0	<0.0001	40	0.885	52	0.202
Concentration/attention deficiency	76	0	<0.0001	67	0.210	88	0.041
Loss of immediate memory	70	6	<0.0001	56	0.040	84	0.028
Confusion	8	0	0.007	0	0.0038	20	0.023
Fatigue	88	12	<0.0001	72	0.0047	94	0.216
Insomnia	74	6	<0.0001	47	<0.0001	92	0.001

Table 3: Symptom Hierarchy for EHS and MCS subjects c.f. normal subjects [ibid]

[1] See: (*Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment.* Belpomme & Irigaray September 2022. PMID: 35537497 DOI: 10.1016/j.envres.2022.113374)
[2] See: **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**. PMID: **32168876**; PMCID: **PMC7139347**
[3] See: https://pmc.ncbi.nlm.nih.gov/articles/PMC8304862/ section 5.1

Clinical Symptoms	EHS (%)	Normal Controls (%)	p **	MCS (%)	p ***	EHS/MCS (%)	p ****
Depression tendency	60	0	<0.0001	29	<0.0001	76	0.022
Suicidal ideation	20	0	<0.0001	9	0.027	40	0.003
Transitory cardiovascular abnormalities	50	0	<0.0001	36	0.046	56	0.479
Ocular deficiency	48	0	<0.0001	43	0.478	56	0.322
Anxiety/panic	38	0	<0.0001	19	0.003	28	0.176
Emotivity	20	12	0.176	16	0.461	20	1
Irritability	24	6	<0.001	14	0.071	24	1
Skin lesions	16	0	<0.0001	14	0.692	45	<0.0001
Global body dysthermia	14	0	<0.0001	6	0.236	8	0.258

Table 3: Symptom Hierarchy for EHS and MCS subjects c.f. normal subjects (continued) **ibid**

7. Following up on the work by Belpomme and Irigaray, in July 2021, an important "Scientific Consensus International Report" was published by a large group of established experts in this field. The paper was titled, "The Critical Importance of Molecular Biomarkers and Imaging in the Study of Electrohypersensitivity." [1] The paper affirmed the clinical relevance of the Belpomme and Irigaray biomarkers, and outlined additional biomarkers such as increased plasma glucose levels. It was further stated that most symptoms of EHS have a neurological foundation, and that imaging studies have demonstrated brain neurovascular dysfunction. **ibid**

8. In general, it is important to undergo a range of tests that establish current level of inflammation in the body – such as the **HS-CRP** test, histamine, and markers for oxidative and nitrosative stress. (Where the contested-literature cascade described in Section 14 Mechanism 3 operates, elevated systemic inflammatory markers would be one downstream signature; the markers themselves are non-specific, so an elevated panel is consistent with - but not specific to - RF-related inflammatory processes.)

9. The onset of the EHS needs to follow significant exposure to MMMs.

10. Level of exposure – both night and day – need to be estimated as accurately as possible. This would include assessing or estimating, frequency (rarely, sometimes, often), duration (short or long periods of time), and EMF types of exposure.

[1] https://pmc.ncbi.nlm.nih.gov/articles/PMC8304862/

11. If possible, signal characteristics need to be measured, including: signal intensity (peak hold, maximum, average (RMS); signal frequency (carrier wave, message signal, harmonics); crest factor (peak-to-average ratio); pulse characteristics (frequency, duration, rise-time, fall-time); and modulation type (frequency, amplitude, or phase modulation). [1]
12. Symptom onset can be gradual or sudden. In the contested-literature case-series and self-reported-cohort data, longer exposure duration is associated with greater symptom severity in many but not all patients, and progressively lower exposure thresholds appear to trigger symptoms in some patients with established sensitisation. Both patterns are reported but neither has been quantified in prospective controlled studies.
13. Conversely, major efforts to minimise exposure to MMMs, will usually lessen at least some of the symptoms. However, many of them persist over time – such as chronic brain inflammation, compromised mitochondria, and chronic mental and physical fatigue.

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[1] See: EMF Guideline - Katharina Consulting

20. Mitigation Strategies Recommended by EMF Experts, for Man-Made Microwaves & other RF-EMFs

20.1 SAR testing and real-world use

Modern smartphones are required to demonstrate compliance with regulatory limits on Specific Absorption Rate (SAR) before they can be sold. The SAR limit caps the rate at which the body absorbs RF energy when a phone is held near it. The point worth being explicit about is the test geometry: SAR compliance is measured against a tissue-simulating phantom at a manufacturer-specified separation distance from the phone, and that test distance does not correspond to how most people actually use their phones.

The U.S. Federal Communications Commission (FCC) allowed compliance testing at separation distances up to 15 mm from the body from 1996 until April 2025; in April 2025 the FCC reduced its allowed test separation to a maximum of 5 mm. The European framework that New Zealand follows via NZS 2772.1:1999 (which adopts ICNIRP test methodology) has long required testing at 5 mm separation. Real-world use, however, is typically zero to a few millimetres of separation: phones are held against the ear during voice calls, carried in pockets directly against the body, or rest in shirt pockets directly against the chest. Because near-field RF coupling falls off rapidly with distance from a phone's antenna, a phone that demonstrates compliance at the test distance can produce considerably higher local SAR at zero or near-zero separation in real use.

The 2019 Chicago Tribune investigation by Sam Roe commissioned an FCC-accredited laboratory to retest several popular phones (iPhone 7/X/XS, Samsung Galaxy S9, Motorola Moto g6 play, BLU Vivo 5 Mini) at a 2 mm pocket separation rather than the then-15 mm certification distance. Several phones substantially exceeded the FCC's 1.6 W/kg SAR limit at 2 mm; the iPhone 7 was the worst performer, reading more than double the limit. The FCC ran its own confirmatory testing in response. Its public report (December 2019) showed the phones complying with the SAR limit when tested at 5–15 mm. The FCC also tested the same phones at 2 mm; those test results showed most phones exceeding the SAR limit. The 2 mm findings were labelled "confidential" in FCC internal documents and were not included in the FCC's public report or in its filings in either Apple v. Cohen (where plaintiffs alleged exactly this issue) or Berkeley v. CTIA (where the wireless industry sued the city of Berkeley over its phone-distance disclosure ordinance). The withheld 2 mm results were released by the FCC to the Environmental Health Trust (EHT) on 29 September 2023 in response to an EHT-submitted Freedom of Information Act request (11 records released; FOIA Control Nos. 2023-000281 and 2023-0003).[1]

The April 2025 FCC rule change to a 5 mm maximum partially closes the gap for newly certified devices. Devices certified before April 2025 are still in the field on the old 15 mm basis. New Zealand's position, via ICNIRP at 5 mm, has been better than the United States' pre-April-2025 position throughout. But the broader real-use problem remains: even at 5 mm certification, compliance does not represent the worst-case in-pocket / against-skin / low-signal exposure that produces the highest in-body SAR for many users.

The implication for risk mitigation practice is direct and does not depend on accepting any contested mechanism literature. The available manufacturer-specified separation distance is documented in the user manual or RF-exposure section of every smartphone sold in N.Z. Users wishing to maintain certified-compliance-equivalent exposure at home or at work can keep the phone at that distance from the body –

[1] Roe 2019 - We tested popular cellphones for RF radiation. Now the FCC is investigating (Chicago Tribune); FCC OET SAR Compliance Testing report (Dec 2019); EHT - FCC FOIA release of 11 records of withheld 2 mm SAR test data (29 Sept 2023); FCC April 2025 Final Rule on RF Exposure Compliance Testing Distance (47 CFR Part 2).

such as on a desk, in handbag, and during voice calls using speakerphone, or a wired headset, or hands-free. This is a no-cost risk mitigation step that requires no regulatory change.

20.2 Some further published, noteworthy guides / resources:

Keeping yourself and your children safe

Home

Use wired connections for phone and internet.

Do not let children use wireless devices.

Use hands free if HAVE to use mobile phone. Earphones must be airphones.

Throw away baby monitors cordless phones fit bits and smart watches.

If there is a tower beaming into your home, try to shield, or move.

Clean up smart meters, solar, dirty electricity, and magnetic fields.

Contact a building biologist.

Purchase your own hand held meters.

Turn all screens off at 10pm. Blue light off at sunset.

