ATTACHMENT

For Item

#6

Wednesday, August 7, 2019

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Rodriguez, Chrystal

From: Desmond, Jim
Sent: Tuesday, August 06, 2019 11:08 AM
To: bgolomb@salk.edu
Cc: Mills, Benjamin; FGG-DL, LSDOCS
Subject: RE: San Diego County 5G Deliberations: A Doctor's Appeal
Attachments: Attachment I. SB649.pdf; Attachment II. Golomb 2018 - Diplomats Mystery Illness and Pulsed RF.pdf; Attachment III. Zalyubovskaya 1977- mm wave eff.pdf; Attachment IV. Alster - Captured Agency.pdf; Golomb CV 2019-08-05.pdf

Dear Dr. Golomb,

Thank you for your email. I appreciate you sharing your thoughts on this matter. When this item comes before the Board of Supervisors, I will consider your input and all other input before making a decision.

Again, I appreciate you contacting my office. Please feel free to contact me or my Land Use Policy Advisor, Ben Mills, if you have any questions at (619) 531-5555.

Sincerely,

Jim Desmond
County of San Diego
Supervisor, 5th District

From: Beatrice <bgolomb@salk.edu>
Sent: Tuesday, August 6, 2019 10:36 AM
To: Desmond, Jim <Jim.Desmond@sdcounty.ca.gov>
Cc: Beatrice Golomb <bgolomb@ucsd.edu>
Subject: San Diego County 5G Deliberations: A Doctor's Appeal

UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

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Beatrice Alexandra Golomb, MD, PhD

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Phone: 858 558-4950 x201

To: Jim Desmond, San Diego County Board of Supervisors

Re: 5G / Small Cell Rollout in San Diego County August 6, 2019

Dear members of the San Diego County Board of Supervisors,

I am writing in relation to deliberations related to the 5G rollout. I will provide some background on health effects and ethical considerations; then a list of requests; then my CV/ credentials to comment.

I. Health Effects of Radiofrequency/ Microwave Radiation Generally

- **Attached is a letter addressing health effect concerns related to 5G** from the time of California bill SB649 (**Attachment I**). This addresses health effects of radiofrequency/ microwave radiation, and risks posed in consequence by 5G.
- **I have published strong evidence that the "mystery illness" reported to affect American (and Canadian) diplomats in Cuba and China is due to pulsed radiofrequency microwave radiation** [1] **Attachment II**. Per Jacqueline Kalil, a CBS "60 Minutes" reporter who has tracked this issue, all government agencies with whom she has communicated now acknowledge radiofrequency/ microwave radiation to be the most likely cause of diplomats' illness (personal communication, Feb 19, 2019).
- My work showed (for instance) that not only symptoms, but objective findings and brain damage on imaging, match between affected diplomats and a vulnerable subgroup of civilians *already* affected by communications sources of radiation. It is expected that persons already affected may become more seriously injured; and a new group may become affected – and marginalized from society - as 5G and small cells continue to be rolled out.

II. Health Effects of 5G "millimeter waves" specifically

- **Evidence on 5G health effects is limited.** However, absence of evidence is not evidence of absence. **Moreover: Available evidence supports health risks from 5G.**
  - **A 1977 study, declassified by the CIA in 2012** [2] **Attachment III, exposed rats to millimeter waves for just 15 minutes a day for 60 days.** Not only the skin and nerves were affected, but the brain, heart, bone marrow – and liver, kidney, and spleen. The energy powerhouses of cells, called "mitochondria," were damaged in organs throughout the body. (Damage to mitochondria especially imperils highly energy demanding tissues like brain[3], and heart – the organs most often reported to be affected by persons citing injury from radiofrequency/microwave radiation.) The degree of injury to exposed animals increased with exposure time/ days; and animals varied widely in how affected they were[2] – just as is seen in people exposed to radiofrequency/ microwave radiation.
  - **Small cell radiation will not replace existing radiation but add to it. Evidence suggests that multiple frequencies of radiation have synergistic toxicity.** For instance, a 1976 Defense Intelligence Agency report states: "Soviet investigators have conducted studies on the effects of microwave frequencies in combination with ionizing radiation, magnetic fields, drugs, **and nonionizing electromagnetic radiation of other wavelengths. Generally, synergistic effects have been observed**"[4] {emphasis added}. Since different sources of radiation compete for and can overwhelm antioxidant defenses, and since they may also depress antioxidant defenses, synergistic toxicity may be expected. And since many other toxins also act through oxidative mechanisms, these exposures may compound toxicity from chemical sources.
  - **Even were it true that only skin-deep effects could occur with 5G (as some have sought to claim but as the above report refutes): cataracts and melanoma would remain concerns.** Indeed, cataracts[5-8] and melanoma[9-11] (including ocular melanoma) are reported as risks with radiation frequencies on both sides of 5G "millimeter wave" frequencies –not only with higher frequency "ionizing radiation", but also with frequencies lower in the radiofrequency/ microwave range.

III. The Telecommunications Act of 1996 stipulates that environmental effects cannot be considered, *but it says nothing about health effects*. (Section 332(c)(7)(B)(iv): "No State or local government ...may regulate the placement,

construction, and modification of personal wireless service facilities on the basis of the **environmental** effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions" {emphasis added}.

- **This bill was "described by South Dakota Republican senator Larry Pressler as 'the most lobbied bill in history'",** and reportedly 13 of the 15 Congressional staffers who helped the lobbyists to write it went on to become lobbyists themselves [12]. Such coopting of legislation and governance by industry is not how our Republic was intended to operate.
- **Even so: It excludes consideration only of environmental effects: These do not equate to health effects.** Environmental scientists cannot write prescriptions nor approve hospitalizations.
- Interpreting environmental effects to encompass health effects and then preventing people and their elected representatives from speaking up to defend their health infringes on fundamental American principles such as freedom of speech, and the basic right to self-defense. In the US, we are not to punish people without due process; nor to impose "cruel and unusual punishment" even with due process. Yet affected persons frequently describe their experience as like torture, and do not understand how this can be inflicted on them *with no recourse*, in America. This seems like what might be expected of a malign totalitarian state. We expect that our elected officials will protect us.

IV. There are ethical imperatives at stake. Following orders will not necessarily be a viable defense.

- In the Nuremberg War Crimes Trial, defendants were charged with "perform{ing} medical experiments upon concentration camp inmates and other living human subjects, without their consent, in the course of which experiments the defendants committed the ... brutalities, cruelties, tortures, atrocities, and other inhuman acts {described in the indictment}"[13, 14]. The Court designated rules for research to be ethical (the Nuremberg Code), including the requirement for informed consent, and the option of participants to terminate participation at any time Animal experimentation was also to precede and inform experimentation in humans to keep humans safe.
- Failure, in the 5G rollout, to have proper research controls or to systematically collect information about potential health impact does not make the 5G experiment any more ethical, it makes it less so - particularly in the face of the many independent (nonindustry) scientists and doctors worldwide that have called for a 5G moratorium (**5G appeal) and/or** aired concerns about the potential health impact[15]; and legal analysis that concludes that a 5G rollout is in violation of international standards for human rights[16].
- In the present case, though industry PR has concocted a dubious "race to 5G" as a means to ram past ethical and health concerns (as well as cybersecurity and energy concerns), there is not even the imperative of active war to partially mitigate the offense.
- The Environment minister of Brussels, Céline Fremault, reportedly said, in halting the 5G rollout in that city: "The people of Brussels are not guinea pigs whose health I can sell at a profit. We cannot leave anything to doubt"[17].
- We hope our elected leaders and government officials show equal courage in defense of their people. Pressures to prioritize industry over human interests will be strong. Lucrative industries and the PR operations with which they work have well learned the lessons pioneered by Big Tobacco, heavily funding science and scientists to generate doubt and deny health problems; using resources to influence or "capture" legislators, legislation, nonprofits, media, journalists and regulators (e.g. prwatch.com, many articles). This is detailed for the case of US federal telecommunications regulation in the Harvard Safra Ethics Center Report by Norm Alster entitled *Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates* [12]. **Attachment 1V.**

Requests:

1. **Place a hold on 5G roll-out until the below requests are all fully implemented and active.**
2. **Adverse Effect Reporting System:** Have a fully-operational formal and highly publicized system where people can report health effects they attribute to 5G (akin to FDA's MedWatch for drug adverse effects). Individual case reports are usually the first signal of adverse effects, and where adequate follow-on studies of other designs are conducted, the signals identified in cases are often vindicated. These have the benefit over other observational designs that people are compared to themselves (vs other groups that may differ in other respects); and they can be compelling especially when there is on-off-on exposure with problems worsening-ameliorating-worsening; and/or when many persons report similar problems that are unusual or had for them been unusual. Also, average findings in group level studies are not necessarily pertinent to vulnerable individuals, who deserve protection as well. Include a systematic "active surveillance" (outreach) component; and ensure active monitoring of results by parties with no industry conflict of interest (and who contract for a long time to remain without one).
3. **Epidemiological Study**: Set up epidemiological studies to compare health events pre-post roll-out, and as a function of timing of roll-out, by parties completely independent of industry (and who contract for a long time to remain so). Health effects that should be monitored (and are reported to arise for some with existing communications radiation exposure) include rise in blood pressure or new hypertension, rise in blood sugar or new diabetes, rise in other "metabolic syndrome" factors and precursors, tinnitus, hearing loss, heart failure, cataracts, seizures, heart attack, heart failure, heart arrhythmia, dementia, stroke, certain types of cancer (melanoma, ocular melanoma, leukemia and other hematological malignancies, glioma/ glioblastoma, Schwannoma, and breast cancer), and adverse birth outcomes.
4. **Housing and Transportation Corridors:** Provide unexposed areas, including both regions for housing and transportation corridors, repurposing other government land if necessary, to domicile those who develop health effects, providing ample and adequate capacity with both interim and permanent housing. Ensure that affected people and their advocates are an integral part of the planning process. Ensure access to facilities is rapid: Russian follow-up studies of those with Microwave Illness show that for those who are at least moderately affected, **return to the setting in which they will be reexposed leads to a course that is progressive**[18].
5. **Insurance:** Require that adequate and ample insurance is carried by any entity that places a small cell (or any other cell) tower, to cover any and all forms of harm that may occur. Note that bills introduced to indemnify industry and government from harm represent tacit recognition that harm will be imposed – apparently seeking to first compel exposure to something with predictable potential for harm, precluding any ability to remain unexposed, then to disallow compensation when predictable harms occur. This is indefensible.
6. **Begin to aggressively incentivize wired over wireless technology**: The only route out of a path driven by massive financial interests may be an alternate path made preferentially remunerative. Wired technology is vastly more energy efficient (for those concerned about climate change – or simply sustainability), vastly more cybersecure, safer from a health standpoint, and more resilient to natural calamity. As stated in a Foreword by Frank Clegg (Past President, Microsoft Canada) to the report *Re-Inventing Wires: The Future of Landlines and Networks:* "This paper sets the record straight … offering consumers, business leaders and policy makers the critical facts they need to rethink a more intelligent and secure future with reliable, secure, wired communications more resilient to storm, flood and fire, and reducing the enormous carbon foot print from the present wireless approach. It also demonstrates why the mistaken upcoming 5G frenzy, with its millions of small cell antennas, destined to clutter all neighborhoods and public right-of-ways, is dangerous, wasteful and unnecessary"[19]

Sincerely,

Beatrice A. Golomb, MD, PhD

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** As just one citation exemplifying this. August scientists in India concerned about 5G are reported to include:

1. **Prof V S Ramamurthy, former Secretary of the Department of Science and Technology (DST)**
2. **Dr T Ramasami, also a former Secretary of DST and a former Director-General of the Council of Scientific and Industrial Research (CSIR)**
3. **Prof Girish Kumar, Department of Electronics, Indian Institute of Technology (IIT)-Bombay, who has written a book on EMF radiation hazards**
4. **Dr L V Krishnan, former Director of Safety Research and Health Physics Programmes at the Indira Gandhi Centre for Atomic Research, Kalpakkam**
5. **Dr P C Kesavan, a noted radiobiologist and a former Dean, School of Life Sciences, Jawaharlal Nehru University (JNU), Delhi**
6. **Dr R S Sharma of Indian Council for Medical Research, Delhi, who has studied RF radiation effects on rats**
7. **Dr Mahadevan Srinivasan, a former atomic scientist at Baba Atomic Research Centre (BARC)**

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August 22, 2017

To whom it may concern,

I urge in the strongest terms that you vigorously oppose California SB 649.

If this bill passes, many people will suffer greatly, and needlessly, as a direct result.

This sounds like hyperbole. It is not.
My research group at UC San Diego alone has received hundreds of communications from people who have developed serious health problems from electromagnetic radiation, following introduction of new technologies. Others with whom I am in communication, have independently received hundreds of similar reports. Most likely these are a tip of an iceberg of tens or perhaps hundreds of thousands of affected person (-- or millions, if estimates are correct, that several percent of persons are affected). As each new technology leading to further exposure to electromagnetic radiation is introduced – and particularly introduced in a fashion that prevents vulnerable individuals from avoiding it – a new group become sensitized to health effects. This is particularly true for pulsed signals in the radiowave and microwave portion of the spectrum, the type for which the proposed bill SB 640 will bypass local control.

Mechanisms by which health effects are exerted have been shown to include oxidative stress (the type of injury against which antioxidants protect ,see optional section below), damage to mitochondria (the energy producing parts of cells), damage to cell membranes[1, 21], and via these mechanisms, an impaired "blood brain barrier"[3-5] (the blood brain barrier defends the brain against introduction of foreign substances and toxins; additionally, disruption can lead to brain edema[6]), constriction of blood vessels and impaired blood flow to the brain[7], and triggering of autoimmune reactions[8, 9]. Following a large exposure, that depresses antioxidant defenses, magnifying vulnerability to future exposures, some persons no longer tolerate many other forms and intensities of electromagnetic radiation that previously caused them no problem, and that currently cause others no problem. But this group deserves – nay needs -- the right to be able to avoid these exposures.

Affected individuals not only experience "symptoms" that "merely" cause them distress and suffering, when they are exposed – symptoms like headaches[10, 11], ringing ears[10, 11] and chest pain[10] from impaired blood flow, heart rhythm abnormalities[10, 11], and inability to sleep[10, 11]. These symptoms arise from physiological injury. Moreover, **many experience significant health problems that can include seizures[11], heart failure, hearing loss[12-14] and severe cognitive impairment[11, 15].** The mechanisms involved are those also involved in development and progression of neurodegenerative conditions including Alzheimer's disease[16].

Fully half who were employed when their problems developed lost their job because of the problem, among participants of a survey we conducted. They reported that their condition had cost them up to 2 million dollars to date. Many had lost their homes. A number became homeless, and have swelled the ranks of so-called "EMF refugees"[17-19]. Among those affected, many were previously high functioning individuals – engineers, doctors, lawyers. The best and the brightest are among those whose lives – and ability to contribute to society –will be destroyed. High profile individuals with acknowledged electrohypersensitivity include, for instance, Gro Harlem Brundtland – the former 3-time Prime Minister of Norway and former Director General of the World Health Organization[20]; Matti Niemela, former Nokia Technology chief[21]; as well as the wife of Frank Clegg[22], who formerly headed Microsoft Canada and is current head of Canadians for Safe Technology[23].

