

Pulsed RF from Smart Meters: Should we be concerned?

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Professor of Medicine

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My Relevant Credentials

My work has led to policy change at the National Institutes of Health, the Food and Drug Administration and the Department of Defense.



Physics – B.S. Summa Cum Laude (age 19)

Graduate fellowship offers: Harvard, Cal Tech

Engineering: Jet Propulsion Laboratory, Engineer

Biology – Ph.D., focus Neuroscience

Machine learning – Postdoc, Salk Institute, pioneer

Medicine – M.D. Chief Resident, 20 years clinical experience

Research methods – RAND/UCLA Robert Wood Johnson Clinical Scholar

Think Tank RAND - Sole author best selling report

Testified to U.S. Congress

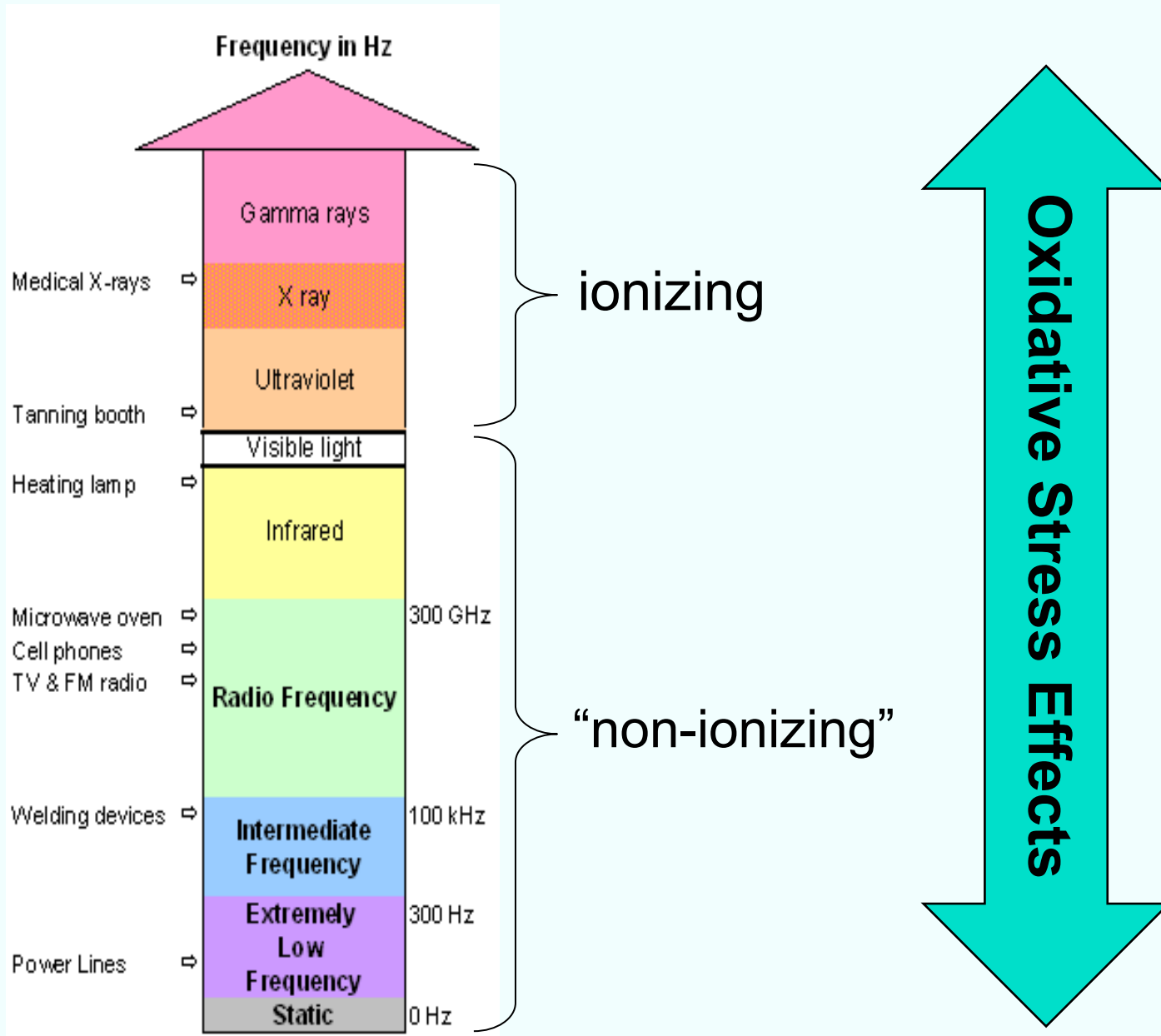
Press briefing from Pentagon

Many briefings to U.S. Government agencies & advisory groups

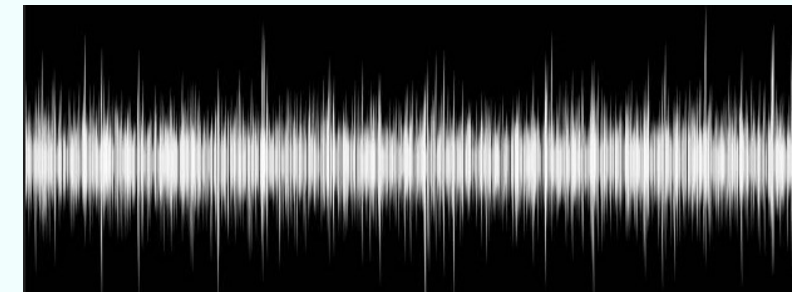
My lab focuses on:

- Exposures + conditions tied to free radical damage and cell energy impairment, i.e. relevant to effects of RF and other environmental stressors
- Research methods

Electromagnetic Radiation (EMR)



Sine wave without information



Low frequency pulses in digital radiofrequency transmission

Pulsed RF is more damaging ¹

1. Burlaka A et al, 2014. Changes in mitochondrial functioning with electromagnetic radiation of ultra high frequency as revealed by electron paramagnetic resonance methods. Int J Radiat Biol 90(5):357-362.

Multicolor Image:

http://ec.europa.eu/health/scientific_committees/opinions_layman/de/elektromagnetische-felder/l-2/1-electromagnetic-fields.htm

Historical Record: Longstanding Concern About Harm

“Experimental evidence has shown that exposure to low intensity radiation can have a profound effect on biological processes”⁶

1. Bell WH 1931. Effects of super-high frequency radio current on health of men exposed under service conditions. **US Navy** Medical Bulletin 29: 525-551.
2. Glaser 1972. Bibliography of reported biological phenomena ('effects') and clinical manifestations attributed to microwave and radiofrequency radiation. **Naval Medical Research** Inst, National Naval Medical Center. Bethesda MD. Second Printing, with Revisions, Corrections, and Additions: 20 April .
3. Gordon VZ 1974. Biological effects of radiofrequency electromagnetic fields. Translation from the Russian, Biologich-eskom Deystvii. Elecktromagnitnykh Poley Radiochastot 4 1973, Moscow, US Joint Publications Research Service
4. Adams RL, William RA 1976. Biological effects of electromagnetic radiation. Radiowaves and microwaves – Eurasian Communist Countries. **Defense Intelligence Agency**. Report # DST-1810S-074-76. March. 34 pp.
5. Raines 1981. Electromagnetic field interactions with the human body: observed effects and theories. **NASA** CR 166661.
6. Bolen SM 1988. Radiofrequency/microwave radiation biological effects and safety standards: a review. **Air Force** Materiel Command. Report #: RL-TR-94-53. Rome Laboratories, June.