Do not have electronic items in bedrooms (use a battery powered clock not a phone)

Do not sleep near active wires or phone chargers in your bedroom, or with an electric blanket plugged in (even if off).

Turn of power in bedrooms at night with a demand switch.

Stop streaming video as much as possible.

Out and About

Mobile phone and laptop / tablets

- **Airplane mode ON**
- **Location services OFF, Bluetooth OFF, WiFi OFF**

Check messages and send then disable again

Don't make calls/stream in car bus or train (Faraday cage) / low signal areas

Don't carry your phone in your pocket, bra or handbag

Lifestyle

Look up. Breathe. Play music, sing, dance, read, go for walks, plant herbs and trees, play games with children.

Eat a healthy multicoloured antioxidant rich diet.

Reduce stress.

Get good sleep (10pm lights out). Get good sunlight.

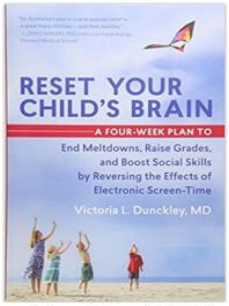
Pray.

GIZMOS WILL NOT PROTECT YOU

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

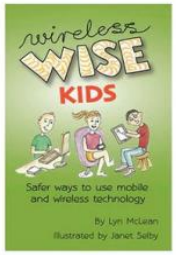
What to do: Parents

- Model safe / wise technology use
- Promote human over technology
- relationships (Steiner-Adair, 2015)



Dunckley, V. L. (2015). *Reset Your Child's Brain: A Four-Week Plan to End Meltdowns, Raise Grades, and Boost Social Skills by Reversing the Effects of Electronic Screen-Time*. New world library.

https://emraustralia.com.au/



Wireless Wise Kids: Safer Ways to Use Mobile & Wireless Technology

https://www.buildingbiology.com.au/

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

Don’t put mobile phones near bed

Bad Idea

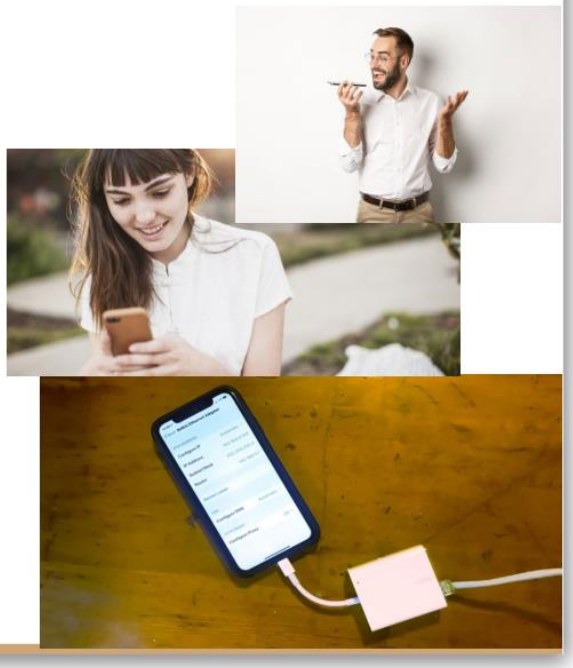
- Medical Students > 2 hours/day → sleep deprivation and day sleepiness (Yogesh et at 2014)
- Pulsed-modulated EMF affects cerebral blood flow and brain electrical activity (Huber et al. 2002)
- Increased Slow Wave Activity during exposure to pulse-modulated RF-EMF at end of the sleep period → reduction in performance improvement after sleep (Lustenberger et al 2013)
- Insomnia headaches and tinnitus after installation of smart meters in Victoria (Lamech, 2014)

EMF Hazards Summit April 2025, Dr Julie McCredden (ORSAA) presentation

Recommendations

For children, pregnant women/birthing people, and women trying to get pregnant:

- Turn off all cell phones, cellular devices, and Wifi at night before going to bed
- Download music or videos instead of watching or listening to them using streaming
- Carefully consider the pros and cons of a “smart house”
- Keep phones on airplane mode or off as often as possible, ideally plug into ethernet
- Use cell phones mostly for texting, use speaker phone for calls when needed
- Hardwire schools with ethernet to reduce RF-EMF in schools



EMF Hazards Summit April 2025, Bonnie Tucker presentation

Onerahi (Whangārei) 5G mini cell tower directly outside residential home – photo taken by the author

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21. Summary of Key Findings by Section

Section 6 - Is EHS a Real Health Condition & what may be causing it? – An Introduction

In this Section it was established that EHS is a long-standing (1991) diagnosis in the W.H.O.'s classification of diseases - the then ICD-10 - and remains in the current ICD-11. On its Website, Health N.Z (Te Whatu Ora) recognises this W.H.O. system of classification (ICD-10-AM) as being valid and currently extant for diagnostic purposes in New Zealand.

Leading researchers, Belpomme and Irigary have built a very extensive database of EHS sufferers, and thereby been able to demonstrate an objective and consistent range of key diagnostic symptoms and tests. They also state that, "… we show that EHS is in fact **causally** associated with increased exposure to man-made EMF."

Earlier in 2025, the W.H.O. partially commissioned 12 (meta-analysis) studies on a possible causal relationship between RF-EMFs and a range of health conditions and diseases. One of these studies uniquely utilised a **narrative** analysis of data – rather than statistical – and determined there is "**moderate certainty** evidence of an increased risk of some rare cancers …"

Section 7 - Why is it Vital to Learn about Electromagnetic Hypersensitivity (EHS)?

The key takeaway in this Section was the impoverished level of knowledge amongst the general public regarding health risks apparently posed by man-made microwaves, and, why this continues to be so.

Section 8 - Introduction to EMF Waves – including microwaves

This Section explained the basic physics of EMF waves, with Radio Frequency EMF waves being one band within EMFs, and man-made microwaves being a narrow band of waves within Radio Frequencies.

Section 9 - Cause for Confusion regarding Health Risks of Radio Frequency Electromagnetic Fields (RF-EMFs)

This Section reviewed the multiple reasons why conducting research into man-made microwaves is so fraught with methodological challenges, and hence why there is much variation in research results. Further, why it is very difficult to uncover underpinning causal pathways to the effects obtained – with an in-depth knowledge of human biophysics **and** biochemistry being necessary. There appears to be only a small group of medical/scientific experts around the globe who have such extensive, cross-discipline knowledge.

Section 10 - Sources of Information on Dangers of RF-EMFs – including man-made microwaves

Based on the writer's extensive research, there appears to be a very limited number of medical/scientific experts with the multidisciplinary expertise to understand how MMMs could adversely affect humans. Some of these experts were delineated. Similarly, there is shortage of Websites that contain only reasonable quality (unbiased) material. Some of these sources were also listed. Other resources such as books and Internet Search Engines were enumerated. (There will certainly be other quality sources that the writer is yet to become aware of.)

Section 11 - What are the EMF Frequencies considered of Most Concern to Health?

This Section introduced man-made microwaves as appearing to be significantly harmful to humans. It also elaborated the large range of devices or systems that utilise microwave EMFs. At the same time, frequency bands above and below man-made microwaves, appear to frequently produce harm to humans.

Section 12 - If there are thousands of studies on negative outcomes of microwave exposure, why don't we hear more in the Media & from Governments?

This Section discussed why vastly resourced Telco companies around the world seem to have a powerful influence over local governmental advice, policies and relevant legislation.

Section 13 - Why Man-Made Microwaves are apparently so damaging – even at non-heating (non-ionising) levels

This important Section examined in depth, why man-made microwaves appear to frequently cause wide-ranging damage and dysfunction to the human organism. This is at a biophysical and biochemical level, and naturally occurring microwaves do not normally pose such potential for detrimental health effects.

Section 14 - Known (or Suspected) Pathways/Mechanisms of Man-Made Microwave Action

This key Section outlined the postulated pathways and mechanisms by which man-made microwaves appear to have a deleterious impact on human health, organised into sixteen postulated mechanisms across four thematic groups, with several connected stages of a common upstream cascade - including calcium-ion influx through voltage-gated channels, oxidative and nitrosative stress, mitochondrial dysfunction, blood-brain-barrier disruption, neurotransmitter changes, and others. The secondary effects are interconnected stages of a common upstream cascade rather than fully independent pathways.