Each new roll-out of electromagnetic technology for which exposure is obligatory, swells the ranks of those who develop problems with electromagnetic fields (EMF) - particularly following a significant exposure to pulsed radiowave-microwave radiation, and particularly when people have no ability to avoid it.

Many state that they didn't give credence to the problem (if they had heard of it at all) **until they themselves fell prey to it.**

This is not a psychologically driven condition. Multiple objective physiological changes reflecting mechanisms of injury have been shown in persons with this condition[24, 25].

The role for oxidative stress, that has been shown in innumerable studies (below)**, is affirmed by evidence of a link of this condition to genetic variants in antioxidant defenses**, that are less avid in defending against oxidative stress[307]. People cannot manipulate their genes, to produce such an outcome by suggestibility.

An analysis by a University of Washington researcher showed that most studies funded by industry reported failure to show physiological effects. However, most studies without such industry bias affirmed effects. This is redolent of findings shown in medicine[26], regarding which the former editor in chief of the BMJ (the British Medical Journal), Richard Smith, noted, based on findings of a study, "This {result} suggests that, far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies."[27]. So where articles deny injury from nonionizing radiowave-microwave radiation, there is commonly a stake aligned with financial benefit from such denial.

Those who are affected are in desperate need of *protection* by our elected officials. They need creation of safe spaces and housing, and roadways to allow travel, not removal of any prospect of one; protection of local rights to make decisions - **not removal of any recourse or ability to avoid what injures them**. They are far more strongly in need of protections than a great many protected classes – their problems arose due to actions of others, against which they were given no control – *and can be reversed,* in most cases, if the assault on them is rolled back. Through no fault of their own, and in some cases against their will (e.g. before opt out was permitted with smart meters), they were subjected to an

exposure that has altered their lives as they knew them, and forced them – needlessly - to the margins of society.

Let our focus be on safer, wired and well shielded technology – not more wireless.

This legislation, if passed, and the resulting unrestricted roll-out of this technology, will predictably and directly injure and disable a new group, and add depth of suffering to those already affected.

In other spheres we abridge freedoms to protect the vulnerable few. We require that every schoolchild be vaccinated, supposedly to protect the vulnerable few who may not respond effectively to a vaccine. The need to protect the vulnerable group is deemed to be so great that it justifies the decision to abridge individual rights.

In contrast, this bill seeks to abridge individual freedoms, and local rights, in the service of *harming* a vulnerable group, and creating a new one.
(The common factor appears to be that in both cases, the direction is aligned with a powerful industry that influences political decisions.)
Luckily, no abridgment of individual rights and freedoms is required to protect, here.

If any group can opt out (such as, I understand, firefighters*)[28]; **then *every* group deserves that equal right**. Others should not be second class citizens, subject to fewer protections.

It would go far to helping this cause if anyone complicit in promoting or passing the legislation (and then after that, *their* families) were required to be the first subjected, for a substantial test period, to the *greatest* amount of exposure that anyone *else* (and their families) may be subjected to, when new policies of this type are rolled out. It will still not do them equal damage; because they may not represent the vulnerabilities that others will have; but such a policy might help them to think twice. *That* is a bill I would strongly endorse.

Most who are now affected – were not, until they were. This may become you – or your child or grandchild. Moreover, if you have a child, or a grandchild, his sperm, or her eggs (all of which she will already have (in the form of ovarian follicles) by the time she is a fetus *in utero*), will be affected by the oxidative stress damage created by the electromagnetic radiation, in a fashion that may affect your future generations irreparably.

It was noted above that, among survey completers, fully half of those who were employed at the time they developed electrosensitivity, lost employment *due to* this problem. (This may understate the scope of the tragedy, since this most-affected group may be least likely to be able to respond to an online survey.) **Many who previously had no problem navigating in the world are now restricted from access to basic services** like hospital care, post offices and libraries because of these problems. With each new introduction of technology that exposes many to yet a new nondiscretionary source of electromagnetic radiation, particularly (but not exclusively) that which emits pulsed radiation in the

radiowave-microwave part of the spectrum, a new group of people are affected; and the suffering of those who are already affected increases greatly.

Please, defend the public and our future. Protect the rights of the individual and the locality, against a form of incursion that will lead to serious harm to some – and set a terrible precedent. **Vote no on California SB 649**, and urge that everyone else do the same.

Sincerely,

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine

*Comment on the fire fighter exemption:"The legislature granted an exemption from SB 649 to the firefighters who requested it for health reasons. Throughout California firefighters have long complained of often disabling symptoms from cell towers on their stations. Cities frequently rent out space on fire stations to add to city revenue. …Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn't recall how to start the procedure over again…Prior to the installation of the tower on his station, this medic had not made a single mistake in 20 years. A pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse control in all 6 firefighters tested (https://ecfsapi.fcc.gov/file/7022117660.pdf). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada."[15, 28]
Clearly, others who experience similar problems also deserve protections.

Optional – More on the Science

There is a robust literature showing that electromagnetic radiation, including in nonionizing frequencies, and at *levels*[29, 30] *below* those that are cause thermal effects (heating) – causes physiological effects, injury, and cell death –not only in humans but many animals and plants[3, 7, 31-49]. Unsurprisingly, industry has sought – against the tide of evidence to the contrary - to maintain that radiation must be ionizing or heating to cause injury.

Scores or hundreds of studies show that radiation, including specifically radiowave-microwave spectrum radiation, and including low-level exposure, can impair antioxidant defenses, increase "oxidative stress" (free radical injury) and damage mitochondria, the energy producing parts of cells[1, 2, 34, 50-6930, 70-104105-13646, 137-171]. These effects occur with ionizing and nonionizing radiation, at thermal and subthermal levels. (Indeed, much or most

of the damage by ionizing radiation, and radiation above the thermal limit, occurs by mechanisms also documented to occur without ionization, and below the thermal limit.) These mechanisms cohere with the mechanisms documented to play a role in symptoms and health conditions that are reported in those who are electrosensitive – extending to seizures[172-176], heart failure[177-184] and cognitive decline[5, 32, 57, 108, 185-195].

These mechanisms have known involvement in induction of **brain cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, and neurodegenerative conditions**, conditions that have exploded. In each case these have been linked, or presumptively linked, in some studies to electromagnetic radiation[8, 9, 16, 34, 196-219].

Such radiation also has effects on sperm[33, 100, 220-228]; and the DNA of sperm[229] (consistent with recent news reports of marked recent declines in sperm counts and function)..

Such radiation also has toxic effects in pregnancy[230], to the fetus and subsequent offspring[231-235] including at low levels[236], and is tied to developmental problems in later life, including attention deficit and hyperactivity[31, 235-241]. It is critical to defend pregnant women (and eggs of girls who may at a later time become pregnant) from exposures with such toxicity.

Electromagnetic radiation across much or most of the spectrum (not excluding visible light) has been shown to depress levels of melatonin[40, 72, 242-252]**,** which is best known for its role in sleep (and indeed, impaired sleep is the most consistent symptom in affected individuals[10, 11]).

Melatonin is in fact a critical antioxidant that defends the body against harm from *many* toxic exposures[253-266] **including electromagnetic radiation itself** [61, 66, 67, 82, 101, 107, 118, 121, 138, 144, 151, 204, 249, 267-284]**- reducing the oxidative stress** that is implicated in cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, bipolar disorder and neurodegenerative conditions, and that also plays a role in heart attack and stroke[9, 285-329330-343].

Radiation, and specifically radiation in the radiowave-microwave portion of the spectrum can also depress levels of other critical antioxidant systems that also defend the body against chemical, radiation, and other sources of injury. These other antioxidant systems include the glutathione system, superoxide dismutase and catalase[81, 102, 115, 116, 233, 344-358] - which are also involved in defending against health problems.

This suggests that depression of antioxidant defenses due to electromagnetic radiation may magnify risk of chemically induced health effects (and depression of antioxidant systems due to some chemicals may amplify risk of harm from electromagnetic radiation). Indeed just such effects have been reported[359, 360].

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Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation

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Importance: A mystery illness striking U.S. and Canadian diplomats to Cuba (and now China) "has confounded the FBI, the State Department and US intelligence agencies" (Lederman, Weissenstein, & Lee, 2017). Sonic explanations for the so-called health attacks have long dominated media reports, propelled by peculiar sounds heard and auditory symptoms experienced. Sonic mediation was justly rejected by experts. We assessed whether pulsed radiofrequency/microwave radiation (RF/MW) exposure can accommodate reported facts in diplomats, including unusual ones.

Observations: (1) Noises: Many diplomats heard chirping, ringing or grinding noises at night during episodes reportedly triggering health problems. Some reported that noises were localized with laser-like precision or said the sounds seemed to follow them (within the territory in which they were perceived). Pulsed RF/MW engenders just these apparent "sounds" via the Frey effect. Perceived "sounds" differ by head dimensions and pulse characteristics and can be perceived as located behind in or above the head. Ability to hear the "sounds" depends on high-frequency hearing and low ambient noise. (2) Signs/symptoms: Hearing loss and tinnitus are prominent in affected diplomats and in RF/MW-affected individuals. Each of the protean symptoms that diplomats report also affect persons reporting symptoms from RF/MW: sleep problems, headaches, and cognitive problems dominate in both groups. Sensations of pressure or vibration figure in each. Both encompass vision, balance, and speech problems and nosebleeds. Brain injury and brain swelling are reported in both. (3) Mechanisms: Oxidative stress provides a documented mechanism of RF/MW injury compatible with reported signs and symptoms; sequelae of endothelial dysfunction (yielding blood flow compromise), membrane damage, blood-brain barrier disruption, mitochondrial injury, apoptosis, and autoimmune triggering afford downstream mechanisms, of varying persistence, that merit investigation. (4) Of note, microwaving of the U.S. embassy in Moscow is historically documented.

Conclusions and relevance: Reported facts appear consistent with pulsed RF/MW as the source of injury in affected diplomats.

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Nondiplomats citing symptoms from RF/MW, often with an inciting pulsed-RF/MW exposure, report compatible health conditions. Under the RF/MW hypothesis, lessons learned for diplomats and for RF/MW-affected civilians may each aid the other.

1 Introduction

More than two dozen American diplomats in Cuba (Lederman, 2018; Perlez & Myers, 2018) and their families (Lederman & Lee, 2017), plus a smattering of Canadian diplomats in Cuba (Cochrane, 2017; Lederman, Weissenstein, Lee, & Associated Press, 2017) and their families (Panetta, 2017), reportedly developed a "mystery" illness (Associated Press in Washington, 2017; Cochrane, 2017; "Cuba's sonic attacks," 2017; Associated Press, 2017a) that "has confounded the FBI, the state department and US intelligence agencies" (Associated Press in Washington, 2017), "baffling US officials" (Lederman, Weissenstein, & Lee, 2017): "'It's just mystery after mystery after mystery"' (Lederman, Weissenstein, & Lee, 2017). Problems began in 2016, began to be widely reported in 2017, and as of January 2018, "'We are not much further ahead than we were in finding out why this occurred,' Undersecretary of State Steve Goldstein said" (Lederman, 2018). Similar problems first were recognized in China in April 2018, and "a number of diplomats at the US consulate in Guangzhou, China, had been sent home with similar symptoms" (Buckley & Harris, 2018; Harris, 2018a; Perlez & Myers, 2018; Stone, 2018)—by June's end, "at least eight" from the consulate in Guangzhou, and "at least 11" from China more broadly (Myers, 2018).

Media reports have long characterized these so-called health attacks (Associated Press, 2017a, 2017b; Robles & Semple, 2017a, 2017b) as "sonic attacks" (Associated Press in Washington, 2017; Board, 2017; "Cuba's sonic attacks," 2017; Gearan, 2017; Lederman, 2017a; Lederman, Weissenstein, & Lee, 2017; Perlez & Myers, 2018; Associated Press, 2017c).

This characterization persisted despite rejection of sonic explanations by experts (Associated Press in Washington, 2017; Lederman, Weissenstein, & Lee, 2017; Associated Press, 2017c; Zimmer, 2017a, 2017b), for example, "No single, sonic gadget seems to explain such an odd, inconsistent array of physical responses" (Lederman, Weissenstein, & Lee, 2017). According to psychoacoustics expert Joseph Pompei, "'Brain damage and concussions, it's not possible.' . . . 'Somebody would have to submerge their head in powerful ultrasound transducers"' (Lederman, Weissenstein, & Lee, 2017). Some suggested a viral hypothesis (Lederman, 2018), but this fails to explain many features of these cases, including the strange noises associated with inciting events in some, and there is not a known viral illness with a compatible profile of symptoms. Though "officials told senators the US government knew of no weapon, sonic or otherwise, that could produce

the effects seen in the Cuba patients" (Lederman, 2018), to this date, some media sources continue to reference sonic attacks (Perlez & Myers, 2018).

A different explanation is proposed that, it is suggested, better accommodates the facts, including the "odd, inconsistent array of physical responses" (Lederman, Weissenstein, & Lee, 2017) and other "mysterious" and protean features reported. Reported features are assessed for compatibility to known effects of radiofrequency/microwave radiation (RF/MW), particularly pulsed RF/MW. Symptoms and signs are assessed against symptoms and signs reported by people who report health effects from RF/MW exposure, a condition that has been termed "radiofrequency sickness" (Johnson Liakouris, 1998), "microwave syndrome" (Navarro, Segura, Portoles, & Gomez-Perretta, 2003), or to encompass people experiencing problems from exposures beyond a specific part of the electromagnetic spectrum, "electromagnetic hypersensitivity" (Genuis & Lipp, 2012; Hagstrom, Auranen, & Ekman, 2013; Hardell et al., 2008; Leitgeb, 1998; McCarty et al., 2011), "electrosensitivity" (Woolston, 2010; www.es-uk.info; www.esnztrust Electrosensitivity New Zealand) or "electrohypersensitivity" (Belpomme, Campagnac, & Irigaray, 2015; Carpenter, 2014; Heuser & Heuser, 2017; Johansson, 2006, 2015; Redmayne & Johansson, 2014).

2 Methods

Features of diplomats' "health attacks"—origins, symptoms, and findings—are delineated and examined in relation to evidence regarding symptoms from RF/MW.