The Causality of Symptoms from RF is Supported by the Use of the Widely Accepted Hill Criteria ¹

Unlike drugs, no randomized controlled trial safety studies on humans have been carried out.

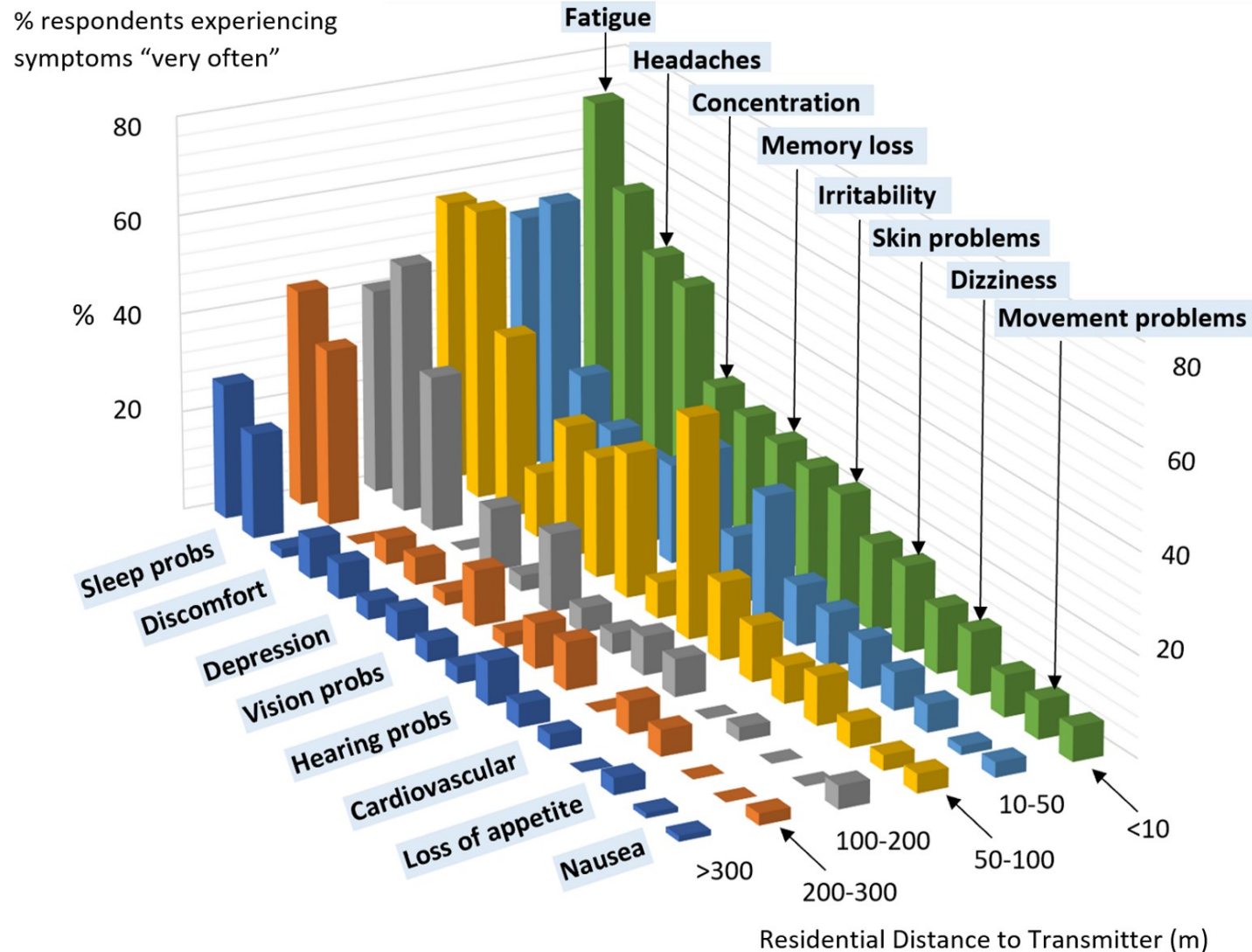
A relationship can be causal (cause-effect) even if Hill's criteria are not satisfied. The case for causality is strongest when (more of) these criteria are satisfied:

- ✓ Strength
- ✓ Consistency
- ✓ Timing: Exposure before Problem
- ✓ Dose-Effect Relation
- ✓ Plausible Mechanism
- ✓ Fit with Other Evidence
- ✓ Specificity

1. Hill AB 1965. The environment and disease: association or causation. Proceedings of the Royal Society of Medicine 58:295-300.

Relation is Strong and Dose-Related

Symptoms as a Function of Residences' Distance to a Cellular Phone Base Station



Santini 2002. [Investigation on the health of people living near mobile telephone relay stations: Incidence according to distance and sex].
 Pathol Biol (Paris) 50: 369-73
<https://www.safespaceprotection.com/emf-health-risks/emf-health-effects/cell-towers/>

The Timing is Right

- Symptoms arise after RF Source is introduced ¹
- Symptoms progress while RF Source is present ^{2,3}
- Symptoms improve after RF Source is removed ⁴

1. Lamech F 2014. Self-reporting of symptom development from exposure to radiofrequency fields of wireless smart meters in Victoria, Australia: A case series. *Altern Ther Health Med* 20(6):28-39. (<http://www.ncbi.nlm.nih.gov/pubmed/25478801>).

2. Sadchikova, MN and KV Glotova 1973. The clinic, pathogenesis, treatment, and outcome of radiowave sickness. {Translated from Russian: Moscow 0 BIOLOGICHESKOM DEYSTVII ELEKTROMAGNITNYKH POLEY RADIOCHASTOT in Russian, No 4, 1973 pp 43-48} Translated 1974. Biological Effects of Radiofrequency Electromagnetic Fields. Z. V. Gordon. Arlington, VA, U.S. Joint Publication Research Service: 54-62.

3. Zalyubovskaya NP 1977. Biological effects of millimeter radiowaves. *Kiev Vracherbnoye Delo* {translated from Russian}. 3: 116-9. Declassified by the CIA in 2012.