Section 15 - Man-Made Microwaves: Some apparent neuropsychological effects on humans

This important Section outlined 12 different apparent effects on neuropsychological function that researchers have identified. These were, apparent: poor short-term and long-term memory; brain fog; chronic mental (and physical) fatigue; dizziness; headaches; ringing in the ears; agitation, aggression and hyperactivity; anxiety, nervousness and obsession-compulsion; low mood or depression; poor sleep; and reduced verbal expression and comprehension (in children).

Section 16 - Onset and Progression of my Presumed EHS, & Relevant Medical Assessments

This Section detailed the development of my major health decline, beginning in 2018. This was subsequent to ongoing exposure to high levels of Wi-Fi in my workplace. (Knowing the nature and progression of my symptoms may prove instructive to others in N.Z. who have been seeking to understand their health declines.) This Section also outlined some key medical tests I undertook in order to rule out other possible causes of my health crisis, and to potentially rule in microwaves as the most likely, dominating cause of my decline. Such advanced-level tests should be available via any health practitioner who is allied with the Company FxMed in Napier.

Section 17 - Protective Measures I Apply in My Own Household

In this Section, I outlined a huge range of measures that I have taken, and continue to take, to reduce the apparently damaging effects of man-made microwaves on my health. The Section included contact details for purchasing a number of protective resources and for contacting EMF consultants. However, I am not recommending any particular Company and product and the reader needs to undertake due diligence – and consult relevant health experts – before making any health or financial decisions. Happily, taken

together, mitigation measures I have employed have resulted in a significant reduction in the severity of my symptoms.

Section 18 - Who May be More at Risk for EHS, or Damaging Effects of Man-Made Microwaves?

This Section suggested a range of health issues that might make one more susceptible to health damage from exposure to man-made microwaves. These are suggestions only, and relevant health experts should be consulted for any needed follow-up. A central theme of risk, was any health condition that included pre-existing abnormal levels of oxidative or nitrosative stress and/or inflammation in the body.

Section 19 - How Qualified Medical Professionals May Consider Going About Diagnosing EHS

Accurate diagnosis clearly requires a very detailed, in-depth and comprehensive approach that does not miss out any of the key diagnostic steps. Existing health conditions that are known to result in symptoms similar to EHS were denoted. A key diagnostic biomarker that is reasonably exclusive to (or at least highly indicative of) EHS, is **autoantibodies against O-myelin.** Also pointed to, was the importance of inflammation assessment, via tests such as **HS-CRP**, histamine level, and markers for oxidative and nitrosative stress. As an excellent first step towards diagnosis of EHS, see the symptom checklist at **SaferTech.NZ**: Survey.

Section 20 - Mitigation Strategies Recommended by EMF Experts, for Man-Made Microwaves & other RF-EMFs

Some of these expert-recommended strategies mirror the personal strategies I briefly outlined in Section 17 above, and in much more detail in the Appendix (My Personal Experience – extended testing & protective measures) below. However, additional strategies and resources include some specific to pregnancy, parenting, and to early childhood development.

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22. Recommendations: Immediate, Risk Mitigation Steps for the New Zealand Government to Consider

1. Immediately place the 5G roll-out on hold until there has been a full and independent assessment of the safety of this technology. Rushing to deploy a multifaceted technology with likely health hazards would be short-sighted and risks undermining both public health and the long-term economic wellbeing of the Country.
2. Contract non-industry aligned independent scientists to conduct thorough research into health effects in areas where 4G and 5G cell towers have already been deployed. Existing, published questionnaires that assess symptoms of EHS could be used, along with blood samples from volunteers.
3. Conduct an urgent, thorough independent Inquiry into safety standards for all man-made microwave emissions. This includes 4G and 5G mobile cell towers, mobile phones, Wi-Fi routers, Bluetooth devices, smart meters, smart appliances, and other microwave-emitting devices.
    a. The Inquiry would be prompted by the fact that electromagnetic-hypersensitivity is a serious health concern and that neurodevelopmental and cellular damage in early childhood would increase the risk for poor life outcomes. Current evaluatory and regulatory processes appear to the writer to have failed to conduct a comprehensive, balanced review of the evidence on these risks.
    b. Adopt the FCC's stricter SAR limit (1.6 W/kg averaged over 1 g of tissue) for handset compliance testing in New Zealand, in place of the current ICNIRP-derived limit (2.0 W/kg averaged over 10 g). New Zealand currently follows ICNIRP via NZS 2772.1:1999, which sets the public mobile-phone SAR limit at 2.0 W/kg averaged over 10 g of tissue. The U.S. FCC sets the equivalent limit at 1.6 W/kg averaged over 1 g of tissue. The headline numbers (2.0 vs 1.6) suggest that ICNIRP is the stricter standard, but the reverse is true once the averaging volume is taken into account. According to Professor Akimasa Hirose and other dosimetry researchers, an SAR of 2 W/kg averaged over 10 g is approximately equivalent to 4–6 W/kg averaged over 1 g - meaning the FCC limit is roughly 2–3× more protective in effective terms when applied to the localised tissue regions that matter for phone-against-head exposure. India and South Korea have adopted the FCC limit on these grounds.[1] Adopting the FCC standard does not require winning the broader scientific dispute over whether the thermal-mechanism framework is sufficient - it requires only choosing the more protective of two existing recognised international frameworks. This is risk mitigation action that any government can take immediately and that aligns directly with the SAR-testing-vs-real-use point in Section 18.1.
    c. Independently evaluate the sufficiency of **ICHEF** expertise - in the context of the wider risk environment and the myriad of scientific findings pointing to the raft of health dangers and damage posed by MMMs. [2] This review (of ICHEF) would need to evaluate composition against the full range of disciplines required to meet its tasked duties. In the author's opinion, disciplines that bear directly on the biological and medical effects of chronic MMM exposure include: EMF (including man-made microwave) physics, human biophysics, human / medical biochemistry, human neurology, psychology, RF engineering, dosimetry,

[1] ICNIRP 2020 Guidelines for limiting exposure to EMF (100 kHz – 300 GHz) (Health Physics); FCC OET Bulletin 65 - SAR for Cell Phones (47 CFR §§ 2.1093, 2.1091); Standards New Zealand NZS 2772.1:1999 - RF fields maximum exposure levels (3 kHz to 300 GHz).

[2] See: PSGR NZ recent Substack article - The EMF Problem: RF Radiation Governance Without Democratic Risk Assessment, https://psgrnz.substack.com/p/the-emf-problem-rf-radiation-governance

occupational health, environmental health, paediatrics, and building biology / EMF remediation.

d. Where the current ICHEF composition does not adequately cover any of these disciplines, the review ("c" above) should recommend specific roles to fill, and selection of individuals to those roles should be conducted by a body that is independent of the telecommunications industry. This process recommendation does not prejudge which specific researchers should serve on ICHEF; it ensures that whoever does serve covers the technical breadth the Committee's mandate requires.
e. It is reasonable to expect that a full report to Government will be delivered within a month of each of the (ICHEF) consecutive, six-monthly review meetings, with authorship of this review clearly denoted. Also, for each of these reports to be readily and immediately available to medical and health practitioners, scientists and the lay public.
f. ICHEF to also publish readily accessible, plain-language summaries of: the scientific reviews and studies it has considered in arriving at its current recommendations; the reasoning by which it has weighed considered evidence; reasons for excluding any peer-reviewed published research by established independent experts; the basis for its current exposure-limit recommendations; any updates over time; and its responses to public submissions, scientific challenges, and OIA queries.
g. ICHEF to regularly (6-monthly and at least a month before its scheduled meetings) seek submissions from informed (and independent) GPs and relevant health practitioners, qualified (independent) scientists, and apparently microwave-affected members of the public.
h. It would be acceptable (to the author) to have a maximum of 1 representative from local Telco companies on ICHEF, with representatives from all relevant Government Ministries – such as Health NZ, Ministry of Health and Ministry of Education – needing to be high-ranking and reasonably well-informed.