Features to be examined for compatibility with an RF/MW-explanation include the following. Strange noises were heard by some diplomats during apparent inciting episodes (Lederman, Weissenstein, Lee et al., 2017; Stone, 2018). The noises that were heard differed markedly for different diplomats (Lederman, Weissenstein, Lee et al., 2017). Descriptions included high-pitched chirping similar to crickets or cicadas, ringing and grinding (Lederman, Weissenstein, & Lee, 2017). The noises were heard primarily at night (Lederman, Weissenstein, & Lee, 2017). Other diplomats heard no noises (Lederman, Weissenstein, Lee et al., 2017) and were not aware of any inciting episodes—just onset of symptoms. In some cases, noises were confined to "parts of rooms with laser-like specificity" (Lederman, Weissenstein, & Lee, 2017). "Others in the immediate vicinity heard nothing" (Golden & Rotella, 2018). Within the area in which a sound was perceived, it seemed to follow the person around the room (Stone, 2018).

Auditory symptoms are a prominently reported and distinctive feature (though not present in all) and include hearing loss (Associated Press, 2017b; Associated Press in Washington, 2017; Lederman, Weissenstein, & Lee, 2017; Panetta, 2017; Robles & Semple, 2017a; Wilkinson, 2017) and tinnitus (Associated Press in Washington, 2017; Harris, 2018b; Lederman,

Weissenstein, Lee et al., 2017; Panetta, 2017), and, particularly during inciting episodes in some, ear pain (Harris, 2018b; Lederman, 2018).

Other symptoms are protean and vary markedly from individual to individual—"an odd, inconsistent array of physical symptoms"—Lederman, Weissenstein, & Lee, 2017). Sleep symptoms (Associated Press, 2017a; Panetta, 2017; Swanson et al., 2018), headaches (Associated Press in Washington, 2017; Harris, 2018b; Panetta, 2017; Swanson et al., 2018), cognitive dysfunction (Harris, 2018b; Lederman, Weissenstein, & Lee, 2017; Panetta, 2017; Swanson et al., 2018), fatigue (Harris, 2018b; Panetta, 2017), and dizziness (Associated Press in Washington, 2017; Harris, 2018b; Panetta, 2017; Swanson et al., 2018) are prominent among the "nonspecific" symptoms. In some, problems were temporary and apparently recovered with time away from the exposure (Associated Press in Washington, 2017); others experienced persistent problems (Lederman & Lee, 2017; Lederman, Weissenstein, Lee et al., 2017).

Potentially objectively measurable problems with speech (Associated Press in Washington, 2017; Lederman, Weissenstein, & Lee, 2017), balance (Associated Press, 2017a; Associated Press in Washington, 2017; Lederman, Weissenstein, & Lee, 2017; Swanson et al., 2018), and vision (Associated Press, 2017a; Swanson et al., 2018), as well as epistaxis (nosebleed) (Associated Press in Washington, 2017), are a feature in some. Peculiar sensory symptoms of pressure and vibration are reported (Swanson et al., 2018). Brain injury (Associated Press in Washington, 2017; Harris, 2017a; Lederman & Lee, 2017; Lederman, Weissenstein, Lee et al., 2017), white matter abnormalities (Weissenstein, 2018), and brain swelling (Associated Press in Washington, 2017; Lederman, Weissenstein, Lee et al., 2017) have been reported.

To assess compatibility of symptoms in diplomats with those experiencing symptoms from RF/MW, we focus on those who are symptomatic in each group. "Only a minority of embassy staff were stricken" (Stone, 2018), and it is these who have been reported on and studied. The minority who are symptomatic from RF/MW exposures are the appropriate comparator.

Peer-reviewed publications are the primary source of information. However, the most authoritative source for information about symptoms and experiences of individuals is affected individuals themselves, peer review confers no benefit and has no power to adjudicate individuals' reports. For this reason, the peer-reviewed literature to address issues of science is complemented by sources that have elicited and reported on symptoms and experiences of diplomats, or of RF/MW affected individuals, extending to encompass news reports, surveys, statements of affected individuals, or, when applicable, other "gray literature." For diplomats, news and other media reports are complemented by a *JAMA* report focused on neurological symptoms in diplomats (Swanson et al., 2018). Information that references "news" rather than science also cites media sources.

Mechanisms by which RF/MW may cause reported problems are cursorily addressed. Sources of RF/MW reported to affect the comparator group, and potential RF/MW sources of diplomats' symptoms, are briefly reviewed.

3 Results

Table 1 reviews characteristics of noises reported by diplomats in inciting episodes and compatibility with RF/MW. Pulsed RF/MW in the 2.4 to 10,000 MHz range produces perceived noises that resemble sounds "such as a click, buzz, hiss, knock, or chirp," just as diplomats report (Elder & Chou, 2003). Ability to hear RF/MW "sounds" is reported to depend on high frequency hearing, and on low ambient noise (Elder & Chou, 2003) through a phenomenon termed the *Frey effect*. (Synonyms include *microwave auditory effect*, *RF hearing*, and variations of these.) This fits reports that noises were not universally perceived. The requirement for low ambient noise accounts for perception of "sounds" primarily at night (Lederman, Weissenstein, & Lee, 2017). The primary pitch perceived reportedly relates to head dimensions (Elder & Chou, 2003)—in addition to pulse waveform and other characteristics (Lin, 1980)—accounting for different "sounds" perceived by different diplomats. Sounds were localized with "laserlike" specificity in some cases, supposedly defying known physics (Lederman, Weissenstein, & Lee, 2017). This may defy the physics of sound but not the physics of RF/MW: lasers *are* electromagnetic radiation (EMR). One diplomat reported that the sound seemed to follow him within the space in which it was heard (Stone, 2018). Frey sounds also follow the person, often perceived as slightly behind the head, regardless of the body orientation relative to the source of radiation (Bolen, 1988; Elder & Chou, 2003; Frey, 1961). Covering ears did not lessen noise, consistent with RF/MR "sounds" (Tucker, 2018). Frey induction is not governed by average radiation intensity but the energy in a single pulse (Elder & Chou, 2003). (Analogously, if a jackhammer hit each 2 minutes, the low time-averaged pressure would not explain the damage.)

Table 2 reviews diplomats' symptoms and signs, and compatibility of these with RF/MW. Auditory symptoms, including tinnitus, hearing loss, and ear pain or pressure, are prominent in diplomats (Swanson et al., 2018) and in persons affected by RF/MW (Conrad & Friedman, 2013; Halteman, 2011; Kato & Johansson, 2012; Lamech, 2014). Symptoms are protean in both groups. Prevalent among nonauditory nonspecific symptoms are sleep problems, headaches, cognitive problems, and, to a lesser degree dizziness and nausea (Associated Press in Washington, 2017; Conrad & Friedman, 2013; Halteman, 2011; Harris, 2018c; Kato & Johansson, 2012; Lamech, 2014; Lederman, Weissenstein, & Lee, 2017; Swanson et al., 2018). Additional more specific symptoms that are in principle objectively measurable include problems with balance, speech, vision, and epistaxis (nosebleed) (Associated Press in Washington, 2017; Conrad & Friedman, 2013; Halteman, 2011;

Table 1: Features of Noises Reported by Diplomats during Apparent Inciting Episodes.

Diplomats' Reports	Compatibility with RF/MW
Strange noises were heard by many "of the 24 'medically confirmed"' affected U.S. diplomats (Lederman, 2018), during what were perceived as inciting episodes (Lederman, Weissenstein, & Lee, 2017).	Sound ordinarily results from air-pressure waves (which are longitudinal waves—variation occurs along the direction of travel of the wave), whereas radiation arises from electromagnetic waves (which are transverse waves—variation occurs perpendicular to the direction of travel of the wave). In each case, a frequency is defined by the number of cycles of the wave (that pass, say, a given point) per second, for the respective wave type. Though electromagnetic signals are not themselves sound, RF/MW can lead to perceived noises through the so-called Frey effect (Elder & Chou, 2003) (also called the microwave auditory effect or RF hearing). A 1976 Defense Intelligence Agency report stated, "Sounds and possibly even words which appear to be originating intracranially can be induced by signal modulation at very low average-power densities" (Adams & Williams, 1976). A 1988 Air Force Materiel Command report stated, based on knowledge at the time, that "individuals exposed to pulsed RF/MW radiation have reported hearing a chirping, clicking or buzzing sound emanating from inside or behind the head. The auditory response has been observed only for pulsed modulated radiation emitted as a square-wave pulse train. The pulse width and pulse repetition rate are factors that appear to determine the type of sound perceived. . . . James Lin . . . reports that the sensation of hearing in humans occurs when the head is irradiated at an average incident power density level of about 0.1 mW/cm^2 and a peak intensity near 300 mW/cm^2. Auditory responses have been observed for a frequency range of 200–3000 MIHz and for pulse widths from 1-100 us" (Bolen, 1988). The frequency range within which sounds can be heard was broadened by 2003: it was reported that sounds can be perceived by persons exposed to RF/MW in the 2.4 to 10,000MHz range (Elder & Chou, 2003). It was noted that the same frequency did not produce the same sound from person to person.
Not all diplomats heard noises (Lederman, Weissenstein, & Lee, 2017).	Ability to hear RF/MW-induced "sounds" (using the term to refer to the perception, not the stimulus) at all depends on individuals' high-frequency hearing (Elder & Chou, 2003), as well as on low ambient noise (Elder & Chou, 2003).

Table 1: Continued.

Diplomats' Reports	Compatibility with RF/MW
Among those who heard noises, the noises reported differed markedly for different diplomats (Lederman, Weissenstein, Lee et al., 2017).	In RF hearing/microwave hearing, the "sound" perceived reportedly relates not to the radiation frequency (cycles/sec) but to head dimensions and pulse characteristics (Elder & Chou, 2003; Lin, 1980). This comports with reports that different sounds were heard by different diplomats, even if they were exposed to the same frequency (or, conceivably, frequencies) of radiation. Of note, whether sound is perceived from RF/MW is not governed by the average radiation level but the energy in a single pulse. Injury to cells (in part through membrane damage) is also materially greater with pulsed radiation (Bonnafous, Vernhes, Teissie, & Gabriel, 1999; Shil, Sanghvi, Vidyasagar, & Mishra, 2005). (Analogously, if a jackhammer hit very hard but very briefly at 2 minute intervals, the low time-averaged pressure would not explain the effects produced.) The relatively high proportion of affected diplomats reporting Frey-type noises suggests the possibility of comparatively high intensity of pulses and frequencies within the designated 2.4 to 10,000 MHz range.
These noises included a high-pitched "chirping," ringing and "grinding" (Lederman, Weissenstein, & Lee, 2017; Associated Press, 2017c).	Frey "sounds" are "similar to other common sounds" "such as a click, buzz, hiss, knock, or chirp," consistent with sounds that diplomats reported (Elder & Chou, 2003). In a 2007 Dutch survey completed by 250 persons with electrosensitivity (ES), queries related to noise included buzzing (reported by 96), hissing (reported by 80), strong low-frequency sounds (reported by 56), and "sound of bells clanging" (reported by 28) (Schooneveld & Kuiper, 2007). The term *chirping* (if there is a Dutch equivalent) was not included among inquiries. Of note, the "strong low frequency sounds" are potentially consistent with the "blaring, grinding noise" reported by a diplomat ("blaring" indicative of "strong," and "grinding" consistent with low frequency), while the "sound of bells clanging" is consistent with reports of diplomats who awoke to hear ringing "and fumbled for their alarm clocks, only to discover the ringing [clanging] stopped when they moved away from their beds" (Lederman, Weissenstein, Lee et al., 2017).

Table 1: Continued.

Diplomats' Reports	Compatibility with RF/MW
	In the Maine Smart Meter survey report (Conrad & Friedman, 2013), comments by affected persons were included. Exemplars involving Frey noises included these: "The noise I have in my head since smart meters is almost unbearable, sleep is at times impossible because it is so loud" (Conrad & Friedman, 2013) and "I became electrically sensitive almost immediately upon smart meter installation. My ears buzz, hum, and click constantly, pressure in the head and ears, . . . agitation and irritability all since the PLC smart meter was placed on my home. . . . I was able to vacation where there was no smart meter installed and it felt as if a vice had been loosened from around my head" (Conrad & Friedman, 2013). A post regarding a woman who removed her smart meter after becoming symptomatic repeated several times that the exposure caused her to hear "grinding" ("Smart meters or no power at all?" 2012), confirming this descriptor as among perceived RF/MW-hearing induced noises. Among those with ES who communicated with the UCSD ES Survey group, one stated that in proximity to "electrosmog producing devices, 'I hear sounds like beehives and similar [buzzing].'" Another stated, "The hissing in my ears is unbearable sometimes." One wrote "annoying noise" was among other symptoms.
Sound doesn't lessen when cover ears (Tucker, 2018).	RF/MW noises do not lessen with ear occlusion, and may intensify (Frey, 1961). [After] "72 Itron AMI smart meters [were installed] near me in my townhome complex. . . I hear a constant buzzing that is driving me crazy. It keeps me awake and makes it hard to think. I am not sure if it is an actual sound, or if it is being generated inside my head, because when I put my fingers in my ears I still hear it. . . . In addition, at about every 15 or 20 minutes, a more intense whine is added that lasts about 12–15 seconds, that hurts and gives me a mild headache which stops when the whine stops. . . When I go out into the state and regional parks around me where there are NO smart meters for miles, I no longer hear the buzzing and my heart doesn't race."
The noises were heard primarily at night (Lederman, Weissenstein, & Lee, 2017).	Ability to hear RF/MW-induced sounds at all depends on low ambient noise (Elder & Chou, 2003). Night is generally a time of low ambient noise.

Table 1: Continued.

Diplomats' Reports	Compatibility with RF/MW
A sound that has been recorded in Cuba and reported to be "similar" to some sounds heard is consistent with chirping of crickets or cicadas (Lederman & Weissenstein, 2017). Frey effect sounds should not be able to be recorded.	Recorded sounds, if *similar* to what was "heard" by some, need not *be* what was "heard." (Just as Frey sounds are "similar to other common sounds," so those other common sounds can resemble the Frey sound.) The recorded sound does not cause symptoms in listeners. The sound does not fit reports by other diplomats of either the character of the sound or of strict sound localization (such as reports that when one moved from the bed, sound disappeared). Some diplomats had cited perceived sounds similar to crickets or cicadas, the recorded noises were reportedly very similar to the chirping of crickets or cicadas that are abundant along the northern coast of Cuba (Weissenstein & Rodriguez, 2017). Since Frey effects can sound like crickets chirping, presumably recordings of crickets chirping could resemble those Frey effect sounds. Dr. Allen Sanborn, an expert in Latin American cicadas, listened to a dozen recordings made by Havana diplomats, and stated, "They sounded to me like cicadas" (Golden & Rotella, 2018). Those deploying causative devices could, of course, capitalize on misguided sonic hypotheses to lead the United States astray by adding a recorded sound resembling Frey sounds; however, there seems little need to postulate this.
There was apparent laser-like localization of sounds in some cases.	For diplomats, "at least some of the incidents were confined to specific rooms or even parts of rooms with laser-like specificity, baffling U.S. officials who say the facts and the physics don't add up" (Lederman, Weissenstein, & Lee, 2017). One incident was described in media as follows: "The blaring, grinding noise jolted the U.S. diplomat from his bed in a Havana hotel. He moved just a few feet, and there was silence. He climbed back into bed. Inexplicably, the agonizing sound hit him again. It was as if he'd walked through some invisible wall cutting straight through his room. Soon came the hearing loss and speech problems" (Lederman, Weissenstein, & Lee, 2017). Even for sounds described as loud, others close by heard nothing (Golden & Rotella, 2018). In claims that "the facts and the physics don't add up" (Lederman, Weissenstein, Lee et al., 2017), it was the physics of *sonic* devices that was inconsistent. The physics of EMR is, to the contrary, compatible: lasers are themselves focused EMR. Tautologically, EMR can be focused in "laser-like" fashion.
Within the room or parts of the room where sounds were heard, the sound follows the listener (Stone, 2018).	A diplomat reported that "a really odd loud noise seemed to follow him in the room" (Stone, 2018). Frey "sounds" are also reported to "follow" the listener, often perceived as slighty behind the head, regardless of the body orientation relative to the source of radiation (Bolen, 1988; Elder & Chou, 2003; Frey, 1961). In other cases, "sounds" are perceived inside or above the head (Cain & Rissmann, 1978; Elder & Chou, 2003; Ingalls, 1967).