4. Shinjyo T, Shinjyo A 2014. Significant decrease of clinical symptoms after mobile phone base station removal - an intervention study. *Umwelt-Medizin-Gesellschaft*. 27(4):294-301. (<https://www.elettrosensibili.it/2015/10/14/significant-decrease-of-clinical-symptoms-after-mobile-phone-base-station-removal-signifikanter-ruckgang-klinischer-symptome-nach-senderabbau/>).

In Shinjyo (Japan): Successive installation of two cell tower antennae on a condo led many to have symptoms. Removal of antennae led most symptoms to resolve.

There is a Well Demonstrated Mechanism, and Findings Fit Other Evidence

Major Mechanism: Oxidative Stress (OS)

i.e. disturbed oxidant / antioxidant balance in the body, closely connected to mitochondrial impairment (low energy production) ^{1,2}

- 93 of 100 studies show: Low intensity RF leads to OS ³
- People with genetic markers for low defense against OS have 10 times greater risk of EHS ⁴
- People with EHS have more often markers of OS *effects* ⁵
- Antioxidants protect (to some degree) against both ionizing ⁶ and non-ionizing radiation ⁷

1. Xu S et al 2010. Exposure to 1800 MHz radiofrequency radiation induces oxidative damage to mitochondrial DNA in primary cultured neurons. Brain Res 1311:189-196.
2. Yoshida T et al 2012. Mitochondrial dysfunction, a probable cause of persistent oxidative stress after exposure to ionizing radiation. Free Radic Res 46(2):147-153.
3. Yakymenko et al 2015. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. Electromagn Biol Med 35 186-202.
4. De Luca 2014. Metabolic and genetic screening of electromagnetic hypersensitive subjects as a feasible tool for diagnostics and intervention. Mediators Inflamm DOI 924184.
5. Belpomme 2015. Reliable disease biomarkers, characterizing & identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. Rev Environ Health 30 251-71.
6. Jang 2013. Melatonin reduces X-ray radiation -induced lung injury in mice by modulating oxidative stress and cytokine expression. Int J Radiat Biol 89 97-105.
7. Sokolovic 2008. Melatonin reduces oxidative stress induced by chronic exposure of microwave radiation from mobile phones in rat brain. J Rad Res 49: 579-86.

EMR is Clearly Linked to Oxidative Stress (OS)

-- At “All” Frequencies

1. Singh et al 2015. "Effect of occupational EMF exposure from radar at two different frequency bands on plasma melatonin and serotonin levels." Int J Radiat Biol:1-9.

2. Gurler et al 2014. "Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic." Int J Radiat Biol 90(10): 892-6.

3. Avci et al 2012. "Oxidative stress induced by 1.8 GHz radio frequency electromagnetic radiation and effects of garlic extract in rats." Int J Radiat Biol 88(11): 799-805.

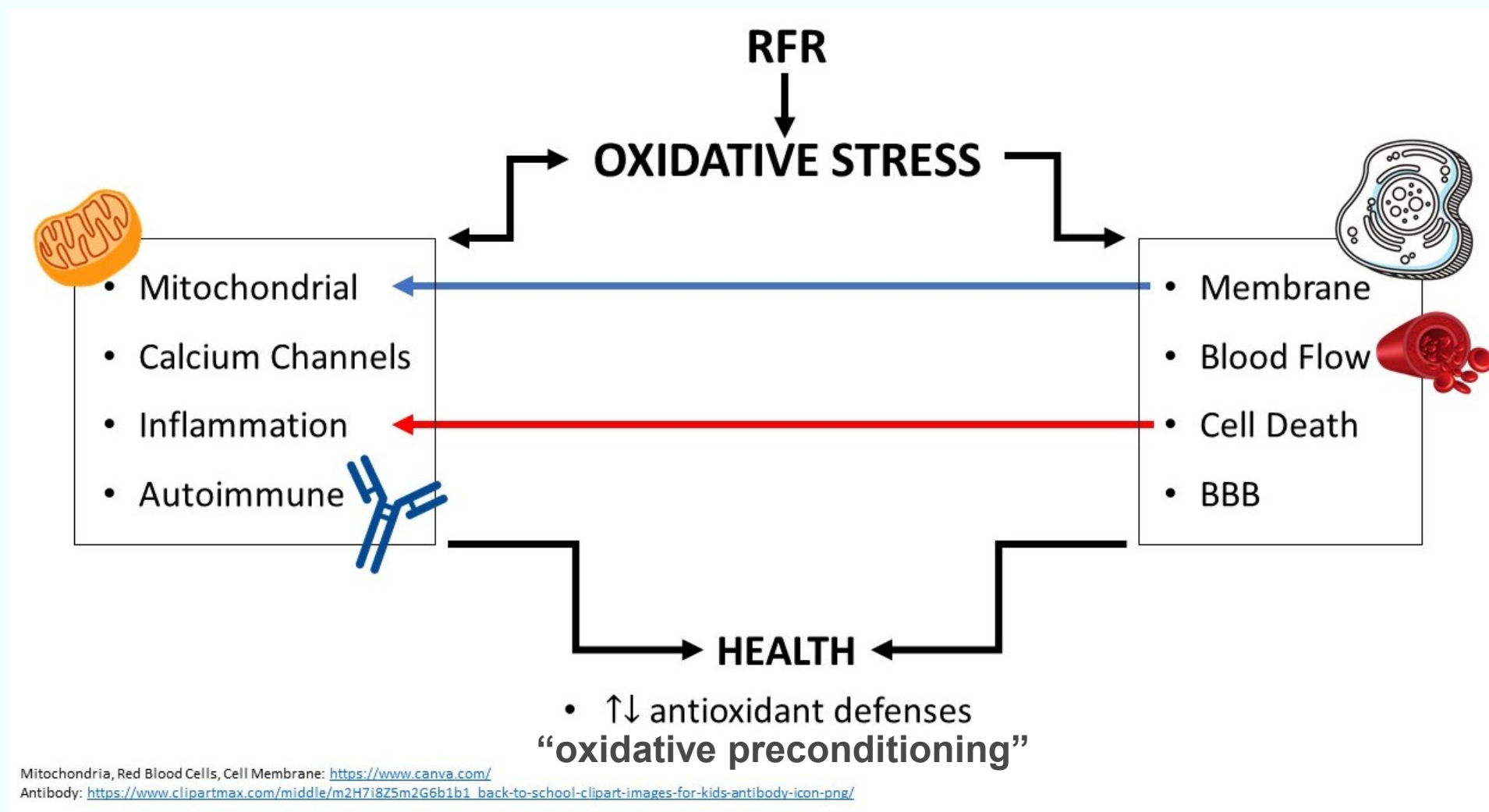
4. Koylu H et al 2006. "Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain." Toxicol Ind Health 22(5): 211-6.6.