4. In the writer's opinion, for the Advisory Committee (ICHEF) to be fully effective, it would need to be legally mandatory for the Government of the day to entirely adopt the recommended safety standards - without political pressure or influence of industry lobbyists.
5. Based on the "Precautionary Principle" and rational risk mitigation, to mandate that all Wi-Fi is removed from Pre-School-level facilities, Primary and Secondary Schools, reverting back to safe optical fibre, with Ethernet cable connections to the Internet routers. At a minimum, Wi-Fi exposure in Primary and Secondary schools needs to be highly controlled and minimised. E.g., as per France, with no Wi-Fi in pre-school educational facilities (with children under 3 years present), and tightly restricted Wi-Fi use at the Primary School level: Wi-Fi access points (in Primary Schools) installed after the Abeille Law came into force (February 2015) must be switched off when they are not being used for digital educational activities. Also, any proposed Wi-Fi installation at a school must be approved by the School Board. [1]
6. In New Zealand, where children are regularly in any confined public areas, these need to be mandated as Wi-Fi-free. In addition, undertake independent (Wi-Fi) emissions testing throughout the Tertiary education sector, and public institutions including libraries and hospitals.
7. Look to urgently amending relevant Laws and Regulations, so home owners and local authorities can challenge proposed nearby cell tower installations on the basis of likely (or proven) health harms, and/or environmental damage, and/or economic loss to the value of nearby houses. This would likely require City and/or Regional Councils to be involved in decision making, with Telco Companies needing to advise affected residents (and governing Councils) many months in advance

[1] See: https://www.legifrance.gouv.fr/loda/id/JORFTEXT000030212642

of any proposed installation. It would also require an independent panel of qualified scientists and health practitioners to be central to the hearing process, with their advice being binding on the approval authority. (Such independent, established experts could be sourced at a national or international level, with comprehensively updated ICHEF safety guidelines as a key basis for assessment.)

8. Look to mandating cell-tower-free and Wi-Fi-free multiple zones in towns and cities, providing individuals and families some choice over their level of exposure to microwaves. These regions can act as a 'control' group, which can support scientific research on health risks in the future. (Just as N.Z. has mandated "green areas" for safeguarding and enhancing public health, in the writer's opinion, having MMM-free areas is at least equally important.)
9. Contract non-industry aligned, independent scientists to thoroughly research and establish the minimum safety distance from 4G and 5G towers. Such minimum distances must then be legally enforced. This would include removing 4G and 5G cell towers that are too close to schools, and/or in close, hazardous proximity to the general populace.
10. For these same experts (bullet-point 7) to determine safe distances from Wi-Fi microwaves in public areas. This would be based on key factors such as the frequency and power intensity of the microwaves, age and health of exposed individuals, and estimating the level of accumulating health damage to individuals from ongoing exposure across all public settings.
11. Look to the formal (public-health-level) recognition of EHS is a medical disease. Then, ensure that all medical and health practitioners are well-educated in electromagnetic hypersensitivity ("EMR Syndrome"), with skills to determine whether or not microwave exposure is a significant factor in presenting illness symptomatology. Relevant Government agencies to disseminate information and materials to assist clinicians and the public to recognise that EHS is a valid, recognised, and accepted, health condition.
12. Post diagnosis of EHS, for Government financial compensation to be available, along with payment for needed remediation at home, school or work settings. Assessment of the level of affectedness, and required compensation and remediation, would need to be conducted by fully independent experts – that are Government approved. Where it is medically/scientifically confirmed that emissions from a specific Telco Company cell tower have at least partly contributed to a person's health decline, that Company could be legally required to immediately remove the offending cell tower.
13. Where possible, employers need to offer Wi-Fi-free (shielded) zones in the workplace. It may be that where there are 5 or more staff in a workplace, such a protected zone could be legally required.
14. In April 2023, Prof. Paul Heroux *et al.* provided an in-depth biophysical and biomedical analysis of why current cell phone technology safety limits appear to be fundamentally outdated and inadequate. [1] At the end of the journal article, he and his colleagues outlined several reasonably inexpensive fixes that Governments could readily mandate to improve safety of this technology. [ibid] For example, software-based solutions controlling RFR emission levels, as well as hardware changes to antenna designs. He also explained that fibre-based connections perform better across every dimension and ought to be the default (rather than wireless), whenever feasible.

[1] See: Cell Phone Radiation Exposure Limits and Engineering Solutions | MDPI

Dr Paul Heroux, Professor of Toxicology & Health Effects of Electromagnetism, McGill University, Canada [1]

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[1] See: https://emfconference2021.com/speaker/paul-heroux-phd/

23. Additional References & Resources

Resources Directly Relevant to this Monograph

1. EHS Diagnosis
2. Papers etc on EHS & Effects of RF-EMFs to 22 Mar 26
4. EMF Hazards Summit - The EMF Guy - 48hrs free viewing (Permanent access to these talks is currently available for USD $69.) If the reader finds these talks beneficial, you may wish to look out for further – annual - Summits by "The EMF Guy", Nick Pineault.

Prior Resources Current to 2022

5. EHS - Electrohypersensitivity (to 2022)
6. EMF Health Risks - PhyreMedical.org - Docs for Drs & Scientists
7. EMF Videos - for Drs, scientists & educationalists (to 2022)
8. Prof H Lai - Summaries - Univ of Washington (to 2019)
9. Wi-Fi & Other Microwave-Length Harms - docs (to 2022)

23.1 Submission to Government on 5G Heath Concerns, Oct. 2019 (References)

- ***5G Risk –The Scientific Perspective - Dr Martin Pall (127 pages).pdf*** : https://1drv.ms/u/s!AjzzdFqsbwaaeEEN2kV60U4OpXs?e=2Nye8A
- ***5G Crisis Online Summit (August 2019)*** – 42 scientific and legal experts discuss the threat that 5G and other RF radiation pose, along with what can be done about it. Word-renowned speakers include Prof. Martin Pall (Washington State University), Dr Dietrich Klinghardt (Sophia Health Institute), Dr Magdha Havas (Trent University), Dr Paul Heroux (McGill University), and Robert F Kennedy Jr. (prominent environmental lawyer) See: https://1drv.ms/u/s!AjzzdFqsbwaah1ocVfSEWFq1Ohe3?e=dwJyHL Full access can be gained to all talks via payment at https://the5gsummit.com]
- ***BioInitiative Report*** – updated to 2019: https://bioinitiative.org ; or https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=7mJG8t
- ***Collection of Relevant Documents on EMF Radiation – including 5G***: https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=c4SYFD
- ***Dangers of EMFs for Children – including Wi-Fi and cell phones:*** https://1drv.ms/u/s!AjzzdFqsbwaahDyE9grqvl7sI4OB?e=8U5exH
- ***Dr Martin Pall to EU-on 5G Harm March 2018.pdf*** in https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=efv6F3
- ***Dr Neil Cherry (Lincoln University) Research Papers:*** http://www.stayonthetruth.com/neil-cherry.php
- ***EMF News:*** http://www.emfnews.org
- ***EMF Scientist:*** https://www.emfscientist.org
- ***Environmental Health Trust***: https://ehtrust.org/science/
- ***INTERNATIONAL APPEAL to Stop 5G on Earth & in Space - Submission (2019).docx*** – International appeal from over 200 scientists from around the world. Addressed to the United Nations, W.H.O., European Union, Council or Europe, and governments of all nations. This scientific document expresses severe concerns over the roll-out of 5G on earth and in space. (123 scientific references are provided, regarding health dangers). See: https://1drv.ms/u/s!AjzzdFqsbwaaeckMUtayEwtd5ac?e=kgkUGH (multiple common languages provided)
- ***Multiple Countries Ban Wifi & Cell Phones Around Schools, Young Children & Fetuses.docx*** in https://1drv.ms/u/s!AjzzdFqsbwaahDyE9grqvl7sI4OB?e=J9f0Uc
- ***Physicians for Safe Technology:*** https://mdsafetech.org/physicians-call-for-safety-with-wireless-technology/
- ***Stop 5G in New Zealand – action Website:*** 5G.org.nz

- ***The Harmful Effects of EMF & 5G On Health - Dr Martin Pall (Jan 19).pdf*** in https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=WNcaGK

180 Scientists - Appeal for 5G Moratorium (September 2017)

(See: *180 Scientists -Appeal for 5G Moratorium (13 Sept 17).pdf* in https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=blfiIT)

Dr Martin Pall Submits 54-Page Research to European Union on Harmful Effects of 5G Radiation (March 2018)

(See: *Dr Martin Pall to EU-on 5G Harm March 2018.pdf* in https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=blfiIT)

Resubmission of International EMF Scientist Appeal to the United Nations etc. (July 2019)