Note: Though "sound" refers to air pressure waves, we will refer to what diplomats "heard" as (perceived) sound.

Table 2: Symptoms and Signs.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
Distinctively prominent auditory symptoms	Auditory symptoms are prominent in reports of diplomats' experience, including ear pain or pressure (Swanson et al., 2018), sometimes within minutes of the perceived attack (Lederman, 2018); tinnitus (Associated Press in Washington, 2017; Harris, 2018b; Lederman, Weissenstein, & Lee, 2017; Lederman, Weissenstein, Lee et al., 2017; Panetta, 2017) and hearing loss (Associated Press, 2017a, 2017b; Associated Press in Washington, 2017; Lederman, Weissenstein, & Lee, 2017; Robles & Semple, 2017a; Swanson et al., 2018; Wilkinson, 2017). This, coupled with the strange noises in diplomats' reports, likely launched the sonic theory. These idiosyncratic features are key to winnowing potential causes. Symptoms like headache and fatigue arise with many exposures and in many conditions. New onset of tinnitus and hearing loss is far more distinctive. It is particularly so in the context of the spectrum of other reported symptoms and effects, and in the context of characteristics of instigating episodes. These distinctive auditory problems are similarly prominent in people reporting symptoms from RF/MW (Halteman, 2011; Lamech, 2014) Tinnitus and hearing loss were cited by 80% and 34%, respectively, in the UCSD survey of 202 individuals with current symptoms from EMR, with pulsed RF/MW causing symptoms in the vast majority (Golomb, 2015a). "Initial" symptoms were reported to include tinnitus in 50%, ear pain in 30%, and hearing loss in 11%. Case descriptions shared by affected individuals underscore auditory effects. From the UCSD survey: "I bought a Kindle W-Fi. I charged it not realizing the default setting was 'on.' After 5–10 minutes exposure, I became nauseated, had a headache, loud tinnitus . . . and was dizzy. I turned the Wi-Fi off and the symptoms completely resolved in 5–10 minutes" (Golomb, 2015a). A description by former educator Brinchman (2011) characterizes her abrupt development of headaches and hearing loss following introduction of pulsed RF/MW-emitting smart meters to her (and her neighbors') homes. Similarly, physicians and physician groups that assessed patients with health effects from RF/MW and recognized the connection also highlight effects on hearing. A psychotherapist in Germany with a long-time practice described a new group of patients with a physiological illness profile encompassing organic brain disease, with constellation of symptoms compatible with other reports of RF/MW injury. She was the one to discern the tie between patients' symptoms and their proximity to RF/MW sources (a connection that her patients had often missed obviating nocebo effects as a source; see Table 4), and to note recovery with removal from those sources (Aschermann, 2009). She describes "sudden hearing loss" as among the symptoms (in addition to sleep problems described as an "almost ubiquitous" headache as extremely frequent, also noting, for example, fatigue, cognitive problems, and tinnitus).

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	A group of 114 physicians, referencing their analysis of medical complaints of 356 people in Oberfranken, signed an open Letter to the Prime Minister of Germany in 2004 (referred to as the Bamberg Appeal), stating, "The pulsed high frequency electro magnetic fields (from mobile phone base stations, from cable-less DECT telephones, amongst others), led to a new, previously unknown pattern of illnesses with a characteristic symptom complex" (Waldman-Selsam, 2004). Prominent and repeated mention is made of hearing loss: "People suffer from one, several or many of the following symptoms: Sleep disturbances, tiredness, disturbance in concentration, forgetfulness, problem with finding words, depressive mood, ear noises, sudden loss of hearing, hearing loss, giddiness, nose bleeds, visual disturbances, frequent infections, sinusitis, joint and limb pains, nerve and soft tissue pains, feeling of numbness, heart rhythm disturbances, increased blood pressure episodes, hormonal disturbances, night-time sweats, nausea. . . . It is no way only a subjective sensitivity disturbance. Disturbances of rhythm, hearing problems, sudden deafness, hearing loss, loss of vision, increased blood pressure, hormonal disturbances, concentration impairments, and others can be proved using scientific objective measures" (Waldman-Selsam, 2004). Note also the mention of "ear noises" (the Frey effect). Some studies that experimentally examine effects of RF/MW on hearing show effects, though not all do (See Table 4 for discussion of "inconsistent" effects.) A material consideration is that evidence is consistent with a vulnerable subgroup. One experimental study in humans found that 60 minutes of close exposure to EMR from a mobile phone "had an immediate effect on HTL [hearing threshold limits] assessed by pure-tone audiogram and inner ear (assessed by DPOAE) in young human subjects. It also caused a number of other otologic symptoms" (Alsanosi et al., 2013). Of note, melatonin, which can be depressed by EMR (see Table 4) and is low in those with EHS (Belpomme et al., 2015), protects against oxidative radiation injury (see Table 4), including to the inner ear (Karaer et al., 2015). Pulsed RF/MW (more than continuous) has been shown to increase tympanic temperature, even when, for instance, colonic temperature is not increased (Frei, Jauchem, & Heinmets, 1988). Since blood flow is critical for cooling and oxidative stress leads to endothelial dysfunction and may compromise blood flow, affected individuals (see below; by hypothesis those with greater oxidative stress effects) may experience greater impairment in blood flow—so less cooling and also impaired delivery (via impaired blood flow) of oxygen, glucose, and other energy substrates as well as antioxidant defenses. The downstream effects of oxidative stress (e.g., apoptosis, inflammation; see below) and impaired cell energy/ mitochondrial dysfunction (cell dysfunction and death) may contribute to auditory pathology.

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	In a study examining the histopathology of cochlear nuclei of rats "exposed continuously for 30 days" to "a GSM-like 2100 MHz EMF" "with a signal level (power) of 5.4 dBm (3.47 mW) to simulate the talk mode on a mobile phone," compared to a control group of rats not similarly exposed, "an increase in neuronal degeneration and apoptosis in the auditory system" was observed in the RF/MW exposed group (Celiker et al., 2016). "The histopathologic analysis showed increased degeneration signs in the study group ($p = 0.007$). In addition, immunohistochemical analysis revealed increased apoptotic index in the study group compared to that in the control group ($p = 0.002$)" (Celiker et al., 2016). In another animal study, "a prominent effect of EMS [electromagnetic stimulation] was . . . severe cochlear damage and permanent sensorimotor hearing loss in experimental animals" (Counter, 1993).
Protean symptoms	Beyond the auditory symptoms, the profile of symptoms in diplomats varies from person to person. Different people report markedly different symptoms (Lederman, Weissenstein, Lee et al., 2017). It was said that "the symptoms and circumstances reported have varied widely, making some hard to tie conclusively to the attacks" (Lederman, 2017b), and "The cases vary deeply: different symptoms, different recollections of what happened. That's what makes the puzzle so difficult to crack" (Lederman, Weissenstein, Lee et al., 2017). Reported symptoms encompass sleep problems (Associated Press, 2017a, 2017b; Panetta, 2017), headaches (Associated Press, 2017a; Lederman, Weissenstein, & Lee, 2017; Panetta, 2017; Robles & Semple, 2017a), cognitive problems (Associated Press, 2017a; Lederman, Weissenstein, & Lee, 2017), nausea (Lederman, Weissenstein, & Lee, 2017), fatigue (Panetta, 2017), and dizziness (Lederman, Weissenstein, & Lee, 2017; Robles & Semple, 2017a). Similar concerns had been raised with RF/MW injury. As Aschermann noted (translated from German), "In the *Deutsche Aerzteblatt* [official journal of the German medical association—Bundesaerztekammer] did an article ask the incredulous question: How could so many different symptoms possibly be attributed to one common underlying mechanism?" (Aschermann, 2009). Despite the protean character of symptoms, multiple survey studies verify that a strikingly reproducible suite of protean symptoms *are* reported in setting after setting, and in people citing development of symptoms in response to EMR including RF/MW (see Table 3). The profile of symptoms is strongly similar from study to study, with sleep/fatigue, headache, and cognitive problems commonly topping the list and auditory and visual symptoms, dizziness, and nausea figuring in it.

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	A similar primary list (sometimes augmented with a few additional symptoms, often including heart rhythm problems) is mentioned in other settings. Aschermann's (2009) analyses of 65 patients cite symptoms of learning concentration and behavioral problems, headaches, insomnia, exhaustion, tinnitus, hearing loss, dizziness, nerve and soft tissue pain, "inner agitation," as well as arrhythmia problems. In the 2004 Bamberg Appeal signed by 114 physicians to the German prime minister, based on analysis of 356 patients: "The pulsed high frequency electro magnetic fields (from mobile phone base stations, from cable-less DECT telephones, amongst others), led to a new, previously unknown pattern of illnesses with a characteristic symptom complex. People suffer from one, several or many of the following symptoms: Sleep disturbances, tiredness, disturbance in concentration, forgetfulness, problem with finding words, depressive mood, ear noises, sudden loss of hearing, hearing loss, giddiness, nose bleeds, visual disturbances, frequent infections, sinusitis, joint and limb pains, nerve and soft tissue pains," also nausea, and "feeling of numbness, heart rhythm disturbances, increased blood pressure episodes, hormonal disturbances, night-time sweats. . . . The symptoms occur in temporal and spatial relationship to exposure. It is no way only a subjective sensitivity disturbance. Disturbances of rhythm, hearing problems, sudden deafness, hearing loss, loss of vision, increased blood pressure, hormonal disturbances, concentration impairments, and others can be proved using scientific objective measures" (Waldman-Selsam, 2004). Among individuals participating in a physiological provocation study examining heart rate variability with RF/MW, among 25 patients, 40% of whom believed themselves to be moderately or severely electrosensitive, "the most common symptoms of exposure to electrosmog, as identified by this group of participants, included poor short-term memory, difficulty concentrating, eye problems, sleep disorder, feeling unwell, headache, dizziness, tinnitus, chronic fatigue" (Havas et al., 2010). Of note, the same symptoms also arise in the vulnerable subgroup of persons who develop health problems following other exposures that share a documented ability to cause mitochondrial impairment and oxidative stress (Chen et al., 2017; Golomb et al., 2014; Golomb, Koslik et al., 2015; Koslik, Hamilton, & Golomb, 2014; Steele, 2000). However, the profile, which symptoms dominate, differs from exposure to exposure, based on factors such as what part(s) of the body the exposure may differentially reach and whether additional mechanisms of injury are involved that potentiate damage to one domain.

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	Sleep and auditory effects are clearly disproportionately represented, in diplomats and with RF/MW exposure, relative to their prevalence following other exposures that cause oxidative stress. The strong effects on sleep may relate to depressions in melatonin that can be produced with EMR/ RF/MW (see Table 4). Auditory effects are addressed above. A 1990 study commissioned in response to a petition by residents who cited adverse health experiences from a shortwave radio transmitter in their small town of Schwarzenburg, funded in part by Swiss Telecom, reported that sleep disruption in association with transmitters related directly to the EMR field strength of the transmitter and affected 55% of those over age 45 (Altpeter et al., 1995; Lamech, 2014). (There the denominator is *not* restricted to those who were symptomatic.) A 1988 Air Force Materiel Command reports that "pulsed RF/MW radiation was reported to have an analeptic effect in animals. Experimental results presented by R. D. McAfee in 1971 showed that anesthetized animals could be awakened by irradiation from a pulsed 10 GHz RF/MW source. . . Experiments conducted on rats showed that these animals were aroused from states of deep sleep by irradiation" (Bolen, 1988). The prominence of auditory effects (see above for more on these symptoms) may relate in part to the absence of a skull structure to protect the inner ear, producing an incident stimulus that is of greater effective intensity. The coherence of symptoms in response to RF/MW, with findings in Cuba (and China) diplomats, adds further support to the case for a common cause within each group – and across the two groups.

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
Symptoms that are (potentially) objectively measurable: *speech* (Associated Press, 2017a; Associated Press in Washington, 2017; Lederman, Weissenstein, & Lee, 2017); *vision* (Associated Press, 2017a). *balance* (Associated Press, 2017a; Lederman, Weissenstein, & Lee, 2017). Nosebleeds in some (Associated Press in Washington, 2017; Golden & Rotella, 2018).	The symptoms reported in media and Swanson et al. (2018) for diplomats, extending to the more specific (e.g., dizziness/balance, vision and speech problems), are also reported in survey studies of those affected by RF/MW (see Table 3). *Speech* problems, mentioned in diplomats, were also among symptoms elicited and reported in a survey study examining effects of RF/MW following "smart meter" introduction in Australia (Lamech, 2014). Reported cases illustrate speech problems arising following RF/MW exposure. In a case referenced in the *LA Times*, a woman reported that if someone fails to turn off their cellphone on entering her home, she gets symptoms within 2 hours: "'After four hours I can't speak anymore'" (Woolston, 2010). In a case described in a 2015 Australian presentation on ES (Weller, 2015), "Within hours, it felt as if someone had tied a thick rubber band around her head. Then came nausea, fatigue, ringing in her left ear–an onslaught of maladies all at once, and she had no idea why. . . . A week or two into the job, whatever was affecting her wasn't abating, and before long her speech became so jumbled that she couldn't form a complete sentence in front of an audience. . . . She went outside to inspect the place and found no fewer than 17 new 'smart' electricity meters strapped to the side of the building." In a case reported to UCSD investigators, new-onset right-sided ear pain and hearing loss attended the inciting episode (seated for 6 hours, unknowingly, directly across the wall from a bank of multiple smart meters for a building, slightly toward her right), along with vise-like headache, concentration problems, and two nights of no sleep (followed by chronic lesser sleep impairment), and, abating over months, continued to be triggered, always exclusively or predominantly on the right side, by previously tolerated RF/MW exposures thereafter. Many months later, left ear predominant ear symptoms developed for the first time. A bank of smart meters was identified to the left of where she had sat, hidden by plants so missed in an initial reconnaissance. That occasion, the only one with left predominant ear and hearing symptoms, was accompanied by speech difficulty, which resolved over about a week. In these two cases, aphasia was associated with left predominant ear symptoms (Broca's area, damage of which leads to expressive aphasia, is left prefrontal). It is an empirical question whether left-predominant auditory involvement will prove more often tied to affected speech. *Balance* is multifactorial, involving vision, muscle strength, and vestibular function, for example. In some media reports of diplomat health, the term *vertigo* is used (Harris, 2018b, 2018c). Balance and vestibular testing were performed in diplomats (Swanson et al., 2018). Clinical examinations and objective measures raised concern for balance problems in 81% (higher than the percent reporting subjective dizziness or balance problems) (Swanson et al., 2018).