5. Esmekaya et al. 2011. "900 MHz pulse-modulated radiofrequency radiation induces oxidative stress on heart, lung, testis and liver tissues." Gen Physiol Biophys 30(1): 84-9.

6. El-Helaly 2010. Oxidative stress, melatonin level, and sleep insufficiency among electronic equipment repairers. Indian J Occup Environ Med 14:66-70.

Non Ionizing Radiation Type	Hz	Example OS Finding
Radar	12-18 GHz	Long-term radar workers ↑ Serotonin ↓ Melatonin ¹
Microwave, cell	2.45 GHz	Low level EMF → OS to DNA brain, blood ²
GSM mobile communication	1.8 GHz	↑ AOPP (advanced oxidation protein product) in brain ³
Cell phone	930 MHz	Cell phone EMR → brain OS; protected by melatonin ⁴
Pulsed RF	900 MHz	OS injury liver lung testis heart & ↓ OS defense ⁵
Power lines	60 Hz	Electronic repair workers have ↑ OS (+ ↓ melatonin) ⁶

Downstream Mechanisms are Known¹



1. Golomb BA 2018. Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation. Neural Computation 30(11):1-104. DOI: 10.1162/neco_a_01133.

The “Havana Syndrome”

- US Diplomats in Cuba, then Guangzhou, China
- Diplomats heard strange noises; followed by varied symptoms
- Findings mirror EHS:
 - Vulnerable subset of the population
 - Same symptom profile ¹
 - Objective signs (subsets): impaired hearing, vision, speech, balance ¹
 - Brain imaging: resembles Traumatic Brain Injury ^{1,2,3}
 - Some of them have become electrosensitive ⁴
- Accepted by the US National Academies (premier US scientific authority) as likely caused by pulsed RF ⁵

1. Golomb BA 2018. Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation. *Neural Computation* 30(11):1-104. DOI: 10.1162/neco_a_01133.

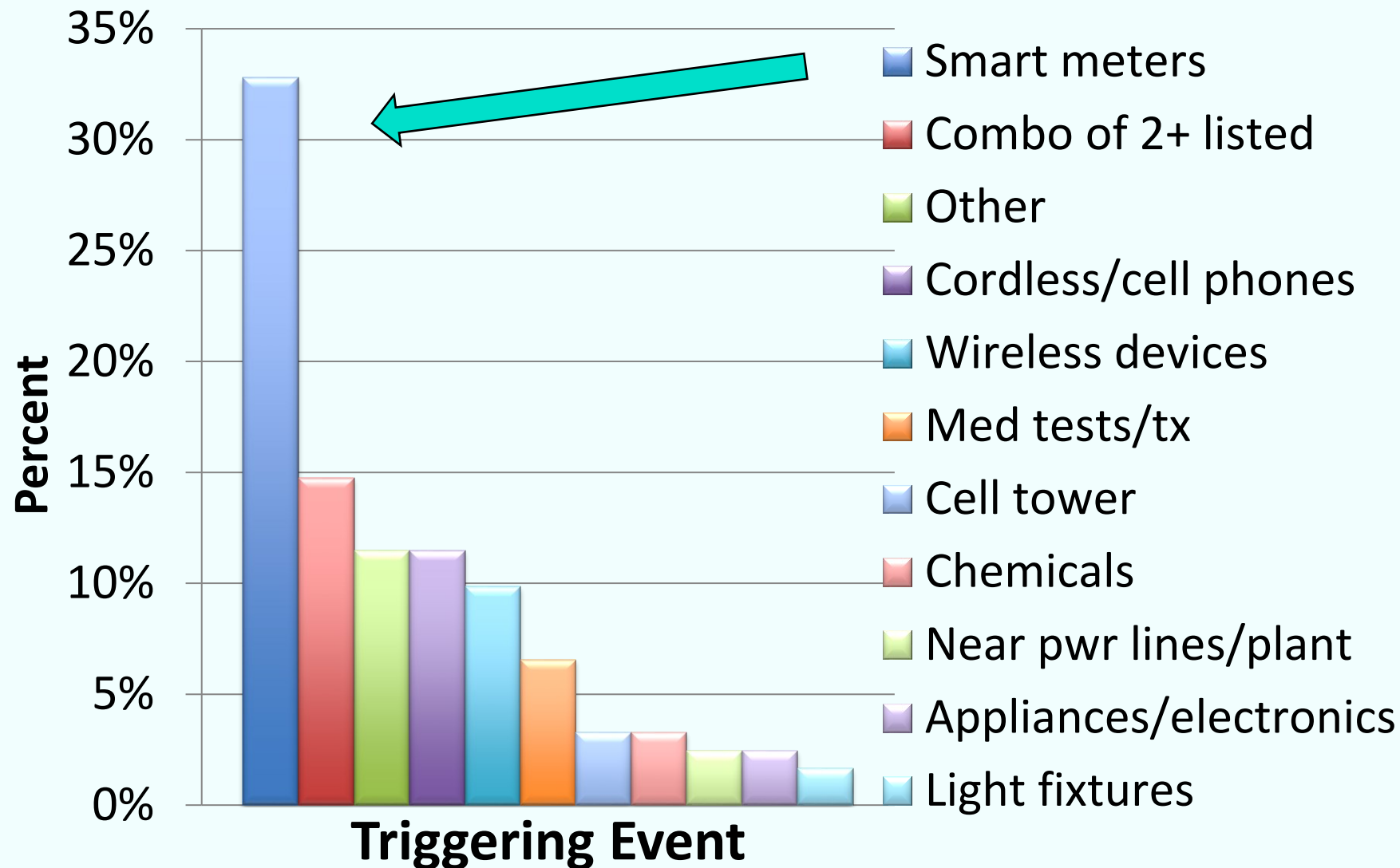
2. Swanson RL et al 2018, Neurological manifestations among US Government personnel reporting directional audible and sensory phenomena in Havana, Cuba. *Journal of the American Medical Association* Feb 15 published online(doi:10.100/jama.2018.1742)

3. Heuser G, Heuser SA 2017. Functional brain MRI in patients complaining of electrohypersensitivity after long term exposure to electromagnetic fields. *Rev Environ Health* 10.1515/reveh-2017-0014.