Owing to increasing concerns over the roll-out of 4G and 5G technologies around the world, the 248 scientists from 42 countries, resubmitted their Appeal to the United Nations. They requested that:

> *the UNEP reassess the potential biological impacts of next generation 4G and 5G telecommunication technologies to plants, animals and humans.*

The same scientists stated that:

> *There is particular urgency at this time as new antennas will be densely located throughout residential neighborhoods using much higher frequencies, with greater biologically disruptive pulsations, more dangerous signaling characteristics, plus transmitting equipment on, and inside, homes and buildings. The Advisors to* ***The Appeal*** *recommend UNEP seriously weigh heavily the findings of the independent, non-industry associated EMF science.*
>
> *The Advisors to the International EMF Scientist Appeal call upon the UNEP to be a strong voice for the total environment of the planet, and an effective catalyst within the United Nations with regards to the biological and health effects of electromagnetic pollution.*
>
> (See https://www.emfscientist.org)

INTERNATIONAL APPEAL to Stop 5G on Earth & in Space – Submission (2019)

International appeal from over 240 scientists from around the world; addressed to the United Nations, W.H.O., European Union, Council of Europe, and governments of all nations. This scientific document expresses severe, science-based concerns, over the roll-out of 5G on earth and in space. (123 scientific references are provided, regarding health dangers to all life forms.) [See link in REFERENCES Section.]

This Appeal called upon all member Nations of the U.N. to:

> *urgently … halt the deployment of the 5G (fifth generation) wireless network, including 5G from space satellites. 5G will massively increase exposure to radio frequency (RF) radiation on top of the 2G, 3G and 4G networks for telecommunications already in place. RF radiation has been proven harmful for humans and the environment. The deployment of 5G constitutes an experiment on humanity and the environment that is defined as a crime under international law.*

Brussels Bans 5G Pilot Project Due to Health Concerns (April 2019)

Plans for a pilot project to provide high-speed 5G wireless internet in Brussels have been halted due to fears for the health of citizens. (The Brussels Times, https://www.brusselstimes.com/brussels/55052/radiation-concerns-halt-brussels-5g-for-now/)

> *"I cannot welcome such technology if the radiation standards, which must protect the citizen, are not respected, 5G or not," Environment Minister Céline Fremault (CDH) told Bruzz. "The people of Brussels are not guinea pigs whose health I can sell at a profit. We cannot leave anything to doubt," she added.*

Geneva Bans Further 5G Roll-Out Due to Health Concerns (May 2019)

> *"Antonio Hodgers, the head of Geneva's executive, announced a ban on the erection of further 5G mobile antennas in the canton, according to an interview on RTS.*
>
> ***le News** reported, "motivated by uncertainty on the potential health effects of the new technology, the temporary freeze is the most the cantonal government can do to stop the rollout of the technology. The governments of both Geneva and Vaud have now put the brakes on 5G rollout in their territories by putting a freeze on permits to erect further 5G antennas."*
>
> *Other Swiss cantons are following the developments in Vaud. A similar parliamentary motion has been put forward in Geneva and the parliament of Valais will discuss the issue when it next sits."*

(Le News: https://lenews.ch/2019/05/02/geneva-blocks-the-erection-of-5g-mobile-antennas/)

TPG (major Telco) says community health fears stopped its 5G rollout in Australia (18 Sept. 2019)

> *TPG chief operating executive Craig Levy has told the Federal Court that the Telco pulled its plans to roll out a 5G network in Australia due to community fears regarding the health impact of the technology.*
>
> *"If people have concerns about the impact on their health… they are not just looking at our model in a positive manner," chief operating executive Craig Levy told the Federal Court on Tuesday, as reported by the Sydney Morning Herald.*
>
> *You don't think there is any scientific rationale for this do you?" ACCC counsel Michael Hodge QC then asked Levy.*
>
> *Levy responded that while it was "not his area of expertise…the equipment that we were using was well within the standard and it is very much acceptable in terms of the standards".*
>
> *Hodge QC then asked if "there was some segment of the community that held an irrational concern about the effects" of the small cells used in a 5G network?*
>
> *"I wouldn't call it irrational. I think people have rational concerns," Levy responded.*
>
> *While TPG has listed several reasons for pulling the plug on its new network, it has now testified that those health fears were a major factor.*
>
> *America's Fox News ran a news segment with host Tucker Carlson asking 'are 5G networks medically safe?'*

(See: ***TPG says community health fears stopped its 5G rollout in Australia (18 Sep 19.docx***, in https://1drv.ms/u/s!AjzzdFqsbwaaeBazK6jbyQv6WdQ?e=c4SYFD)

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24. Case Study: Personal Experience - Extended Medical Testing and Protective Measures

Introductory disclaimer:

As previously acknowledged throughout this monograph, the author is a registered psychologist and not a medical practitioner. The information presented in this Appendix is for informational purposes only. Any health decisions made by the reader should be made only after consultation with a qualified health practitioner. None of the practices, test interpretations, or suppliers mentioned below constitute diagnosis, treatment, or recommendations. With Companies and products discussed below, I am **not** claiming efficacy for any of these, nor am I saying these are the only suitable ones, nor am I recommending the reader purchase any particular product from any of these Companies. You need to do your own due diligence, including consulting with qualified health specialists.

This appendix collects two strands of personal experience that sit alongside the substantive case made in the main text. The first (Section 1 below) is the battery of functional-medicine and direct-to-consumer genetic and metabolic tests I undertook over 2020–2021, together with my reading of how each result may relate to my health decline. The second (Sections 2 through 8) is the wider set of protective measures I have personally adopted that go beyond the mainstream-supported practical measures described in Section 17. **These are measures and tests I personally adopted that go beyond mainstream risk mitigation guidance and beyond mainstream clinical chemistry; some are contested in the scientific /allopathic mainstream.**

Readers struggling with EHS-like symptoms may find the autobiographical detail useful as a starting point for their own enquiries with qualified practitioners; readers approaching this document from a policy or clinical perspective can skip directly to Section 18. Both strands are presented as personal experience rather than as part of this document's substantive case. The author's choices here reflect the author's own assessment of his individual circumstances and should not be taken as advocacy for any particular intervention, product, or supplier.

Section 1 - Functional medicine and Direct-to-Consumer (DTC) genetic testing results (2020–2021)

Editorial note: several of the tests described below - including DTC SNP panels, hair-element analysis, organic-acids profiling, and live-blood analysis - are functional-medicine tests rather than mainstream clinical chemistry. The interpretations are the author's personal reading of his own test results and are not validated diagnostic findings. For the methodology limitations of live blood analysis specifically, see also Section 14 Mechanism 4.

Over 2020 and 2021 I underwent many very expensive health tests that were Functional Medicine tests not available in NZ. (A Naturopath or Functional Medicine Practitioner with an account with **FxMed** in Napier should be able to order such tests.) This was to rule out any other possible underlying factors that could be compromising my health, to try to find any biological processes or genetic predispositions that could have led to my EHS, and to discover any biomarkers that corresponded to known EHS effects. This testing included airfreighting frozen urine and faeces samples to the USA for high-end analysis and reporting.

Testing Outcomes that the writer believes to be of significance for him:

- **Non-ideal genetic inheritance for genes responsible for detoxification**. (DNA Health Test) Good detox function is essential to rid the body and brain of heavy metals such as mercury and aluminium. Both of these metals are strongly linked with brain inflammation and therefore

increased sensitivity to microwave exposure. [1] Hair testing (see below) had already established a very high (toxic) level of mercury and an elevated level of aluminium in my body.

- **Gene-based disposition for poor absorption of Vitamin A** from food (DNA Health Test) Vitamin A is known to decrease the risk of several chronic diseases, to play an important role in innate and acquired immunity, to be involved in reproductive health, and in the body's response to inflammation. It is understood to be essential for skin and eye health. [2] Therefore, low Vitamin A levels would make one more susceptible to any inflammatory or immune function impacts of MMMs.

- **Gene-based poor ability to methylate well** (DNA Health Test). Methylation is a key process in the regulation of gene expression, genomic stability and repair of DNA. [3] The quality of methylation in the body is a dynamic and powerful biomarker for predicting health outcomes, biological aging and disease risk. Therefore, possessing this genetic disadvantage would very likely lead to an increased impact from exposure to MMMs.