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	Vestibular function involves the same (eighth) cranial nerve as hearing. Vertigo, hearing loss, and tinnitus can arise (as adverse effects) as a triumvirate (Porto Arceo, 2003; Sepcic et al., 2010). Dizziness more generally, in contrast to vertigo, is a nonspecific finding that arises with many forms of brain insult, including brain hypoperfusion (low blood flow). Of note, cerebral hypoperfusion has been reported in persons with symptoms following RF/MW (Belpomme et al., 2015). In some surveys of RF/MW-affected individuals, dizziness and balance are queried together (Lamech, 2014); other surveys use only the term *dizziness*. Individual reports of balance and dizziness problems were included among participant narrative reports in the Maine survey—for example: "'Balance problems have worsened since installation of the smart meter, leading to several falls"' (Conrad & Friedman, 2013) and "'I could not understand the dizzineness which was scary. I actually thought I had a brain tumor all of a sudden"' (Conrad & Friedman, 2013). The Cuba diplomat study considered nausea as a vestibular symptom (Swanson et al., 2018). Though it need not necessarily be, it was linked to dizziness in some RF/MW/EMR affected cases: "'Daily nausea and dizziness"' (Conrad & Friedman, 2013). Loss of balance, with dizziness and disorientation, was identified as one of six clusters of symptoms seen in each of two smart meter surveys from different nations, with the clusters represented nearly in the same order: (1) sleep disruption, (2) headache, (3) ringing or buzzing in ears, (4) fatigue, (5) loss of concentration, memory or learning ability, and (6) disorientation, dizziness, or loss of balance) (Powell, 2015). *Vision*: Vision is affected by oxidative stress and mitochondrial impairment (see Table 4, mechanisms) (Argun et al., 2014; Beatty, Koh, Phil, Henson, & Boulton, 2000; Javaheri, Khurana, O'Hearn T, Lai, & Sadun, 2007; King, Gottlieb, Brooks, Murphy, & Dunaief, 2004; Liang, Green, Wang, Alssadi, & Godley, 2004; Totan et al., 2001), not just to the eye but to cortical systems involved in vision (Pachalska et al., 2002). Effects of these mechanisms include optic nerve damage (Javaheri et al., 2007; Qi, Lewin, Sun, Hauswirth, & Guy, 2007; Rucker, Hamilton, Bardenstein, Isada, & Lee, 2006), age-related macular degeneration (Beatty et al., 2000; Feher et al., 2005; Feher, Papale, Mannino, Gualdi, & Balacco Gabrieli, 2003; Liang & Godley, 2003; Modi, Heckman, & Saffer, 1992; Totan et al., 2001; Yu, Wu, & Lin, 1997), retinal thinning (Sandbach et al., 2001), and cataracts (Gul, Rahman, Hasnain, Salim, & Simjee, 2008; Karslioglu et al., 2005; Ottonello, Foroni, Carta, Petrucco, & Maraini, 2000; Tarwadi & Agte, 2004; Taylor, Jacques, & Epstein, 1995). Where brain swelling ensues (see Table 4), this can affect the shape of the lens, affecting vision.

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	Effects of RF/MW on the eye and on vision have long been reported (Birenbaum, Grosof, & Rosenthal, 1969; Bolen, 1988; Cleary, 1980; Cutz, 1989; Daily, Wakim, Herrick, Parkhill, & Benedict, 1952; McCally, Farrell, Bargeron, Kues, & Hochheimer, 1986; Williams & Finch, 1974; Zaret, 1973). Particular attention has gone to effects on the lens, and on cataracts. RF/MW, via oxidative mechanisms, promotes aging of the lens, which can lead to cataracts. Cataracts have been a reported complication, sometimes in young people, among persons working with microwave radiation (Birenbaum et al., 1969; Bolen, 1988; Cleary, 1980; McCally et al., 1986; Zaret, 1973). A Swiss study (Hassig, Jud, & Spiess, 2012) documented increased cataracts in calves born near cell towers: "We examined and monitored a dairy farm in which a large number of calves were born with nuclear cataracts after a mobile phone base station had been erected in the vicinity of the barn. Calves showed a 3.5 times higher risk for heavy cataract if born there compared to Swiss average. All usual causes such as infection or poisoning common in Switzerland could be excluded." Vision problems are reported in RF/MW-affected persons. In a study in Spain, in persons in proximity to two GSM (Global System of Mobile Communications) cell tower base stations, analysis of the closer group, with exposure in the range 0.25–1.29 V/m2, in a model adjusted for age, sex, and distance, showed that vision problems were elevated with an odds ratio of 5.8 (95% CI 1.7–19.8, $p = 0.005$) (Oberfeld, Navarro, Portoles, Maestu, & Gomez-Perretta, 2004). Eleven percent reported problems with eyes or vision in the Australian smart meter study. Since this includes respondents who are unaffected, rates are lower than in purely symptomatic individuals (Lamech, 2014). Twenty-Six percent of survey participants reported eye/vision problems in the Halteman smart meter impacts survey (Halteman, 2011). Vision problems were reported by 17% as "severe and new," by 38% as "moderate and new," and by 12% as "severe and worsened" in the Maine smart meter survey (Conrad & Friedman, 2013). An assessment of neurological problems in U.S. diplomats in Cuba underscores the potential importance of eye movement dysfunction (Swanson et al., 2018), which is also tied to oxidative and mitochondrial mechanisms (Chen, Li, Wu, Qi, & Wu, 1998; Dodson, Patten, Hyman, & Chu, 1976; Goto, Koga, Horai, & Nonaka, 1990; Hyman, Patten, & Dodson, 1977; Kao, 1994; Land, Hockaday, Hughes, & Ross, 1981; Pineda et al., 2004; Schaefer, Blakely, Griffiths, Turnbull, & Taylor, 2005; Smits, Westeneng, van Hal, van Engelen, & Overeem, 2012).

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	Epistaxis (nosebleed): In a study in Selbitz, Bavaria, nosebleed was significantly more frequently reported ($p = 0.01$) in those less than 200 m from a cell phone base station than 200 m to 400 m away (Eger & Jahn, 2010). Nosebleed was a reported symptom in each of several surveys of ES and symptoms associated with RF/MW, including in a study of smart meter symptoms (Conrad & Friedman, 2013; Golomb, 2015a; Halteman, 2011; Lamech, 2014) (see Table 3). The Bamberg appeal (on behalf of 114 physicians referencing assessment of medical complaints of 356 people with symptoms from cell tower base stations and DECT phones in their homes in Oberfranken) noted the more characteristic RF/MW symptoms (above) as well as nosebleed (Waldman-Selsam, 2004). Comments from participants in survey studies include the following (all from Conrad & Friedman, 2013): "Severe headaches, gushing nosebleeds for the first time ever. . . . They all went away when the smart meter was removed"; "After the first day I was getting bloody noses and not understanding"; "Nosebleeds, nausea, dizziness, . . . ringing ears and intermittent strong agitation. . . . When I am away from wireless devices the symptoms subside"; "Had it not been for the severe nose bleeds I'm not sure I would ever have found out what was causing my health problems".
Peculiar sensory symptoms of "vibration" and "pressure" reported (Swanson et al., 2018)	"Associated sensory symptom" of "pressure" or "vibration" were reported in 43% and 14%, respectively, in a neurological evaluation of diplomats (Swanson et al., 2018). The distinctive sensory symptoms of "pressure" and "vibration" are also reported by subsets of those who report symptoms from RF/MW. Neither were commonly elicited as symptoms in surveys. However, some surveys listed head pressure separately from headache, and in some cases, it was more frequent. Eye pressure (Halteman, 2011) and ear pressure (Conrad & Friedman, 2013) have also been reported in surveys of RF/MW/EMR-affected persons. The UCSD ES survey did include "internal pressure," which was reported as a symptom in 71% of participants who cited symptoms from EMR/RF/MW (Golomb, 2015a). Spontaneous reports of vibration symptoms by different EMR/RF/MW affected persons, shared in a different survey study, include the following (all from Conrad & Friedman, 2013): "I experienced internal shaking and vibrating throughout my body" (along with sleep, mood, headache, head pressure, and other problems, after smart meter installation); "I can't think clearly, or find words when speaking; my body feels like it is vibrating"; and "Have uncontrollable jelly-like quivering throughout whole body." In online comments posted in response to articles on related topics, in which persons describe their ES symptoms, statements include "vibration through my body" (F. Wallace, 2017), and "I have a smart meter on my house and I have been experiencing strange vibrations when I watch TV or use the computer" (Wright, 2013). An email to us from an affected patient (9-2017) sharing her symptoms stated that it "feels like my brain is vibrating and spinning at night—and my tinnitus gets much worse."

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
Brain swelling in some diplomats (Associated Press in Washington, 2017; Lederman, 2017a; Lederman, Weissenstein, Lee et al., 2017).	1. RF/MW may alter blood-brain barrier function via oxidative stress. (a) An analysis reported that of 100 peer-reviewed studies examining whether low-intensity RF/MW causes oxidative stress, 93 found that it did (Yakymenko et al., 2015). (b) Oxidative stress disrupts the blood-brain barrier (Al Ahmad, Gassmann, & Ogunshola, 2012; Blasig, Mertsch, & Haseloff, 2002; Enciu, Gherghiceanu, & Popescu, 2013; Haorah et al., 2007; Hurst, Heales, Dobbie, Barker, & Clark, 1998; Katsu et al., 2010; Lochhead et al., 2010; Nittby et al., 2009; Salford, Brun, Sturesson, Eberhardt, & Persson, 1994; Sirav & Seyhan, 2009, 2011; Takemori, Murakami, Kometani, & Ito, 2013; Tang et al., 2015). (c) Consistent with this, blood-brain barrier disruption has been shown in multiple studies with RF/MW (Nittby et al., 2008, 2009; Salford et al., 1994; Sirav & Seyhan, 2009; Soderqvist, Carlberg, Hansson Mild, & Hardell, 2009; Soderqvist, Carlberg, & Hardell, 2009; Tang et al., 2015). Other studies have not shown blood-brain barrier effects (de Gannes et al., 2009; Finnie, Blumbergs, Cai, Manavis, & Kuchel, 2006; Finnie et al., 2002; Franke, Ringelstein, & Stogbauer, 2005; Franke, Streckert et al., 2005; Fritze et al., 1997; McQuade et al., 2009). Studies vary in many respects (e.g., exposure duration, EMR exposure characteristics, model (in vivo versus in vitro, animal, age), delay between exposure and blood-brain barrier assessment, and blood-brain barrier assessment used, for example). The blood-brain barrier is functional, and barrier function need not be affected for all substances equally. (d) Since genetics of oxidative stress management (De Luca et al., 2014) and levels of key antioxidants (Belpomme et al., 2015) relate to both RF/MW injury and oxidative stress, these factors, together with specifics of the RF/MW exposure, may guide blood-brain barrier disruption with RF/MW. (e) A study that examined gene expression in the brains of rats exposed to GSM radiation, radiation that encompasses the multiple frequencies and pulsed waveforms present in GSM exposures, identified altered gene expression of a marker of blood-brain barrier function (Belyaev et al., 2006). 2. Altered blood-brain barrier can lead to brain edema and "malignant brain edema" (Adair, Baldwin, Kornfeld, & Rosenberg, 1999; Witt, Mark, Sandoval, & Davis, 2008). (Oxidative stress-associated blood-brain barrier disruption is, for instance, thought to underlie neuroleptic-induced cerebral edema (Elmorsy, Elzalabany, Elsheikha, & Smith, 2014).)

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	3. Among case experiences, perceived head pressure occurs with brain swelling and is reported by many with ES. As also noted in relation to the sensory symptom of "pressure," some surveys collate head pressure separately from headache (which, in some studies, it surpasses: Conrad & Friedman, 2013; Lamech, 2014; Schooneveld & Kuiper, 2007). One survey included eye pressure (Halteman, 2011), and in one, several participants spontaneously reported ear pressure (Conrad & Friedman, 2013). Communications to the UCSD ES study included the write-in comment, "Brain feels like it's swelling" (Golomb, 2015a). One man with severe ES who communicated with the UCSD study group and shared documentation of his approval for Social Security disability for his ES reported that the severe brain swelling he experienced in response to EMR had led an eyeball to be pushed from the socket.
Findings are reported to be compatible with traumatic brain injury (Harris, 2017a, 2017b, 2018c; Harris & Goldman, 2017a, 2017b; Rogers, 2017).	1. Based on findings in an fMRI study of electrosensitive individuals it was stated that "the differential diagnosis for the abnormalities seen on the fMRI includes head injury" (Heuser & Heuser, 2017). 2. Six of the 10 ES individuals assessed reported prior head injury (Heuser & Heuser, 2017). However, 4 did not, and also showed evidence consistent with brain injury. Moreover, prior head injury is reported to also be present in at least some, but an unstated fraction of, affected diplomats (Stone, 2018). 3. Head injury could predispose to ES. Head injury, like RF/MW, promotes oxidative stress, and blood-brain barrier disturbance; and melatonin (which is low in those with ES), protects from these effects in head injury (Dehghan, Khaksari Hadad, Asadikram, Najafipour, & Shahrokhi, 2013; Ding et al., 2014; Ozdemir et al., 2005; Senol & Naziroglu, 2014), as it protects against injury from radiation (Argun et al., 2014; Bardak, Ozerturk, Ozguner, Durmus, & Delibas, 2000; Bhatia & Manda, 2004; El-Missiry, Fayed, El-Sawy, & El-Sayed, 2007; Goswami & Haldar, 2014a, 2014b; Goswami, Sharma, & Haldar, 2013; Guney et al., 2007; Jang et al., 2013; Karaer et al., 2015; Karslioglu et al., 2005; Kim, Shon, Ryoo, Kim, & Lee, 2001; Koc, Taysi, Buyukokuroglu, & Bakan, 2003a, 2003b; Liu, Ren, Yang, Zhao, & Mei, 2014; Manda, Anzai, Kumari, & Bhatia, 2007; Manda & Reiter, 2010; Manda, Ueno, & Anzai, 2007, 2008; Naziroglu, Tokat, & Demirci, 2012; Oliinyk & Meshchyshen, 2004; Ortiz et al., 2015; Sainz et al., 2008; Sener, Atasoy et al., 2004; Sener, Jahovic, Tosun, Atasoy, & Yegen, 2003; Sharma & Haldar, 2006; Shirazi et al., 2011; Shirazi, Mihandoost, Mohseni, Ghazi-Khansari, & Rabie Mahdavi, 2013; Taysi, Koc, Buyukokuroglu, Altinkaynak, & Sahin, 2003; Taysi et al., 2008; Vasin et al., 2004; Yilmaz & Yilmaz, 2006)—and from RF/MW . . . (Ayata et al., 2004; Aynali et al., 2013; Koylu, Mollaoglu, Ozguner, Naziroglu, & Delibas, 2006; Lai & Singh, 1997; Meena et al., 2014; Naziroglu, Celik et al., 2012; Oksay et al., 2012; Oktem, Ozguner, Mollaoglu, Koyu, & Uz, 2005; Ozguner, Bardak, & Comlekci, 2006; Ozguner, Oktem, Armagan et al., 2005; Sokolovic et al., 2008; Tok, Naziroglu, Dogan, Kahya, & Tok, 2014; S. Xu et al., 2010).