4. Ioffe J 2020. The Mystery of the Immaculate Concussion. *GQ* Oct 19.

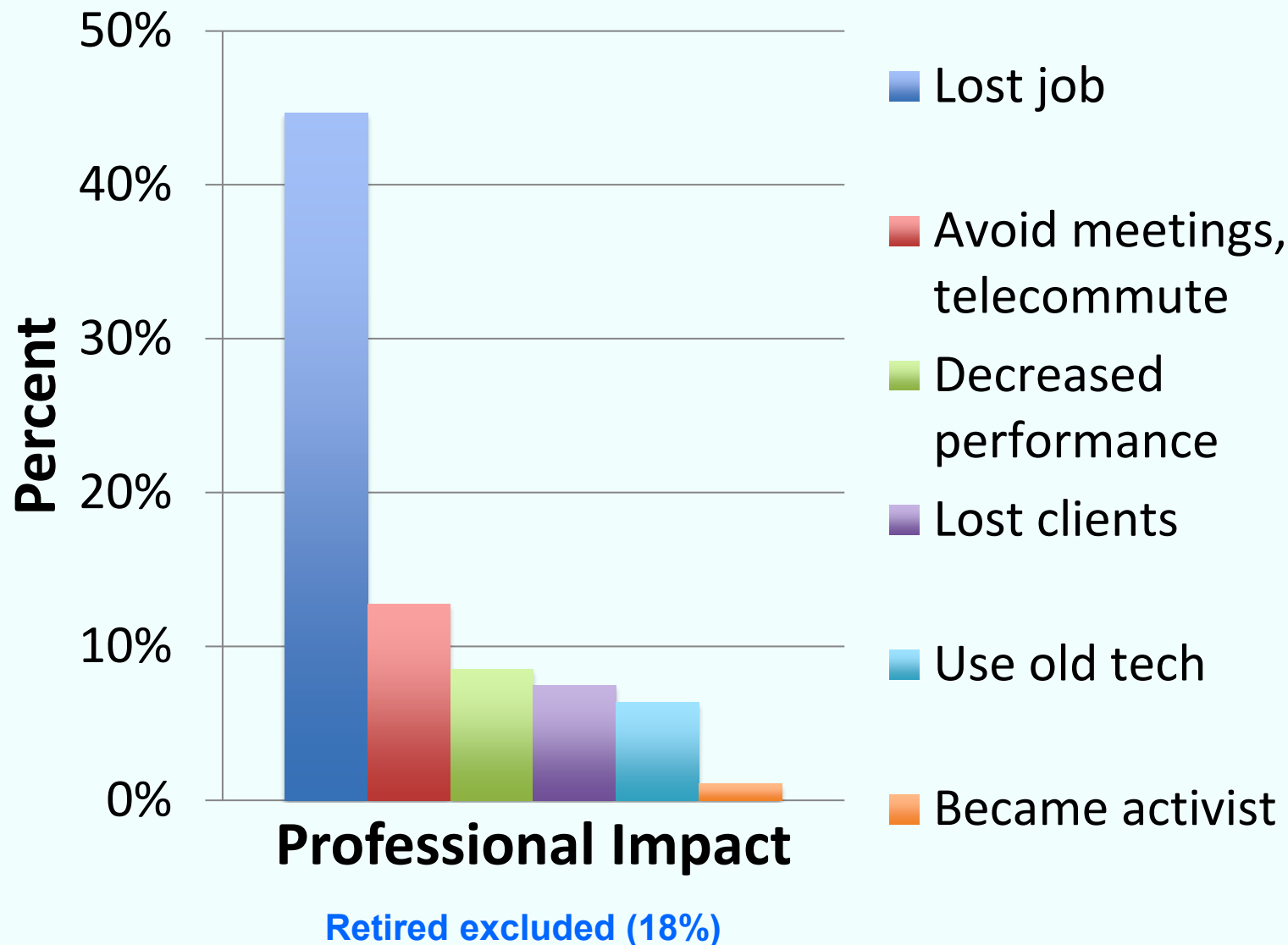
5. National Academies of Sciences, Engineering, and Medicine 2020. *An Assessment of Illness in U.S. Government Employees and Their Families at Overseas Embassies*. Washington (DC): National Academies Press (US).

Cause of EHS: 69% of Respondents Reported A Triggering Event, *with Smart Meters as Top Cause*



Golomb BA 2015. Electrosensitivity:
A 'current' and future problem.
Meeting: Cell Phones and Wireless
Technologies—Should Safety
Guidelines Be Strengthened to
Protect Adults, Children and
Vulnerable Populations?
Commonwealth Club,
San Francisco: June 22.

Professional Impact of Becoming Electro-Hypersensitive



Golomb BA 2015. Electrosensitivity: A 'current' and future problem. Meeting: Cell Phones and Wireless Technologies—Should Safety Guidelines Be Strengthened to Protect Adults, Children and Vulnerable Populations? Commonwealth Club, San Francisco: June 22.

Relation of RF-Radiation to Symptoms is Consistent and Specific

No other exposure or health condition has such a quantitative profile:

Symptom	The Diplomats* ¹	EHS* ²
	%	%
Headache	81*	81
Cognitive problems	81	81
Sleep problems	86	76
Dizziness	62	64
Tinnitus	57	63
Irritability	67	56
Anxiety	57	55

1. Swanson, RL et al 2018. Neurological manifestations among US Government personnel reporting directional audible and sensory phenomena in Havana, Cuba. Jama 319:1125–1133.

2. Kato + Johansson 2012. Reported functional impairments of electrohypersensitive Japanese: A questionnaire survey. Pathophysiology 19:95-100.

* Percentage of affected individuals only

Hill's Causality Criteria are Thus All Satisfied¹

We can conclude that EMF / RF from smart meters and other sources can cause the symptoms of EHS.

- ✓ Strength
- ✓ Consistency
- ✓ Timing: Exposure before Problem
- ✓ Dose-Effect Relation
- ✓ Plausible Mechanism
- ✓ Fit with Other Evidence
- ✓ Specificity

1. Hill AB 1965. The environment and disease: association or causation. Proceedings of the Royal Society of Medicine 58:295-300.

Why Are There Individual Sensitivity Differences?

- Common to have massive individual variation in sensitivity to toxins ¹
- Oxidative stress and mitochondrial impairment are often involved as mechanisms
 - Examples: statins ^{1,2}, organophosphates (OPs) ³ and fluoroquinolones (FQs) ⁴ – even Covid
- In broader context related to phototoxicity / photosensitivity (tied to OS) ⁵⁻⁷
- Sensitivity to OS varies with individual genetic properties ⁷
- Spurred by past exposures to toxins involving OS and mitochondria:
 - Examples: Organophosphates (OPs), Head Injury, Fluoroquinolones (FQs), Electric Shock



Examples from a large literature:

1. Graham DJ et al 2004. Incidence of hospitalized rhabdomyolysis in patients treated with lipid-lowering drugs. *Journal of the American Medical Association* 292(21):2585-90. (http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15572716).
2. Golomb BA, Evans MA 2008. Statin adverse effects : a review of the literature and evidence for a mitochondrial mechanism. *Am J Cardiovasc Drugs* 8(6):373-418. doi:10.2165/0129784-200808060-00004
3. Cherry N et al 2002. Paraoxonase (PON1) polymorphisms in farmers attributing ill health to sheep dip. *Lancet* 359(9308):763-4.
4. Golomb BA et al 2015. Fluoroquinolone-induced serious, persistent, multisymptom adverse effects. *BMJ Case Rep* (In eng). DOI: bcr-2015-209821 [pii]10.1136/bcr-2015-209821.
5. Dalle Carbonare M, Pathak MA 1992. Skin photosensitizing agents and the role of reactive oxygen species in photoaging. *J Photochem Photobiol B* 14(1-2):105-24.
6. Ouedraogo G et al 2000. Damage to mitochondria of cultured human skin fibroblasts photosensitized by fluoroquinolones. *J Photochem Photobiol B* 58(1):20-5.
7. Anstey AV et al 1999. Characterization of photosensitivity in the Smith-Lemli-Opitz syndrome: a new congenital photosensitivity syndrome. *Br J Dermatol* 141(3):406-14. (In eng). DOI: bjd3032 [pii].