- **Gene-based predisposition to produce too much C-Reactive Protein** (mCRP) as part of the body's inflammatory response (DNA Mind). mCRP is a pentameric protein that is centrally involved in inflammatory processes and in innate immunity. [4] (There is also another circulating form of CRP that is anti-inflammatory – pCRP. [ibid]) According to the DNA Mind analysis, "such predisposition can lead to chronic inflammation and can also be associated with cognitive decline." Having this predisposition would very likely lead to increased reactivity to MMM exposure.

- **Gene-based poor ability to absorb Vitamins C, D and B12** from food. (**DNA Health Test**) Vitamins C and D are essential for the proper functioning of the immune system and for helping to quell inflammation. [5] In addition, Vitamin D is important for bone health, maintaining good mood, and may help prevent the development of colorectal cancer. [ibid] Adequate B12 is essential for healthy nerve and brain function, for synthesis of DNA, and for red blood cell formation. [ibid] Any deficits of these vitamins would likely cause increased reactivity to MMMs.

- **Excessive metabolites from methylation**, showing toxic exposure and/or poor (MTHFR) genes. (Organic Acids Test) Excessive metabolites can cause body and brain inflammation, likely leading to increased reactivity to man-made microwaves. [6]

- Very **high level of mercury and elevated level of aluminium** (Toxins & Mineral Analysis Test) - via hair analysis. These heavy metals always accumulate in tissue which is predominantly fat-based, with 60% of the dry weight of the brain being fats such as cholesterol. Both of these heavy metals are independently neurotoxic and add to the brain's inflammatory and oxidative-stress load (see Section 18). Both of these heavy metals in the brain can be acted on by microwaves. [7]

- **Excessively high levels of dopamine** – which force down brain GABA and serotonin levels, and is neurotoxic to the brain. (Organic Acids Test) This excess means that the brain will already be inflamed, likely making it more vulnerable to microwave effects.

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[1] See: Neurotoxicity of metals - PubMed; and Microwave radiation induced oxidative stress, cognitive impairment and inflammation in brain of Fischer rats - PubMed
[2] See: Vitamin A: Benefits, Deficiency, Toxicity, and More
[3] See: Role of DNA Methylation in Human Health and Diseases | Biomedicines | MDPI
[4] See: C-Reactive Protein: Clinical Relevance and Interpretation - StatPearls - NCBI Bookshelf
[5] See: www.healthline.com "All about Vitamin E" and Vitamins A, B, C, D, E, and K: Key Benefits and Food Sources
[6] See: Quinolinic acid: an endogenous neurotoxin with multiple targets - PubMed
[7] See: Neurotoxicity of metals - PubMed;

- Metabolic marker (on the Organic Acids Test) showing **compromised mitochondria function**. Compromised mitochondria function appears to be a key (very common) outcome of prolonged microwave exposure. It is also caused by exposure to exogenous toxins such as heavy metals, and chemical toxins in food, water and air. [1]

- Significantly **compromised diversity of my gut microbiome and some candida overgrowth**. (GI360 Test) Results indicated only one mildly pathogenic bacterial strain, and no evidence of other gut pathogens such as various species of bacteria, viruses or parasites. Prolonged microwave exposure appears to have negative effects on the gut microbiome, associated with gut inflammation, leaky gut, damage to microbial diversity, reduction in pro-health bacteria, and encouraging the proliferation of unhealthy microbes such as candida.

- **Elevated marker for leaky gut** (Zonulin Test). Leaky gut can be caused by chronic exposure to certain foods that are causing prolonged inflammation to the gut lining. It can also be caused by a leaky blood-brain-barrier (BBB), which microwaves appear to be able to cause. (This is via the gut-brain axis.) [2] Functional-medicine practitioners have also linked overgrowth of pathogenic microbes such as candida to increased intestinal permeability, though this association remains contested in mainstream gastroenterology. It has been hypothesized - though not directly demonstrated in human studies - that RF effects on blood sugar and cortisol may secondarily disrupt gut microbiota and intestinal barrier function. So, any of the above factors may have been involved in my leaky gut result.

- **Major clumping (60%) of my red blood cells** via live blood analysis in Auckland. This was after an intentional provocation exposure to 30 minutes of travel with **Google Maps** active on my car's dashboard. (The same test 10 years ago – with no phone microwave exposure - had shown almost zero clumping.) Microwaves appear to have this predictable effect in humans – even after short exposures - regardless of health status. (The study by Dr B Rubik has already been examined in Section 14 above.)

- **Likely chronic mould infection of my sinuses**, as suggested by consistent symptoms over many years, and an online visual contrast sensitivity test: VCSTest.com - Visual Contrast Sensitivity Testing - VCS Testing - Free Limited Results. It is well-established that mould infection of the sinuses is highly likely to produce toxic (microscopic) mycotoxins, which are capable of infiltrating the brain from the sinuses. [3] Such infiltration is very likely to produce chronic brain inflammation, making the brain more reactive to any effects from MMMs. [4] In this regard, a vastly experienced integrative health practitioner - who reviewed an earlier version of this monograph – reported to me that nearly all his patients who were seemingly adversely affected by MMMs, had a pre-existing history of mould infection of the sinuses.

Section 2 - Diet, supplements, and molecular hydrogen

I continue to consume almost exclusively organic (or spray-free) food. I almost entirely avoid any food additives or non-whole foods. I minimise sugar and simple carb intake. I rigorously avoid foods that are known to be pro-inflammatory, and choose to eat a range of anti-inflammatory foods – including many herbs and spices. I usually avoid foods that I have had consistent negative health (inflammatory) outcomes

[1] See: Biological and health effects slide; and Research_Review_V4 (a037613) ORSAA database ODEB – "Effects Categories" etc.
[2] See: Traumatic Brain Injury and Gut Microbiome: The Role of the Gut-Brain Axis in Neurodegenerative Processes - PubMed
[3] See: Chronic Illness Associated with Mold and Mycotoxins: Is Naso-Sinus Fungal Biofilm the Culprit? - PMC ; Mold and Mycotoxin Exposure and Brain Disorders and Sinus Colonization in Mold Illness - Dr. Todd Maderis
[4] See: Mold and Mycotoxin Exposure and Brain Disorders

from – such as gluten-containing grains, dairy products, the nightshade family (containing lectins) and foods high in oxalates.

I have been taking multiple supplements daily, to help reduce systemic and brain inflammation, to support detox pathways, gut health, and to enhance cellular and mitochondrial function. Although I am hesitant to refer to any particular supplement, owing to the immediate (and ongoing) positive effects I experienced, I will make an exception for molecular hydrogen. This has been increasingly studied with regard to its apparent ability to quell the effects of oxidative stress, converting oxidised molecules to harmless water. [1] Apart from its apparent antioxidant ability, molecular hydrogen may also directly lower inflammation, enhance immune system function, reduce premature cell death, better regulate autophagy, preserve mitochondrial function, and enhance the integrity of the blood-brain barrier. [ibid] As it is such a small molecule it reportedly crosses the blood-brain barrier, helping to reduce the destructive fire of brain inflammation. [ibid]

Owing to its reported systemic effects (including in the brain) molecular hydrogen appears able to help with a range of health disorders, including nervous system disorders such as brain ischemia, traumatic brain injury, neuropathic pain, neurodegenerative diseases, cognitive dysfunction, anxiety and depression. ibid In addition, apart from its apparent benefits in reducing harmful free radicals such as the hydroxyl and peroxynitrite free radicals, it seems able to preserve beneficial reactive oxygen species that are essential for adaptation, plasticity and metabolic signalling. [2] According to the referenced researchers, molecular hydrogen can be inhaled as a gas, taken as dissolved tablets in water, or via a saline I.V. [ibid]

In my case I purchased quality molecular hydrogen from a well-recognised U.S. Company, with a high parts-per-million rating. The tablet was dissolved in a glass of warm water and drank immediately on an empty stomach. In early days of recovery I was doing this before breakfast and dinner. (Later, with significant improvement, I was only taking the hydrogen once a day.) As a result of this protocol, I immediately (on the first day) felt a lot more physical and mental energy and much-improved cognitive function. I also felt significantly less exhausted on wakening. Prior to taking the hydrogen I had been struggling to walk more than one kilometre in a flat environment. After 4 days of taking the hydrogen, that weekend I managed to walk about 6 kilometres, including a number of moderate-size hills. The gains I appeared to experience from taking molecular hydrogen were most noticeable over the first few months. However, all this personal experience is purely anecdotal – a case study of 1 person with no control subjects - and cannot be seen as grounds for efficacy of molecular hydrogen.