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	4. One RF/MW affected man who communicated with the UCSD study group indicated his ES was precipitated by a serious occupational head injury. (He also had occupational exposure to EMR, but until the head injury, it had not affected him.) 5. The study did not report the presence or absence of features indicative of greater severity of head injury, such as loss of consciousness or symptoms or sequelae. Both because of this and point 5, there is no clarity about whether prior head impacts were in fact greater in number or intensity than in the general population. But it might be expected that past head injury would be a risk factor. 6. Given findings consistent with low melatonin in those with ES (Belpomme et al., 2015), this condition (and/or common cause) may also predispose to more significant damage from a given impact and character of head injury, so there is a so greater likelihood that a given head impact causes problems and is remembered and reported as a head injury. 7. ES symptoms are sometimes experienced as similar to a head injury. For instance, a Rhode Island teacher likened effects experienced with RF/MW to a concussion ("Math teacher raises concerns about WIFI comparing the effects to a concussion," 2014). Just as it is important to avoid even minor head trauma following traumatic concussion until healing has occurred, so avoidance of RF/MW (or more generally EMR) aggravation may prove important following pulsed RF/MW injury. RF/MW injury may be cumulative (Sadchikova & Glotova, 1973), and in addition to the intensity-duration profile, the interval between exposures may be important in the clinical course (Zaret, 1973).
White matter abnormalities reported (Weissenstein, 2018) in some diplomats.	In diplomats: "Medical testing has revealed that some embassy workers had apparent abnormalities in their white matter tracts that let different parts of the brain communicate" (Weissenstein, 2018). 1. White matter changes were observed in some with ES, in the fMRI study of persons affected by RF/MW/EMR (Heuser & Heuser, 2017). 2. Oxidative stress and mitochondrial dysfunction (to which RF/MW can contribute; see Table 4) are associated with white matter injury (Back et al., 2005; Casta, Quackenbush, Houck, & Korson, 1997; Ikeda, Choi, Yee, Murata, & Quilligan, 1999; Miller, Lawrence, Mondal, & Seegal, 2009; Miyamoto et al., 2013; Munoz-Cortes et al., 2013; Rosenzweig & Carmichael, 2013).

Table 2: Continued.

Diplomats' Symptoms and Signs	Compatibility with RF/MW
	Among potential mechanisms, oxidative stress increases vulnerability of proteins (and, e.g., lipids, DNA, RNA) to autoimmune attack, which can include attacks on myelin (Gelderman et al., 2007; Iborra, Palacio, & Martinez, 2005; Iuchi et al., 2010; Kalluri, Cantley, Kerjaschki, & Neilson, 2000; Kumagai, Jikimoto, & Saegusa, 2003; Liu et al., 2003; Maes et al., 2013; Profumo, Buttari, & Rigano, 2011; Shah & Sinha, 2013; Wang, Cai, Ansari, & Khan, 2007). Indeed, antibodies directed to O-myelin were reported in a subset of the 675 persons with ES who were included in a French study (Belpomme et al., 2015), affirming one mechanism by which white matter changes might occur. 3. Following GSM radiation exposure (study cited previously), examination of gene expression in rat brain showed alterations in myelin-related products (myelin-related glycoprotein) (Belyaev et al., 2006).

Lamech, 2014; Lederman, Weissenstein, & Lee, 2017; Swanson et al., 2018). Peculiar sensory symptoms are reported in both, including pressure and vibrations (Conrad & Friedman, 2013; Swanson et al., 2018). Reported brain findings have included brain swelling, problems consistent with traumatic brain injury, and white matter abnormalities. Each such feature is also observed in those with symptoms ascribed to RF/MW.

Table 3 lists symptoms commonly reported in diplomats, together with percentages reporting each symptom, for symptoms assessed in the neurological appraisal of Cuba diplomats or mentioned in news reports (Associated Press in Washington, 2017; Harris, 2018c; Lederman, Weissenstein, & Lee, 2017; Swanson et al., 2018). These symptoms (when elicited) are ranked by prevalence in surveys of persons exposed to specific sources of RF/MW or with symptoms ascribed to EMR exposure (Conrad & Friedman, 2013; Halteman, 2011; Kato & Johansson, 2012; Lamech, 2014). Fractions of symptomatic diplomats who report each symptom (Swanson et al., 2018) appear similar to fractions of those symptomatic with EMR symptoms, who do so. Comparing rates in diplomats (Swanson et al., 2018) to those in a peer-reviewed study of EMR-affected individuals (Kato & Johansson, 2012) on symptoms tallied in both, symptom rates were: headache, 81% versus 81%; cognitive problems, 81% versus 81%; sleep problems, 86% versus 76%; irritability, 67% versus 56%; nervousness/anxiety, 52% versus 56%; dizziness 67% versus 64%; and tinnitus, 57% versus 63% (Kato & Johansson, 2012; Swanson et al., 2018). Thus, rates conform closely.

The rates of symptoms reported for diplomats appear within reported variation for studies of persons affected by RF/MW/EMR. Sleep problems were reported somewhat less frequently in EMR-affected persons in the Kato study (76%), than in diplomats, but reported sleep problems, or their by-product, fatigue (for which prevalence was not recorded in the diplomat study), dominate the number one symptom position in studies of RF/MW affected persons (see Table 3), and prevalence of sleep problems was higher than for diplomats in some other studies of RF/MW-affected persons (Golomb, 2015a). Of note, the Kato study was performed in Japan, where the traditional diet is rich in fish, which supplies the long-chain omega-3 fatty acids that reportedly benefit sleep and reduce irritability (Conklin et al., 2007; Peet & Horrobin, 2002), the two symptoms that were more than 3% lower than in affected diplomats.

The protean character of symptoms in diplomats (Lederman, 2017a), as for RF/MW-affected individuals, has led some to infer that a single cause cannot account for all. But a number of reports, in a number of nations and settings, tie RF/MW exposure (in vulnerable individuals) to each of the problems reported in diplomats. The coherence of findings in those citing affects of RF/MW, with findings in diplomats, supports a common cause within each group and across the two groups. Of note, a protean suite of generally the same symptoms, though in a different distribution, is reported in other conditions that are tied to mitochondrial alteration and oxidative

Table 3: Symptoms in Diplomats: Comparison to Symptom Rankings in Survey Studies That Report Symptoms with EMR or in Those with ES.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Citation	Study of diplomats (Swanson et al., 2018) News media	Lamech (2014)	Halteman (2011)	Conrad & Friedman (2013)	Santini, Santini, Danze, Le Ruz, & Seigne (2002)	Kato & Johansson (2012)	Golomb (2015c)	Schooneveld & Kuiper (2007)	Johansson (2006); cites Swedish-language article Holmboe & Johansson (2005)	Hagstrom et al., (2013)	Durusoy, Hassoy, Ozkurt, & Karababa (2017)
EMR- or ES-related characteristic	NA	Smart meter exposure	Smart meter exposure	Smart meter exposure	Proximity to cell phone base station	ES	ES	ES	ES, acute phase	ES, acute phase	Cell phone use symptoms during

Table 3: Continued.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Sample characteristics	About 24 U.S. and 2 Canadian diplomats to Havana reporting symptoms attributed to "health attacks" in news: 24 U.S. embassy community members with neurological findings often seen after mild traumatic brain injury/concussion (Swanson et al., 2018)	92 residents of Victoria, Australia, after exposure to smart meter radiation	318 U.S. respondents from 28 states	210 respondents, 68% ES (142)[b]	530 people living near cellular phone base stations	75 Japanese with ES or sensitive to EMF	202 persons with current ES	250 Dutch respondents with ES	22 with ES-ranked symptoms; most common were listed (not ranked)	194 with ES	2150 students in 26 high schools in Turkey
All have symptoms	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No

Table 3: Continued.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Symptom rankings				Two rankings given: for severe or moderate and new/severe and new							
Sleep	86% Swanson et al. (2018). Also see Panetta (2017).	#1	#1	#4/ #1	#3	#4 (76%)	#1 (94%)	#5	Yes	#2	#6
Headache	81% Swanson et al. (2018). See also Lederman, Weissenstein, Lee et al. (2017); Panetta (2017); Robles & Semple (2017a)	#2	#3	#1/ #3 (pressure in head; headache is listed separately and would be #5/#5	#2 (81%)	#2 (81%)	#2	#7, #9, #10 (separated into three questions; #10 is pressure in head; #7 is numb feeling in head)	Yes	#4	#2

Table 3: Continued.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Cognitive	81%. Swanson et al. (2018). Also see Lederman (2017a); Panetta (2017); Associated Press (2017d).	#5	#5	#2/#4	#4, #7	#3 (81%)	#3 (85%)	#2, #13	Yes	#7, #10	#4, #5
Stress anxiety irritability	67% irritability; 57% nervousness; 52% more emotional; 29% sadness. Swanson et al. (2018)	#11	#2	#8/#7 (agitation)	#6 (irritability)	#9 and #10. For "irritation" and "anxiety" (56% and 55%).	#6 in "initial symptoms," irritability (45%)				
Tinnitus	57% Swanson et al. (2018). Also see Lederman, Weissenstein, Lee et al. (2017), Panetta (2017).	#3	#4	#3/ #2	Not queried (except as "hearing")	#7 (63%)	#5 (80%)	Not in main symptom list, but based on number affected in auditory symptom list, #13		Not queried	

Table 3: Continued.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Fatigue	Not elicited[c] in Swanson et al. (2018). Mentioned in news media; Panetta (2017)	#4	#6	#10/#9	#1	#1 (and possibly #5, "sluggish" in the head (85%)	"Exhaustion" was a write-in symptom (not queried).	#1	Yes	#6	#1
Dizziness or balance	67%[d] Swanson et al. (2018). Also see Lederman, Weissenstein, Lee et al. (2017); Panetta (2017); Robles and Semple (2017a)	#7	#7	#7/#7	#14	#6 (64%)	#4 Initial: 49%	#11	Yes	#12	#9

Table 3: Continued.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Vision problems	76%. Swanson et al. (2018). Also see Associated Press (2017a).	#12	#8	#10/#11	#12	—	#8 in initial Symptoms (38%)	#6	—	#13 (photosensitivity)	#10
Nausea	Associated Press in Washington (2017); Lederman, Weissenstein, Lee et al. (2017); Panetta (2017)	#9	#12	—	—	—	#9 "Gastrointestinal symptoms" (64%). Nausea not separately asked.	—	Yes "Symptoms from the gastrointestinal tract."	#20	#15
Epistaxis (nose bleed)	Not elicited in Swanson et al. (2018). Mentioned in news/media: Associated Press in Washington (2017); Golden & Rotella (2018).	#17	#13	#15 in symptoms that intensified. New onset in several write-ins.	—	—	"Nosebleeds" as a write-in symptom (not queried).	— #12 is "nose problems."	—	—	—

Table 3: Continued.

	Cuba Diplomats	Australia, 2014	United States, 2011 (Wireless Utility Meter Safety Impacts Survey)	United States, 2013[a] (Maine Smart Meter Health Effects Survey & Report)	France, 2002	Japan, 2012	United States, 2015[a]	Netherlands, 2007	Sweden, 2006	Finland, 2013	Turkey, 2017
Hearing loss	43% Swanson et al. (2018). Also see Associated Press (2017b); Associated Press in Washington (2017); Panetta (2017); Robles & Semple (2017a); Wilkinson (2017)	#18 (with ear pain)	—	—	#5	—	#11 (34%)	#3	—	—	#14
Speech problems	Not elicited[e] in Swanson et al. (2018). Mentioned in Associated Press in Washington (2017)	#30	—	—	—	—	[f]	—	—	—	—
Comment			[g]	[h]	[i]		[j]	[k]		[l]	

Table 3: Continued.

Note: — = Not queried. Surveys in the smart meter era were prioritized for inclusion; proximity of emitting devices to homes may make these more comparable to diplomat experience. Studies of ES were also prioritized, as these focus on those who are symptomatic, providing symptom rates better suited for comparison to those in affected diplomats. Other studies on similar themes report similar findings. (An exception is that older studies from Scandinavia that focused on exposure to video display terminals from that time report high rates of skin problems.) For instance, in a 2007 study of 85 persons living near the first mobile phone station antenna in Menoufiya governorate, Egypt reported that "the prevalence of neuropsychiatric complaints as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls: (10%), (5%), (5%), (0%), (8.8%) and (10%), respectively ($P < 0.05$)." Sleep, headache, and cognitive again topped the list in frequency (Abdel-Rassoul et al., 2007).

Some studies focus not on ranking, but dose-effect/distance relation. For instance, in Selbitz, Bavaria, those within 200 m of a cell phone base station were compared on reported symptoms to those 200 m to 400 m away and were found to report significantly more sleep problems, headache, concentration problems, "cerebral affections," depression, auditory/vestibular problems, visual problems, GI problems, dizziness, and nosebleed along with cardiovascular problems, joint problems, infections, and skin problems ($p = 0.01$ for dizziness and nosebleed, $p = 0.001$ for the rest; Eger & Jahn, 2010). A 2003 survey study of the "microwave syndrome" "in Murcia, Spain, in the vicinity of a Cellular Phone Base Station working in DCS-1800MHz" reported that symptoms included fatigue, irritability, headache, nausea, insomnia, depression, discomfort, difficulty in concentration, memory loss, visual dysfunction, auditory dysfunction, dizziness, (and several other symptoms) (Navarro et al., 2003). These were more prevalent within 150 m of the station, relative to more than 250 m, in most cases significantly so. It was noted that symptoms abated with removal from the RF/MW source (Navarro et al., 2003). A follow-on study examined rates of problems in relation to measured electric fields and showed significance for 13 of 16 assessed symptoms, with symptom odds ratios as high as 59 (Oberfeld et al., 2004).