One Predisposing Factor: Significant Electric Shock ¹

	EHS %	Control group %	P
	22	4.7	0.003
	Odds Ratio (OR): 6.0 (1.6-38)		
	<u>Example Comments:</u>		
	“I was struck by lightning”		
	“Yes – a lightning strike when I was 17”		
	“High voltage work accident with 440 V”		
	“Near fatal accident with Direct Current (DC) while working in...”		
	“Major shock from a bare wire 30 years ago”		
	“As a child I grabbed a short-circuited refrigerator with wet hands and was unable to release until someone disconnected it”		

Golomb BA 2015.
Electrosensitivity: A 'current' and future problem. Meeting: Cell Phones and Wireless Technologies—Should Safety Guidelines Be Strengthened to Protect Adults, Children and Vulnerable Populations? Commonwealth Club, San Francisco: June 22.

Other Risk Factors Connected to EHS ¹

Feature	Case %	Ctrl %	P
Any Overlap Condition:* ²	70	17	<0.0001
MCS (Chemical Sensitivity)	53	5	<0.0001
CFS (Chronic Fatigue Syndrome)	38	5	<0.0001
IBS (Irritable Bowel Syndrome)	29	7	0.003
FM (Fibromyalgia)	19	5	0.03
Mold sensitivity	40	12	0.0005
*These conditions, which are linked to OS (oxidative stress) and MD (mitochondrial dysfunction), show “overlap” with one another (MCS, CFS, IBS, FM).			

1. Golomb BA 2015. Electrosensitivity: A 'current' and future problem. Meeting: Cell Phones and Wireless Technologies—Should Safety Guidelines Be Strengthened to Protect Adults, Children and Vulnerable Populations? Commonwealth Club, San Francisco: June 22.
 2. Golomb BA 2012. Oxidative stress and mitochondrial injury in chronic multisymptom conditions: From Gulf War illness to autism spectrum disorder. *Nature Precedings* <<http://hdl.handle.net/10101/npre.2012.6847.1>>

Other Risk Factors Connected to EHS (continued) ¹ 19

	Case %	Ctrl %	P
Use of FQ (Fluoroquinolone) (antibiotic harming mitochondria, increasing OS)	27	12	0.036
If FQ: Adverse health effects	47	0*	0.05
Any other toxic adverse effect	88	69	0.003
Autoimmune condition	27	7	0.003
1st degree biological family member with chemical intolerance	26	12	0.046
1st degree biological family member with autoimmune condition	26	11	0.03
Only 5 controls (vs 50 cases) reported taking FQs			

1. Golomb BA 2015.
Electrosensitivity: A 'current'
and future problem. Meeting:
Cell Phones and Wireless
Technologies—Should Safety
Guidelines Be Strengthened to
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Why Is There Controversy Over the Findings?

20

- Outdated focus on thermal harm remains
- Regulators are Captured by Business
 - FCC¹, WHO / ICNIRP ²⁻⁵
- Economic Impact on Media
 - Money to journalists ⁶, ghostwritten articles
 - Pay to “train” journalists:
 - Verizon “5G Journalism Lab” with New York Times ⁷
 - Outright ownership
 - NBC, CNN, Huffington Post, Washington Post, Atlantic...
- PR Techniques ⁸ e.g.
 - Discredit, “neutralize” those who raise concerns ⁹⁻¹¹
 - “We may need to seek them out and destroy them where they live.” ¹²

1. Alster N 2015. Captured Agency: How the Federal Communications Commission is Dominated by the Industries it Presumably Regulates. Harvard University, Edmond J Safr Center for Ethics ([www.harvard.ethics.edu\(https://creativecommons.org/licenses/by/4.0/\)](http://www.harvard.ethics.edu(https://creativecommons.org/licenses/by/4.0/))).
2. Hardell L 2017. World Health Organization, radiofrequency radiation and health - a hard nut to crack (Review). International Journal of Oncology June 21
3. Nordhagen EK, Flydal E 2022. Self-referencing authorships behind the ICNIRP 2020 radiation protection guidelines. Rev Environ Health. DOI: 10.1515/reveh-2022-0037.
4. Maisch D 2006. Conflict of Interest & Bias in Health Advisory Committees: A case study of the WHO's Electromagnetic Field (EMF) Task Group. J Aust Coll Nutr & Env Med;Vol. 25 No. 1:15-17.
5. Leszczynski D 2012. “In Experts We Trust” ...or should we? The Washington Times. July 17. Accessed August 30, 2022.
6. Schwab T 2020. Journalism's Gates Keepers. Columbia Journalism Review. Aug 21 (<https://www.cjr.org/criticism/gates-foundation-journalism-funding.php>)
7. NYT and Verizon: 5G Journalism Lab <https://www.nytimes.com/paidpost/verizon-5g/behind-the-5g-experience.html> (<https://doi.org/10.3892/ijo.2017.4046>).
8. PRWatch.com
9. Ishisaka N 2011. UW scientist Henry Lai makes waves in the cell phone industry. Seattle magazine. August 4. Accessed August 23, 2022.
10. Hertsgaard M, Dowie M 2018. How big wireless made us think that cell phones are safe: A special investigation. The Nation. April 5. Accessed August 23, 2022.
11. Johnson J 2015. Wireless Empire Strikes Back. EMFanalysis.com. March 21. Accessed August 23, 2022. (<https://www.emfanalysis.com/wireless-empire-strikes-back/>)
12. Rout M 2009. Vioxx maker Merck and Co drew up doctor hit list: The Australian. April 1.