Regarding any of the above information on molecular hydrogen, I am **not** recommending anyone else try it without first consulting with an appropriately qualified health practitioner, and I have no idea whether a reader with similar symptoms will gain any benefit whatsoever. With my own health journey, compounding issues such as high oxalate levels and mycotoxins in the sinuses, also needed to be attended to in order to return to a reasonable level of health.

Section 3 - Home shielding

Frustratingly, I have 5 or 6 neighbours with their Wi-Fi signals penetrating my house that I have no complete solution for during the daytime and evenings. However, at nights I always sleep in a protective silver-mesh bed canopy that as far as I can measure, blocks all microwave radiation. (This was purchased from China via www.alibaba.com as it was cheaper than elsewhere. However, beware of possibly

[1] See: Neuroprotective Effects of Molecular Hydrogen: A Critical Review - PMC ; Molecular hydrogen therapy for neurological diseases: a review of current evidence. - Abstract - Europe PMC and https://www.frontiersin.org/journals/physiology/articles/10.3389/fphys.2021.789507/full

[2] See: Molecular Hydrogen: A Foundational Therapy for Neurology, Regeneration, and Integrative Clinical Practice | Carrick Institute and The Research Progress of Molecular Hydrogen in the Treatment of Traumatic Brain Injury: A Review | IntechOpen

unreliable or dishonest suppliers.) And, I make sure my mobile phone is turned off, in a microwave-blocking pouch (see below), and outside of my silver-mesh bed canopy.

If you are considering buying a silver-mesh bed canopy, please be aware that if you are in a building where there are people living in one or more floors below you, you will likely need to buy a canopy that has roof, four sides and a floor to it – that goes under your bed. If you buy a canopy without a floor to it, you risk having microwaves beaming up into your canopy from below, and your canopy will then trap those microwaves, potentially making your exposure worse than no canopy. Also, I have been advised by an EMF consultant that with a shielding canopy, it is highly advisable to earth the canopy. This because if you don't, you could be amplifying exposure to Electric Fields and Dirty Electricity, both of which can create a very unhealthy sleeping environment. If in doubt contact the EMF consultant that lives closest to you: www.emf-solutions.co.nz (Auckland); www.emfconsultants.org.nz/ (Christchurch); and www.earthwaves.co.nz/ (Wellington). (I am not aware of all the EMF consultants in NZ. I am mentioning these 3 Companies as I have had contact with the owners, or the Company has been recommended to me by a colleague.)

As soon as we moved into our new home - a couple of years ago – I phoned local power suppliers to see if they were willing to come and remove the communications chip from our "smart meter." Luckily there was a local option, and for about $50, the technician came a week later to remove the chip. It took him less than 30 minutes, and consequently, we now avoid near-constant microwaves being transmitted from the meter. (We pay a $5 dollar monthly fee to get a manual meter read.) However, my Auckland EMF consultant recently advised me that it is becoming very difficult to find an electricity supplier that will remove the communications chip in their meter. If this is the case, other mitigation strategies need to be considered. This same consultant advises that depending on the meter location, it may be possible to use shielding paint or similar shielding materials to reflect the signals. Again, it is suggested that you contact the nearest EMF consultant for advice.

With the microwaves that continue to invade my home, I am currently considering painting key internal walls with microwave-repelling paint, and installing EMF-repelling curtains for the windows – or possibly microwave/EMF repelling window film. This may become essential if my symptoms start to worsen. Should this problem eventuate, the Auckland EMF consultant (that assessed EMF levels in my home), recommends consulting him or another expert, owing to unexpected problems potentially being caused by household objects such as beds or couches being near to the wall being shielded.

I believe you can buy EMF protective window film in New Zealand from **Solarguard NZ** who is the importer and organises the installation. For paint, consider specialized online stores such as www.emfshop.co.nz, or www.emf-solutions.co.nz, with **New Safe** and **Sound RF-Eco** shielding paints. For EMF-protective curtains (and a range of home protections), contact www.emf-solutions.co.nz, www.groundedkiwi.nz, https://emfshield.co.nz, www.emfshop.co.nz, or https://custodi.co.nz/ as possible suppliers.

If going to protective lengths discussed in the above two paragraphs, I believe it will be essential to have an accurate EMF meter that can measure up to and including, 5G frequencies – or borrow one from a friend with one. This is because microwaves are fully capable of bouncing off solid objects or walls in the house, and if you only protect one or 2 most-directly-affected walls, you could end up making a microwave trap inside your home – that is worse than microwaves being able to pass through your home, unimpeded. If you are not confident to do such installation and EMF assessment/reassessment, consider employing an EMF Protection expert. It will likely take such an expert 1-2 hours to measure current microwave levels in your home (or apartment), to check for other EMF hazards such as "dirty electricity", and to recommend best remediation strategies. Be sure that such an expert is coming back to re-measure microwave levels (etc.), once initial remediation has occurred.

As soon as we moved into our current home I ran Ethernet cables from the Internet router to all the key nearby rooms so that we would **not** need to have Wi-Fi active on the router. This can be done reasonably quickly and cheaply by buying plastic ducting from a local electrical store. This can then be placed where the floor meets the walls, with the Ethernet cables tidily inside the ducting.

Section 4 - Work, travel, and phone-use practices

From an occupational perspective, I work only from my home to avoid working in Wi-Fi drenched offices, seeing occasional psychology clients via an online video platforms such as **WhatsApp** or **Zoom**. (Because of my vulnerability to microwaves, I have been forced to avoid regular, office-based work with its omnipresent Wi-Fi. Consequently, my income over the last few years has been very meagre.)

I almost never have any of my devices in active Wi-Fi mode and always use a wired mouse and keyboard – avoiding activating Bluetooth. If updating Apps on my mobile phone and needing to have W-Fi on, I leave the area and only return when I am reasonably sure that any updating has already occurred. I then immediately turn off Wi-Fi on the device and Internet router.

I have my mobile phone active – connecting to the local cell tower - a couple of times per day to check texts and voice messages. When replying to texts I usually have the phone in Flight Mode, and then activate it to send the message(s). If replying to someone who only has a mobile phone, I text them to phone me on my landline number if that is okay with them.

When travelling, I need to avoid staying in hotels or motels that have Wi-Fi routers in the room, or immediate vicinity. Also, I avoid long distance air travel, especially where there is on-board Wi-Fi. And, I usually only stay with friends or relatives if they agree to have the Wi-Fi router off at night.

If I am carrying my mobile phone on my person (outside of home), I always have it in Flight Mode in my backpack. However, even in Flight Mode, cell phones are still in ongoing contact with overhead satellites. So, I carry my phone in a silver-thread-lined pouch that seems to block at least most microwaves. (When my phone is in active mode in this Faraday bag, and someone in the same room rings my phone, the phones can't connect.) The bags I bought are "Mission Darkness" pouches from an Australian supplier – www.earthingoz.com.au. There should also be Faraday bag suppliers here in N.Z.

If I am driving somewhere and am not sure of how to get there, if possible, I try to only have **Google Maps** active as I am getting near to my destination. If I am unsure of the entire journey's route, I activate **Google Maps** at the start of the journey, allow it to calculate the route, then once I tap to initiate directions, I put the phone into Flight Mode. Google Maps still works in **Flight Mode**, but can be a bit delayed with its directions – or drop out - if communication with overhead satellites diminishes or fails. (Such as in a city with tall buildings.)

Section 5 - EMF meter and personal protective devices

I purchased a quality hand-held EMF meter that can measure up to (and including) 5G microwaves. I use this to test any dwelling that I will be spending significant time living in.

I have tried numerous personal protective devices such as neck pendants, with only one of these appearing to have positive long-term effects – outlasting any possible placebo effect.

Section 6 - Clothing and vehicle

I have chosen to stick with a significantly older model (petrol) car, as these usually have lower EMF emissions than the newer, hi-tech models.