Our rankings do not include as a symptom "onset of electromagnetic hypersensitivity syndrome" or "aggravation of electromagnetic hypersensitivity syndrome." We used the highest ranking if several cognitive queries were used (e.g., memory problems or concentration difficulties) or several head queries were used (e.g. headache, head pressure, heat or strange sensation in head), and exclude later exemplars of the category in ranking the lower-ranked items.

[a]There was no barrier to participation from outside the United States, but participants are predominantly from the United States.

[b]Sixty-eight percent of participants had ES (N =142) of whom 63% felt certain their exposure to smart meter was responsible for initiating the ES. Of the 49 who were ES before smart meter exposure, all 49 (100%) stated that smart meter exposure made their ES not only worse but "much worse."

[c]Though fatigue was not elicited, it is noted that a number reported a "good day bad day" pattern in which mental or physical exertion on one day led to exacerbation for several days.

[d]Separates out balance (67%) and dizziness (63%) and includes nausea (7%) in this category.

[e]Speech problems were not elicited, but speech audiometry, speech therapy, and speech pathology consultation are each mentioned totaling at least six references.

Table 3: Continued.

[f]"Aphasia" was a write-in symptom (not queried).
[g]Seventy-three percent women; 93% over age 40; 43% over age 60; 78% from California; 49% characterize selves as EMF sensitive.
[h]The first number is severe or moderate and new; the second number is severe and new. Pressure in head and headaches were queried separately. The overlap is uncertain. The higher ranking (pressure in head) was used. Concentration and memory were queried separately. The overlap is uncertain. The higher ranking (concentration problems) was used.
[i]Memory and concentration were queried separately, ranked #4 and #7 in the original. Combined might be higher. The higher ranking is used. This analysis provides values at different distances. Orderings for the closest distance are used. Ordering shifts slightly with longer distances, but in general, the more frequently reported symptoms remain the more frequently reported.
[j]Ratings are based on (videotaped) Commonwealth Club slide presentation. Additional symptoms were elicited but not presented.
[k]Notes buzzing ears, hissing sounds, loss of hearing, strong low-frequency sounds, earaches, and sound of bells clanging in 96, 80, 64, 545, 38, and 28 participants
[l]This assesses acute symptoms. It also gives fractions of who report those symptoms before the acute phase, but it is unclear whether someone who reports a symptom (say, headaches, dizziness) before exposure had those symptoms only occasionally.
Note: Percentages are given for diplomats (chosen for being symptomatic) and rankings for studies of persons reporting symptoms with EMR/RF/MW (not restricted to acute stage).

stress (Golomb et al., 2014; Golomb & Evans, 2008; Golomb, Koslik, & Redd, 2015), mechanisms that each promote the other (Lee & Wei, 1997; Wei & Lee, 2002). RF/MW is tied to these mechanisms (Barnes & Greenebaum, 2015, 2016; Gao, Hu, Ma, Chen, & Zhang, 2016; Turedi et al., 2015; Yakymenko et al., 2015; Yuksel, Naziroglu, & Ozkaya, 2016; Zhu et al., 2014). However the distinctive prominence of sleep and auditory symptoms, the peculiar somatic sensory experiences of pressure and vibration, and the noises perceived during apparent inciting episodes are relatively distinctive features—distinctive to diplomats' reports and reported RF/MW problems.

Table 4 reviews several mechanism considerations. Central to this is the critical role of oxidative stress and the relevance of oxidative stress to potential auxiliary mechanisms, such as mitochondrial dysfunction, blood-brain barrier disruption, membrane alterations, impaired blood flow, apoptosis, effects on voltage-gated calcium and anion channels, and triggering of autoimmune reactions. (In some cases, effects are reciprocal—oxidative stress promotes mitochondrial dysfunction, calcium channel effects, inflammation, and autoimmunity—which in turn can promote oxidative stress.) One analysis found that of 100 evaluated studies that examined the relationship of low-level RF/MW to oxidative stress in biological systems, 93% supported a connection (Yakymenko et al., 2015). A role for oxidative stress in RF/MW/EMR-affected persons is cemented by evidence that gene polymorphisms adverse to antioxidant defense are significantly more prevalent in persons experiencing symptoms from RF/MW/EMR (De Luca et al., 2014). In addition, levels of a particular antioxidant, melatonin, known to be critical for RF/MW and broader EMR defense are consistently low in affected persons (assessed by a urinary metabolite) (Belpomme et al., 2015). Oxidative stress has been tied to each of the symptoms and conditions reported in diplomats and RF/MW-affected persons.

Also noteworthy is the repudiation of psychogenic causation in the evaluation of diplomats (Stone, 2018; Swanson et al., 2018), which holds for RF/MW-affected persons as well. Case narratives for those affected by RF/MW underscore that for many, symptoms developed and progressed when affected parties as yet had no knowledge that an RF/MW-emitting device had been introduced or that one could cause problems (Conrad & Friedman, 2013; Golomb, 2015a). A Swiss Telecom-funded study found that sleep problems related to the electromagnetic field strength of the transmitter and did not correlate with personality traits tied to worry about health (Altpeter et al, 1995; Lamech, 2014). The circumstance that some report being affected severely by levels of exposure that cause others no problem is reviewed in the context of effect modification, variations in antioxidant defenses, and demonstrated variable involvement of secondary mechanisms such as autoimmune activation (Belpomme et al., 2015). In fact, analogous marked differences in harm or development of health effects are well known for other exposures, such as peanuts, penicillin, and pesticides. For EMR-affected persons (De Luca et al., 2014), as for many other

Table 4: Mechanism Considerations.

Oxidative stress, mediated by free radicals, is involved in RF/MW injury.	Oxidative stress refers to a kind of injury against which "antioxidants" relatively protect, in which "reactive oxygen species" or "free radicals" produce changes/damage that can affect, for instance, lipids, proteins, DNA, and RNA. Mitochondria, the primary source of energy for cells (and they regulate many other phenomena such as steroid hormone production and apoptosis) are a leading source and target of oxidative stress (Gruber, Schaffer, & Halliwell, 2008; Kowald, 2001; Lee & Wei, 1997; Sastre, Pallardo, & Vina, 2003; Wei, 1998). That is, mitochondrial injury not infrequently accompanies oxidative stress and has been shown with RF/MW (see below). RF/MW produces oxidative stress. As above, in an analysis of 100 studies examining if low-level RF/MW produced oxidative injury, it was reported that about 93 found that it did (Yakymenko et al., 2015). Oxidative stress and mitochondrial dysfunction are implicated in the symptoms and health effects that have been reported by diplomats and RF/MW-affected persons (Adamczyk-Sowa et al., 2014; Berr, Balansard, Arnaud, Roussel, & Alperovitch, 2000; Bonne & Muller, 2000; Brubaker, Mohney, & Pulido, 2009; Carelli, Ross-Cisneros, & Sadun, 2002; Feng et al., 2010; Fetoni et al., 2013; Finsterer, 2008; Fukui et al., 2002; Hoshino, Tamaoka, Ohkoshi, Shoji, & Goto, 1997; Ikeda-Douglas, Zicker, Estrada, Jewell, & Milgram, 2004; Insel, Moore, Vidrine, & Montgomery, 2012; Jeyakumar, Williamson, Brickman, Krakovitz, & Parikh, 2009; Kilic, Selek, Erel, & Aksoy, 2008; Koga & Nataliya, 2005; Koillinen, Jaaskelainen, & Koski, 2009; Kuruppu & Matthews, 2013; Liang et al., 2004; Manwaring et al., 2007; Massin et al., 1995; Neri et al., 2006; Ottonello et al., 2000; Reynolds, Laurie, Mosley, & Gendelman, 2007; Riordan-Eva, 2000; Rosen, 2008; Sandbach et al., 2001; Savastano, Brescia, & Marioni, 2007; Seidman, Khan, Bai, Shirwany, & Quirk, 2000; Sharma et al., 2013; Someya et al., 2009; Tiwari & Chopra, 2013; Vurucu et al., 2013; D. Wallace, 2001; Yamasoba et al., 2007; Zhang et al., 2013; Zoric et al., 2008). For instance, oxidative stress is tied to tinnitus, antioxidants modestly alleviate it, and markers of oxidative stress in tinnitus are reported to be greater in jugular blood (near the ear) than the more commonly measured brachial blood (Neri et al., 2006; Savastano et al., 2007; Van Campen, Murphy, Franks, Mathias, & Toraason, 2002). Two findings substantially cement a role for oxidative stress in RF/MW health effects. First, persons who are "electrosensitive" (i.e., who experience symptoms at levels of radiation that many others tolerate) are significantly more likely to harbor gene variants that confer less avid protection against oxidative injury (De Luca et al., 2014). This is an extremely important finding. People cannot manipulate their genes in response to suggestibility and did not know their genes when they reported their sensitivity status. This powerfully supports a causal role for oxidative stress in the injury experienced.

Table 4: Continued.

	Second, a French study in electrically and chemically sensitive individuals (93% with ES), found consistently low levels of a urinary melatonin metabolite (Belpomme et al., 2015). Since melatonin is an antioxidant that protects against damage to many toxins, but has been shown in numerous studies to be particularly vital for defense specifically against oxidation injury due to radiation across the electromagnetic spectrum (Argun et al., 2014; Bhatia & Manda, 2004; El-Missiry et al., 2007; Goswami & Haldar, 2014b; Goswami et al., 2013; Griefahn, Kunemund, Blaszkewicz, Lerchl, & Degen, 2002; Guney et al., 2007; Imaida et al., 2000; Jang et al., 2013; Karaer et al., 2015; Karslioglu et al., 2005; Kim et al., 2001; Koc, Taysi, Buyukokuroglu, & Bakan, 2003a, 2003b; Manda, Anzai et al., 2007; Manda & Reiter, 2010; Manda et al., 2008; Naziroglu, Tokat, & Demirci, 2012; Ortiz et al., 2015; Sener, Atasoy et al., 2004; Sener, Jahovic et al., 2003; Sharma & Haldar, 2006; Shirazi et al., 2011, 2013; Taysi et al., 2003, 2008; Vasin et al., 2004; Yilmaz & Yilmaz, 2006), including due to RF/MW (Ayata et al., 2004; Aynali et al., 2013; Koylu et al., 2006; Lai & Singh, 1997; Meena et al., 2014; Naziroglu, Celik et al., 2012; Oksay et al., 2012; Oktem et al., 2005; Ozguner et al., 2006; Ozguner, Oktem, Armagan et al., 2005; Sokolovic et al., 2008, 2013; Tok et al., 2014), this dovetails with the genetic data to compellingly support a role for oxidative stress and to show that that those with ES (those who experience symptoms with radiation that others tolerate) are also experiencing greater cellular and subcellular injury from this radiation.
	Many studies show the importance of antioxidant defenses, including melatonin, in protection against RF/MW injury. For instance, melatonin and, to a lesser degree, caffeic acid protect against cell phone–induced oxidative stress in rats, and melatonin increased the activity of other endogenous antioxidant enzymes, superoxide dismutase (SOD), glutathione peroxidase (GPx) and catalase, which were depressed with the cell phone radiation (Ozguner et al., 2006). Melatonin protected against laryngotracheal oxidative injury from wireless (2.45 GHz) radiation in rats (Aynali et al., 2013). It also protected against skin oxidative injury in an experimental mobile phone model in rats (Ayata et al., 2004). It protected against 900 MHz microwave radiation–induced lipid peroxidation in rats (Koylu et al., 2006); reversed the oxidative damage of microwaves to rat testes including protecting testosterone level and sperm count, and protecting against DNA fragmentation (a marker of cell death) (Meena et al., 2014) and protected against oxidative damage from cell phone radiation to rat brain (Sokolovic et al., 2008). Melatonin protects against oxidative damage from Wi-Fi to the lens of rats (Tok et al., 2014). Vitamins E and C protect against “900 MHz radiofrequency-induced histopathologic changes and oxidative stress in rat endometrium” (Guney, Ozguner, Oral, Karahan, & Mungan, 2007). Ginkgo biloba protected against cell phone–induced oxidative injury in rat brain (Ilhan et al., 2004). And so on.

Table 4: Continued.

	Antioxidants work together, for instance, to recycle one another to the reduced form in which they are active as antioxidants. The importance of antioxidant defenses in protection against radiation injury from RF/MW extends what is well known for injury from radiation throughout the electromagnetic spectrum, including so-called ionizing radiation (which includes gamma)—for instance, "A positive correlation was found between GPx activity, glutathione content and cell survival following ionizing irradiation"; Bravard et al., 2002). Glutathione depletion increased with gamma radiation–induced DNA damage (Dutta, Chakraborty, Saha, Ray, & Chatterjee, 2005) and cell death (Dethmers & Meister, 1981). Glutathione determined the survival "shoulder" for X-ray radiation in hypoxic cells (Evans, Taylor, & Brown, 1984), and melatonin protected against X-ray-induced lung injury (Jang et al., 2013). Melatonin protected against radiation–induced cataract (Karslioglu et al., 2005) and increased activity of other critical antioxidant enzymes, SOD and GPx. SOD protected against fractionated radiation–induced esophagitis (and reduced the effect of that radiation on glutathione) (Epperly et al., 2001). Melatonin protected against UVB radiation-induced oxidative skin injury (Goswami & Haldar, 2014a, 2014b), as did glutathione (Hanada, Gange, & Connor, 1990) and chocolate, which is rich in antioxidant polyphenols (Williams, Tamburic, & Lally, 2009). Melatonin has specifically been reported to protect the inner ear against radiation injury in rats exposed to "radiotherapy" at 4 KHz to 6 KHz (Karaer et al., 2015)
	A role for oxidative stress in radiation injury transcends labels of "ionizing" versus "nonionizing," and "thermal" versus "nonthermal" radiation. For this reason, those labels are of questionable utility in understanding radiation damage.
Radiation may depress melatonin—more so in some—and, in part through depressed melatonin, may depress other antioxidants	A number of studies report that EMR, including but not limited to RF/MW, can depress melatonin (Bergqvist et al., 1997; Burch, Reif, & Yost, 1999, 2008; Fernie, Bird, & Petitclerc, 1999; Griefahn et al., 2002; Halgamuge, 2013; Qin et al., 2012; Reiter, 1993a, 1994; Weydahl, Sothern, Cornélissen, & Wetterberg, 2000). Evidence suggests that (like virtually all other biological effects), a subgroup is more vulnerable (Parry et al., 2010; Wood, Loughran, & Stough, 2006). (Note that sunlight, which provides EMR of a kind "expected" evolutionarily, is well recognized to govern (depress) melatonin, toward producing day-night and seasonal effects.)
	Light (a portion of the electromagnetic spectrum) inhibits melatonin as part of establishing circadian and seasonal rhythms (Gammack, 2008; Glickman, Byrne, Pineda, Hauck, & Brainard, 2006; Navara & Nelson, 2007). Evolution did not plan for man-made radiation sources, and one hypothesis is that such radiation sources may induce similar effects in some people.

Table 4: Continued.