Why Is There Controversy Over the Findings? (2)²¹

Economic Influence on Science

- ~70% of industry funded studies showed absence of harm from RF source, while ~70% of non-industry funded studies showed presence of harm¹
- Industry funded studies: ~1/10 the odds of showing harm ²
- Author conflicts—not just study funding—also matter ^{3,4}
- “Inconsistent” results are used to create doubt ⁵
- Where harms to citizens are pitted against industry profits, scientists’ published statements reflect their industry ties: e.g., 96%, 60% and 37% had industry conflicts of interest in those who views of a product were favorable, neutral, or critical (P<0.001) ⁴

"Far from conflict of interest being unimportant in the objective and pure world of science...it [conflict of interest] is the main factor determining the result of studies." ⁶

-- Richard Smith, British Medical Journal, Editor in Chief

1. Lai H 2013 Does mobile phone use affect your health? Keynote address. Symposium on Effects of Electromagnetic Fields on Public Health and Environment 2013;Yildiz Teknik Universitesi, Istanbul Turkey(Nov 8-9).

2. Huss et al 2007. Source of Funding and Results of Studies of Health Effects of Mobile Phone Use: Systematic Review of Experimental Studies. Env Health Perspect 115: 1-4.

3. Barnes DE, Bero LA 1998. Why review articles on the health effects of passive smoking reach different conclusions. Journal of the American Medical Association 279(19):1566-70

4. Stelfox HT et al 1998. Conflict of interest in the debate over calcium-channel antagonists. New England Journal of Medicine 338(2):101-6.

5. Kenyon G 2016. The man who studies the spread of ignorance. BBCcom. Jan 5.

6. Smith R 2006. Conflict of interest: how money clouds objectivity. J R S M 99(6):292-7.

EHS is Not Caused by A Nocebo Effect¹

	No	Yes
At 1st onset of symptoms now attributed to EMR, were you aware that others had similar problems with electromagnetic radiation?	72%	28%
Some had heard of people claiming to be EHS:		
"I knew someone who claimed to be sensitive to EMR but I thought she was nuts."		
"but I had always thought they were just being overly concerned - until I experienced it for myself"		
"but I did not believe that it was real, I thought it was psychosomatic"		

Many Medical (etc) Groups Have Tried to Raise Concern (1)

- 1997 Boston Physicians' & Scientists' Petition To Avert Public Exposures to Microwaves
- 1998 Vienna Resolution
- 2002 Salzberg Resolution
- 2002 Declaration of Alcalá
- 2002 Catalonia Resolution
- 2002 Freiburger Appeal (>1000 physicians signed)
- 2004 Bamberg Appeal (114 physicians in Germany)
- 2004 Maintaler Appeal
- 2004 The Irish Doctors' Environmental Association (IDEA) Position Statement on electromagnetic radiation
- 2005 Coberger Appeal
- 2005 Oberammergauer Appeal
- 2005 Halbacher Appeal
- 2005 Pfarrkirchener Appeal
- 2005 Lichtenfelser Appeal
- 2005 Hofer Appeal
- 2005 Helsinki Appeal

(continued)

Many Medical (etc) Groups Have Tried to Raise Concern (2)²⁴

2005 Parish Kirchner Appeal

2005 Saarlander Appeal

2005 Stockacher Appeal

2006 Benevento Resolution - Intl Commission for Electromagnetic Safety (ICEMS)

2006 Allgäuer Appeal (373 physicians)

2006 WiMax Appeal

2006 International Association of Fire Fighters Division of Occupational Health Safety & Medicine, Position on the health effects from radio frequency/ microwave (RF/MW) radiation in fire department facilities from base stations for antennas and towers for the conduction of cell phone transmissions

200? Schlüchterner Appeal

2007 Brussels Appeal

2008 Venice Resolution -- International Commission for Electromagnetic Safety (ICEMS)

2008 Berlin Appeal

2009 Paris Appeal

2009 London Resolution

2009 European Parliament, Health concerns associated w/ electromagnetic fields

2009 EMF Resolution

(continued)

Many Medical (etc) Groups Have Tried to Raise Concern (3)

- 2009 Dutch Appeal
- 2010 Würzburg Appeal (Eur Acad Env Med, EuroPAEM)
- 2010 Copenhagen Resolution
- 2010 Seletun Consensus Statement (Norway) - Intl EMFAlliance (IEMFA)
- 2011 Porto Alegre Resolution (Doctors many from Brazil)
- 2011 The Declaration of the Official Association of Biologists of Galician:
- 2011 The Russian National Committee on Non-Ionizing Radiation Protection, Electromagnetic Fields from Mobile Phones: Health Effect on Children and Adolescents
- 2011 Potenza Picena Resolution, 2013: "Radar, radiofrequency and health risk "
- 2011 Canadian Medical Association Resolution on Cell Phone Radiation
- 2011 Council of Europe, Parliamentary Assembly Resolution 1815, The Potential Dangers of Electromagnetic Fields and Their Effect on the Environment.
- 2012 Swiss Physicians Association: Swiss Physicians Letter
- 2012 Bioinitiative Report
- 2012 Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses
- 2012 + other year: American Academy of Pediatrics (AAP) Statements
- 2013 IDEA letter (Irish Doctors' Environmental Association)

(continued)

Many Medical (etc) Groups Have Tried to Raise Concern (4)

- 2013 Radiofrequency Electromagnetic Fields and Health. Expert Appraisal.
- 2014: Calif. Medical Association Wireless Standards Resolution Vienna Medical Association: 10 Medical Rules for Cell Phones
- 2014 Declaration: Doctors Call for Protection from Radiofrequency Radiation Exposure (Canada) (55 Canadian doctors)
- 2015. Canadian Parliament Standing Committee on Health, House of Commons, Report "Radio Frequency Electromagnetic Radiation & the Health of Canadians"
- 2016 The French Natl Agency of Health Security of Food, Environment & Labour Report "Radiofrequency Exposure and the Health of Children"
- 2016 The BabySafe Project (>200 physicians, scientists, pub health officials)
- 2018 Eklipse 2018 The Impacts of Artificial Electromagnetic Radiation on Wildlife (flora+fauna).
- International EMF Scientists Appeal (to UN): ≥220 scientists from 41 nations; also 105 EMF advocacy and education groups

(Web addresses may be found at <http://ehtrust.org>)