I often wear protective (silver-threaded) clothes and caps/beanies which appear to help somewhat. This is especially when in town with its many Wi-Fi signals and large, powerful 4G masts, and 5G minitowers. I also wear such apparel when on motorways in Auckland, which have with many microwave (cell tower) transmitters - and most suburban streets are similarly affected. (If interested, these can be bought from www.earthingoz.com.au.) However, the Auckland EMF consultant that assessed my home, recommends not using such garments in the home, as they could become an antenna for electric fields and dirty electricity, thereby increasing EMF exposure.

Section 7 - Grounding, dirty electricity, and the solar inverter

I find **grounding by walking bare feet** on damp grass or damp sand (etc.) to be helpful. One EMF consultant has advised that for grounding mats and pillows, these need to only be used in a "clean" electrical environment, with a separate earthing cable outside. Two different EMF protection experts have advised me to beware of using grounding mats in the home, if there is an issue with dirty electricity. One of the experts (Christchurch) stated that to be safe, it is necessary to have a separate grounding wire running from the grounding mat to the earth outside, or under the house.

Our home had **solar panels** installed about a year ago. At that time, I asked the nation-wide installer about possible high EMFs from the inverter – that converts the DC electricity from the panels, to the AC needed by home appliances. I was told that these high-quality (European) inverters would not be an issue. However, when the Auckland-based EMF Consultant subsequently did his assessment, he found that the solar inverter is giving off high EMFs, and is creating "dirty electricity" throughout the wiring in our home: essentially everywhere inside. The expert also stated that nearly every home he has assessed over the last several years, had the same issue being caused by the solar inverter. So if you are concerned, please get your own assessment done by a qualified expert. Apparently, there are plug-in devices that can be purchased to clean up the dirty electricity. So, I am waiting to find one or more of these that are both effective and affordable.

Section 8 - Outcomes

Owing to the combined effects of all these mitigations strategies, these days my level of EHS symptoms has fallen to mild-to-moderate, rather than the severe level it was at back in late 2018 and much of 2019.

Section 9 - Notes on the contested-literature diagnostic framework (EUROPAEM 2016, Belpomme and Irigaray)

The mainstream clinical literature does not currently recognise EHS as a discrete diagnostic entity, and there are no mainstream-medicine diagnostic guidelines for it at the time of writing. A small contested-literature programme - most prominently the **EUROPAEM EMF Working Group's (2016)** guideline and the diagnostic-framework work of Belpomme and Irigaray - has proposed a structured approach to assessment, with a biomarker panel and a set of supplementary functional-medicine and laboratory tests. [1] The notes below summarise that contested-literature framework as it stands; cross-references in the Section 19 main body point readers to these notes where the contested literature is referenced.

The Belpomme and Irigaray 2020 biomarker proposal. In a 2020 paper titled "Electrohypersensitivity as a Newly Identified and Characterized Neurologic Pathological Disorder: How to Diagnose, Treat, and Prevent It," Belpomme and Irigaray proposed that a small panel of peripheral-blood biomarkers might support a

[1] See: (*Why electrohypersensitivity and related symptoms are caused by non-ionizing man-made electromagnetic fields: An overview and medical assessment.* Belpomme & Irigaray September 2022. PMID: 35537497 DOI: 10.1016/j.envres.2022.113374)

biological case for EHS as a discrete condition. [1] The paper's prevalence figures within the authors' own patient series are reproduced verbatim below.

> *"Moreover, as indicated in Table 5, we were able to show that, in peripheral blood, there is an increase in S100B protein in 15–20% of the patients and an increase in nitrosative stress-related nitrotyrosine (NTT) in 8–30% in the EHS and/or MCS groups, suggesting that these biomarkers may reflect opening of the blood–brain barrier (BBB) in these patients, whatever the patient group considered, since it was shown that S100B protein [15,16] and nitrotyrosine [17–20] are markers associated with BBB opening. In addition, we detected the presence of autoantibodies against O-myelin in about 20% of all cases, whether EHS, MCS or both; meaning that an autoimmune response against the white matter of the nervous system occurs in patients; a finding that may in fact be the consequence of the occurrence of oxidative/nitrosative stress [10,21]." (Belpomme and Irigaray, March 2020.)* [2]

Reader's note on the prevalence figures. The Belpomme and Irigaray prevalences are 15–20% (S100B), 8–30% (nitrotyrosine), and approximately 20% (autoantibodies against O-myelin). More significantly, **80% of the patients with EHS presented with one, two, or three detectable oxidative stress biomarkers** in their peripheral blood, meaning that overall these patients appeared to present with a true objective somatic disorder. However, mainstream rheumatology, immunology, and neurology do not currently recognise this panel as diagnostic of any condition.

The Organic Acids Test (OAT) and functional-medicine assessment. Some patients with EHS-like presentations have pursued additional functional-medicine laboratory testing - most commonly the Organic Acids Test, which provides indirect indicators of mitochondrial function, methylation, neurotransmitter metabolism, and gastrointestinal dysbiosis. The reasoning some patients and practitioners give for ordering the **OAT** in this context is that the contested-literature cascade described at Section 14 Mechanism 3 (Stage 4 - mitochondrial dysfunction and premature cell death) would predict measurable indirect markers of mitochondrial stress. Functional-medicine laboratory testing of this kind is not part of standard mainstream clinical assessment, and the **OAT** itself is interpreted differently across practitioner training traditions. Patients considering this testing should discuss it with a suitably qualified naturopathic or functional-medicine practitioner trained in the relevant collection and interpretation procedures, and should treat the results as supplementary functional-medicine information rather than as standard clinical-chemistry findings - the same caveat that applies to all functional-medicine testing in this monograph.

The EUROPAEM 2016 EMF Guideline. The **EUROPAEM EMF Working Group** published a 2016 guideline ("EUROPAEM EMF Guideline 2016 for prevention, diagnosis and treatment of EMF-related health problems and illnesses") which sets out a more developed structured diagnostic approach including symptom-checklist questionnaires, exposure-history assessment, environmental measurements, and the biomarker panel above. The 2016 guideline is the most developed structured diagnostic framework available in the contested literature; it is not endorsed by mainstream professional medical bodies and should be read as a working framework from a specific clinical community rather than as a consensus medical standard.

Summary

Section 19, main body of this monograph, presents the mainstream-defensible portion of the diagnostic approach - patient symptom questionnaire, comprehensive medical history, differential diagnosis,

[1] See: https://pubmed.ncbi.nlm.nih.gov/32168876/
[2] See: https://pubmed.ncbi.nlm.nih.gov/32168876/

exposure assessment, and standard inflammation markers. This Appendix section preserves the more contested biomarker proposal and the functional-medicine supplementary testing approach, with appropriate framing of their literature status. Both portions together represent the diagnostic-considerations material available to a clinician approaching a patient who self-presents with EHS-like symptoms in 2026.

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25. Appendix: Contact Details for MPs, DHB Officials etc.

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For the attention of the Executive Leadership Team, the Chief Clinical Officers, and the Chief Advisors of the Ministry of Health.

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- Eligibility@health.govt.nz: For eligibility for healthcare
- claimsmanagement@health.govt.nz: For National Travel Assistance (NTA)
- dataquality@adhb.govt.nz: For questions about patient email verification

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26. Glossary

ARCs	Allergic Respiratory Conditions – such as Asthma
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASD	Autism Spectrum Disorder
CHD	Children's Health Defense
DHB	District Health Board
EHS	Electromagnetic Hypersensitivity
EMF	Electromagnetic Field
EMFs	Electromagnetic Fields
EMR	Electromagnetic Radiation
FCC	Federal Communications Commission
GPs	General Practitioners
ICBE-EMF	International Commission on Biological Effects of Electromagnetic Fields
ICD-10-AM	International Classification of Diseases, Tenth Revision, Australian Modification
ICHEF	Interagency Committee on the Health Effects of Non-Ionising Fields
IARC	International Agency for Research on Cancer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEI-EMF	Idiopathic Environmental Intolerance attributed to Electromagnetic Fields
MCS	Multiple Chemical Sensitivity
MMMs	Man-made Microwaves
NGO	Non-Governmental Organization
NIH	National Institutes of Health
NTP	National Toxicology Program
NZ	New Zealand
ORSAA	Oceanic Radiofrequency Scientific Advisory Association
PC	Personal Computer
RF-EMFs	Radiofrequency Electromagnetic Fields
TV	Television
USA	United States of America
WHO	World Health Organization

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