Other Health / Biological Concerns With Non-Ionizing Radiation

1. Peleg et al 2018: Radio frequency radiation-related cancer: assessing causation in the occupational/military setting. *Environ Res* 163: 123-133
2. Hardell L, Carlberg M 2013. Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. *Rev Environ Health*. 28(2-3):97-106. doi:10.1515/reveh-2013-0006
3. Houston BJ et al 2016. The effects of radiofrequency electromagnetic radiation on sperm function. *Reproduction*. 152(6):R263-R276. doi:10.1530/REP-16-0126
4. Yadav H et al 2021. Radiofrequency radiation: A possible threat to male fertility. *Reprod Toxicol*. 100:90-100. doi:10.1016/j.reprotox.2021.01.007
5. Li DK et al 2017. Exposure to Magnetic Field Non-Ionizing Radiation and the Risk of Miscarriage: A Prospective Cohort Study. *Sci Rep*. Dec 13;7(1):17541. doi: 10.1038/s41598-017-16623-8. PMID: 29235463; PMCID: PMC5727515.
6. Lai H, Singh NP 1996. Single- and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation. *Int J Radiat Biol*. 69(4):513-521. doi:10.1080/095530096145814
7. Houston B.J. et al 2019. Whole-body exposures to radiofrequency-electromagnetic energy can cause DNA damage in mouse spermatozoa via an oxidative mechanism. *Sci Rep* 9, 17478. <https://doi.org/10.1038/s41598-019-53983-9>
8. Belpomme 2015. Reliable disease biomarkers, characterizing & identifying electrohypersensitivity and multiple chemical sensitivity as two etiopathogenic aspects of a unique pathological disorder. *Rev Environ Health* 30 251-71
9. Ivanov AA et al 2010. [Autoimmune processes after long-term low-level exposure to electromagnetic fields (the results of an experiment). Part 3. The effect of the long-term non-thermal RF EMF exposure on complement-fixation antibodies against homogenous tissue]. *Radiats Biol Radioecol*. 50(1):17-21.

- Cancer ^{1,2}
- Sperm ^{3,4}
- Birth Outcomes ⁵
- Metabolic Effects
- Cardiovascular Disease
- Cognitive Problems
- DNA Damage ^{6,7}
- Autoimmune ^{8,9}

Also Influenced
by Sleep Effects

Summary

- Strong credentials to comment on the topic of NIR and health effects
- There is a long historical record of recognized biological effects and concerns
- Subset of human populations are affected with symptoms, EHS, and more severe health problems
- Evidence fulfills scientific criteria for causality
- A main causal mechanism is well known – oxidative stress
- Symptoms are real and caused from radiation – not from nocebo effects
- Smart meters seem to be accelerators for EHS onset
- Impact on life can be profound
- Controversy has its roots in economic interests

Thank You

The Proof of the Pudding:

Melatonin Protects against EMR damage – *Non-Ionizing*

ELF	The protective effect of melatonin ...against the negative effects of extremely low frequency electric and magnetic fields on pulp structure in rat teeth. Dogan 2017. Biotech & Biotech Equip 31:979-988
RF/	Melatonin ...block radiofrequency electromagnetic radiation-induced DNA strand breaks in rat brain cells. Lai 1997. Bioelectromagnetics 18: 446-54
MW	Melatonin reduces oxidative stress induced by chronic exposure of microwave radiation from mobile phones in rat brain. Sokolovic 2008. J Rad Res 49: 579-86 Melatonin modulates 900 Mhz microwave-induced lipid peroxidation changes in rat brain. Koylu 2006. Toxicol Ind Health 22 211-6 Melatonin modulates wireless (2.45 GHz)-induced oxidative injury through TRPM2 and voltage gated Ca(2+) channels in brain and dorsal root ganglion in rat. Naziroglu 2012. Physiol & Behav 105:683-92 Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin. Oktem 2005. Arch Med Res 36. 350-5. Protective effects of melatonin against oxidative injury in rat testis induced by wireless (2.45 GHz) devices. Oksay 2012. Andrologia. (Alxo, Xu 2010. etc) Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin. Aynali 2013. Eur Arch Otorhinolaryngol 270: 1695-700 Protective effects of melatonin & caffeic acid phenethyl ester against retinal oxidative stress in long-term use of mobile phone Ozguner 2006. Mol Cell Biochem.282:83-8

The Proof of the Pudding 2:

Melatonin Protects against EMR damage – *Ionizing*

UV	Melatonin improves ultraviolet B-induced oxidative damage and inflammatory conditions in cutaneous tissue of a diurnal Indian palm squirrel Goswami. 2014. Br J Dermatol. 171: 1147-55
Xray	Melatonin blunts the mitochondrial/NLRP3 connection and protects against radiation -induced oral mucositis. Ortiz, F. 2015. J Pineal Res 58: 34-49. Melatonin reduces X-ray radiation -induced lung injury in mice by modulating oxidative stress and cytokine expression. Jang 2013. Int J Radiat Biol. 89 97-105. Melatonin prevents X-ray irradiation induced oxidative damage in peripheral blood and spleen of the seasonally breeding rodent...Sharma.2006.Int J Radiat Biol 82: 411-9. Melatonin reduces X-ray irradiation -induced oxidative damages in cultured human skin fibroblasts. Kim 2001.J Dermatol Sci 26:194-200
γ ray	Ameliorative effect of melatonin against gamma-irradiation -induced oxidative stress and tissue injury. El-Missiry 2007, Ecotoxicol Environ Saf 66: 278-86 Radioprotective effect of melatonin in reducing oxidative stress in rat lenses. Shirazi, A.2911. Cell J 13: 79-82

The Proof of the Pudding 3:

EMR may Depress Melatonin+Other Antioxidants

(conversion 5HT to melatonin; pineal involution)

ELF	• Oxidative stress, melatonin level, and sleep insufficiency among electronic equipment repairers. El-Helaly 2010. Indian J Occup Env Med 14: 66-70 ↓ melatonin • Pineal melatonin level disruption in humans due to electromagnetic fields and ICNIRP limits Halgamuge 2013. Radiat Prot Dosimetry 154:405-16. Reviews 100 studies; ↓ melatonin • Evidence for an effect of ELF electromagnetic fields on human pineal gland function. Wilson 1990 J Pineal Res 9: 259-269. ↓ melatonin • Effects of power frequency electromagnetic fields on melatonin and sleep in the rat. Dyche 2012. Emerg Health Threats J 5. {Melatonin sl ↑}
RF/	More variability & individual differences for RF/MW. Other studies no effect • Effects of 1800-MHz radiofrequency fields on circadian rhythm of plasma melatonin and testosterone in male rats. Qin 2012. J Toxicol Env Health A. 75:1120-8 {↓ melatonin}
MW	• Exposure of rat brain to 915 MHz GSM microwaves induces changes in gene expression but not double stranded DNA breaks or effects on chromatin conformation. Belyaev 2006 Bioelectromagnetics 27, 295-306. ↓ gene expressn 0.48 (p=0.0025) for rate limiting enz in melatonin produxn. • Oxidative damage in the kidney induced by 900-MHz-emitted mobile phone: protection by melatonin. Oktem 2005. Arch Med Res 36. 350-5. ↓SOD, CAT, GSH-Px (Melatonin reversed these reductions) • Impact of microwave at X-band in the aetiology of male infertility Kumar 2012: Electromagnetics 31: 223-32. ↓ melatonin • Effect of occupational EMF exposure from radar at two different frequency bands on plasma melatonin and serotonin levels. Singh 2016. Int J Radiat Biol 1-9. ↓ melatonin if >10 yrs exposure, for 12.5-18 GHz but not (fewer number of) 8-12 GHz gp.