	"EMF [electromagnetic fields] are known to affect Ca2+ homeostasis and suppress melatonin activity in a wide wavelength range. Ca2+ ions in pinealocytes are involved in regulation of cAMP synthesis that mediates conversion of serotonin into melatonin. Their leakage from pinealocytes results in a decrease of the cAMP level and thereby suppresses production of melatonin" (Rapoport & Breus, 2011). Longterm radar workers reportedly have increased serotonin and depressed melatonin, consistent with this impaired conversion and effects in the RF/MW frequency range (Singh, Mani, & Kapoor, 2015). Electronic repair workers have also been reported to have lower melatonin than controls and more sleep problems (El-Helaly & Abu-Hashem, 2010).
	Melatonin and its derivatives, though better known for effects on sleep, provide a critical antioxidant defense system that protects against toxicity of an extraordinary array of toxins and conditions (Abdel Moneim et al., 2015; Antunes Wilhelm, Ricardo Jesse, Folharini Bortolatto, & Wayne Nogueira, 2013; Bandyopadhyay, Ghosh, Bandyopadhyay, & Reiter, 2004; Baxi, Singh, Vachhrajani, & Ramachandran, 2013; Chabra, Shokrzadeh, Naghshvar, Salehi, & Ahmadi, 2014; Chen, Gao, Li, Shen, & Sun, 2005; Ebaid, Bashandy, Alhazza, Rady, & El-Shehry, 2013; El-Missiry et al., 2014; Fuentes-Broto et al., 2010; Garcia-Rubio, Matas, & Miguez, 2005; Jindal, Garg, Mediratta, & Fahim, 2011; Korkmaz, Uzun, Cakatay, & Aydin, 2012; Laothong et al., 2010; Mehta et al., 2014; Melchiorri et al., 1995; Montilla, Vargas et al., 1998; Ochoa et al., 2011; Othman et al., 2014; Shokrzadeh et al., 2014; Skaper, Floreani, Ceccon, Facci, & Giusti, 1999; Sousa & Castilho, 2005; Souza et al., 2014; Thomas & Mohanakumar, 2004; Uygur et al., 2013; S. C. Xu et al., 2010; L. Zhang et al., 2013; Aranda et al., 2010; Carrillo-Vico et al., 2005; Das, Belagodu, Reiter, Ray, & Banik, 2008; El-Sokkary, Nafady, & Shabash, 2010; Esrefoglu, Gul, Ates, & Selimoglu, 2006; Esrefoglu, Gul, Emre, Polat, & Selimoglu, 2005; Fagundes, Gonzalo, Arruebo, Plaza, & Murillo, 2010; Y. K. Gupta, Gupta, & Kohli, 2003; Hu, Yin, Jiang, Huang, & Shen, 2009; Kacmaz et al., 2005; Kerman et al., 2005; Omurtag, Tozan, Sehirli, & Sener, 2008; Ozacmak, Barut, & Ozacmak, 2009; Ozacmak, Sayan, Arslan, Altaner, & Aktas, 2005; Ozcelik, Soyoz, & Kilinc, 2004; Rao & Chhunchha, 2010; Rezzani, Buffoli, Rodella, Stacchiotti, & Bianchi, 2005; Sadir, Deveci, Korkmaz, & Oter, 2007; Sahna, Parlakpinar, Turkoz, & Acet, 2005; Sahna, Parlakpinar, Vardi, Cigremis, & Acet, 2004; Saravanan, Sindhu, & Mohanakumar, 2007; Suke et al., 2006; Tunez, Montilla, Del Carmen Munoz, Feijoo, & Salcedo, 2004; Wang, Wei, Wang et al., 2005; Wang, Wei, Zhang et al., 2005; Watanabe et al., 2004; Zavodnik et al., 2004) (Abdel-Wahab, Arafa, El-Mahdy, & Abdel-Naim, 2002; Bagchi et al., 2001;

Table 4: Continued.

	Behan, McDonald, Darlington, & Stone, 1999; Bruck et al., 2004; Cadenas & Barja, 1999; Chen, Lin, & Chiu, 2003; Dabbeni-Sala, Floreani, Franceschini, Skaper, & Giusti, 2001; El-Sokkary, 2000; Gazi, Altun, & Erdogan, 2006; Hara et al., 2001; Herrera et al., 2001; Karbownik & Reiter, 2002; Lankoff, Banasik, & Nowak, 2002; Martin et al., 2002; Mayo, Tan, Sainz, Lopez-Burillo, & Reiter, 2003; Mayo, Tan, Sainz, Natarajan et al., 2003; Montilla, Tunez, Munoz de Agueda, Gascon, & Soria, 1998; Mor et al., 2003; Morishima et al., 1998, 1999; Ortega-Gutierrez et al., 2002; Othman, El-Missiry, & Amer, 2001; Popov et al., 2015; Princ, Maxit, Cardalda, Batlle, & Juknat, 1998; Sener, Kacmaz et al., 2003; Sener, Paskaloglu et al., 2004; Sener, Sehirli, & Ayanoglu-Dulger, 2003; Shen et al., 2002; Shifow, Kumar, Naidu, & Ratnakar, 2000; Shokrzadeh et al., 2015; Soyoz, Ozcelik, Kilinc, & Altuntas, 2004; Spadoni et al., 2006; Sutken et al., 2007; Tomas-Zapico et al., 2002; Tunez et al., 2003).
	For this reason, to the extent that EMR does depress melatonin, it is expected to potentiate the array of adverse health outcomes tied to these toxins, and other sources of injury.
	Again, melatonin specifically protects against radiation injury at frequencies across the electromagnetic spectrum (Bardak et al., 2000; Cruz et al., 2003; Dogan et al., 2017; Goswami & Haldar, 2014a; Guney et al., 2007; Jang et al., 2013; Karaer et al., 2015; Kim et al., 2001; Koc et al., 2003a, 2003b; Koylu et al., 2006; Liu et al., 2014; Manda, Anzai et al., 2007; Manda & Reiter, 2010; Manda et al., 2008; Naziroglu, Celik et al., 2012; Oliinyk & Meshchyshen, 2004; Ortiz et al., 2015; Sener, Atasoy et al., 2004; Sener, Jahovic et al., 2003; S. Sharma & Haldar, 2006; Sokolovic et al., 2008, 2013; Taysi et al., 2003, 2008; Tok et al., 2014; Yilmaz & Yilmaz, 2006).
	A study examining gene expression in rat brain reported that brain expression of N-acetyltransferase-1, the rate-limiting enzyme in melatonin production (Reiter, 1993b), had significantly reduced expression following 915 MHz GSM-consistent RF/MW radiation (encompassing pulsed RF/MW) in rats, fold difference 0.48 ± 0.13, $p < 0.0025$ (Belyaev et al., 2006).
	Suppressed melatonin or sleep deprivation in turn increases damage to the pineal gland (Lan, Hsu, & Ling, 2001), which produces most of the circulating melatonin. Thus, sufficiently depressed melatonin can beget still further depressed melatonin—and heightened vulnerability to injury from future EMR exposure.
	The ability to sustain adequate melatonin production in the face of EMR/RF/MW, may be a critical determinant of pineal vulnerability. The pineal gland has high antioxidant needs (Lan et al., 2001; Razygraev, 2010), and in the absence of such protections, it is vulnerable to involution (Lin'kova, Poliakova, Kvetnoi, Trofimov, & Sevost'ianova, 2011; Polyakova, Linkova, Kvetnoy, & Khavinson, 2011).

Table 4: Continued.

	Age-related involution of the pineal gland may help to explain why more middle-aged persons are reportedly affected by ES than younger people (Gruber, Palmquist, & Nordin, 2018), though presumably younger adults may be more exposed to technology. (Older persons, however, may have had more years of EMR exposure and injury may be cumulative (Sadchikova & Glotova, 1973).)
	Melatonin supports the levels and activity of other antioxidants, including in the setting of radiation exposures (Karslioglu et al., 2005; Ozguner et al., 2006; Tok et al., 2014). Modest exposure to oxidative stressors (including from radiation) in persons or animals or plants whose system is not overwhelmed can lead to antioxidant upregulation, a phenomenon called *oxidative preconditioning*, seen with many sources of limited oxidative stress, including limited exposure to radiation (Chen, 2006). In part because of this, the net effect of an oxidant exposure on antioxidant levels depends on factors like intensity and duration of exposure, other oxidative exposure (so, mitochondrial dysfunction state), and the status of antioxidant defenses, as well as time from exposure to assessment. Some studies in some systems show antioxidant upregulation (Irmak et al., 2002) or mixed direction effects on different antioxidants (Tok et al., 2014), but many show depression of assessed antioxidants following EMR exposure (Duan et al., 2013; Goswami & Haldar, 2014a, 2014b; Martinez-Samano, Torres-Duran, Juarez-Oropeza, Elias-Vinas, & Verdugo-Diaz, 2010) or specifically RF/MW exposure (Akpinar, Ozturk, Ozen, Agar, & Yargicoglu, 2012; Bahreymi Toossi et al., 2017; Ceyhan et al., 2012; Esmekaya, Ozer, & Seyhan, 2011; Guney et al., 2007; Megha et al., 2015; Ozguner, Altinbas et al., 2005; Oktem et al., 2005; Ozguner et al., 2006; Ozguner, Oktem, Armagan et al., 2005; Ozguner, Oktem, Ayata, Koyu, & Yilmaz, 2005; Tok et al., 2014; Yurekli et al., 2006). Such depressions, coupled with melatonin depressions, may increase vulnerability to future EMR exposures, particularly where genetics provide for less effective variants of one or more antioxidants (De Luca et al., 2014).
	It is expected that mitochondrial impairment (J. Gruber et al., 2008; Lee & Wei, 1997; Sastre et al., 2003; Wei, 1998) or brain inflammation (sometimes itself a result of oxidative stress, amenable to reduction with melatonin; Guney et al., 2007; Halliday, 2005), since associated with greater production of free radicals and an expected less favorable balance of oxidative stress to antioxidant defenses, may be a risk factor for problems with the added oxidative stress from RF/MW or from the depression in antioxidant defenses to which RF/MW may contribute.

Table 4: Continued.

RF/MW may depress xenobiotic protections	RF/MW is reported to depress butyrylcholinesterase (McRee, 1980), a key xenobiotic defense; low levels are tied to higher cardiovascular and all-cause mortality (Calderon-Margalit, Adler, Abramson, Gofin, & Kark, 2006).
Oxidative stress contributes to auxiliary mechanisms of radiation injury, such as mitochondrial dysfunction.	Oxidative stress contributes to multiple documented auxiliary mechanisms of RF/MW damage that likely contribute to health effects in subsets, including membrane alterations—cell membranes (Benderitter, Vincent-Genod, Pouget, & Voisin, 2003) and mitochondrial membranes (Shonai et al., 2002; Thomas, Gebicki, & Dean, 1989; Vayssier-Taussat et al., 2002; Wang et al., 2002), blood-brain barrier disruption (Al Ahmad et al., 2012; Barichello et al., 2011; Freeman & Keller, 2012; Gasche, Copin, Sugawara, Fujimura, & Chan, 2001; Haorah, Knipe, Leibhart, Ghorpade, & Persidsky, 2005; Haorah et al., 2007; Hurst et al., 1998; Lochhead et al., 2010; Nittby et al., 2009; Salford et al., 1994; Zehendner et al., 2013), effects on voltage gated calcium channels (Cui et al., 2012) affected by and affecting oxidative stress—(Nishiyama, Nakano, & Hitomi, 2010; Pall, 2015)—but also on voltage-gated anion channels that are an important part of the outer mitochondrial membrane (Ferrer, 2009) potentially contributing to mitochondrial impairment and amplification of oxidative stress, EEG spiking (Naziroglu, Celik et al., 2012), impaired mitochondrial function (Aitken, Bennetts, Sawyer, Wiklendt, & King, 2005; Xu et al., 2010)—bidirectionally related to oxidative stress (Houston, Nixon, King, De Iuliis, & Aitken, 2016; Mancuso, Coppede, Migliore, Siciliano, & Murri, 2006; Wei & Lee, 2002)—and protected by melatonin (Tan, Manchester, Qin, & Reiter, 2016), impaired blood flow—e.g., via oxidative stress-driven endothelial dysfunction (Engin, Sepici-Dincel, Gonul, & Engin, 2012; Indik, Goldman, & Gaballa, 2001; Jarasuniene & Simaitis, 2003; Loscalzo, 2002), autoantibodies (Ahsan, Ali, & Ali, 2003; Fiorini et al., 2013; Gilgun-Sherki, Melamed, & Offen, 2004; Kirkham et al., 2011; Kumagai et al., 2003; Maes et al., 2013; Ryan, Nissim, & Winyard, 2014), and apoptosis (Aoki et al., 2001; Bresgen et al., 2003; Espino et al., 2010; Filomeni, Cardaci, Da Costa Ferreira, Rotilio, & Ciriolo, 2011; France-Lanord, Brugg, Michel, Agid, & Ruberg, 1997; Li et al., 2015; Li et al., 2008; Salido & Rosado, 2009; Yalcinkaya et al., 2009; Zhang, Zhang, Rabbani, Jackson, & Vujaskovic, 2012)—programmed cell death, which in turn triggers inflammation and coagulation activation (Reutelingsperger & van Heerde, 1997). Laboratory correlates for some of these were reported in ES participants in the French study: about 15% of those with ES had elevated markers of blood-brain barrier permeability; 29% in those with ES (23% in those with ES and multiple chemical sensitivity, MCS) had antibodies to O-myelin (Belpomme et al., 2015).

Table 4: Continued.

Melatonin considerations: RF/MW/EMR versus diplomats	While depressions in a melatonin metabolite were the norm in participants with ES in a French study (Belpomme et al., 2015), this need not necessarily be the case for diplomats, even if a related cause (pulsed RF/MW) and related processes (e.g., tied to oxidative stress) are involved in symptom induction. In persons with "ES," lowered defenses are needed for nominally modest exposures to produce problems. But if exposures in affected diplomats were more intense or otherwise injurious, lowered defenses would not be required to produce injury. To evaluate this, it may be prudent to assess urine melatonin metabolites at the time diplomats are identified with symptoms.
Psychogenic illness has been dismissed	Psychogenic causation has been repeatedly suggested as the basis for diplomats' symptoms (Buckley & Harris, 2018; Myers, 2018; Stone, 2017). This has been correctly dismissed, however, for the Cuba and China diplomats (Harris, 2018c; Stone, 2018; Swanson et al., 2018). Psychogenic causation has similarly been suggested for symptoms from RF/MW (Maisch, 2012) and has been similarly repudiated (Aschermann, 2009; Tressider, 2017). The Swiss Telecom-funded study that documented a relation of sleep problems to transmitter field strength also showed that symptoms were not related to a health-worrying personality (Altpeter et al., 1995; Lamech, 2014). The concordance of symptom profiles across studies, the emergence of RF/MW problems in people unaware of the exposure or its potential for problems, the concordance of symptoms and objective signs with known documented mechanisms of RF/MW injury, the presence of objective markers, and ties to genetics that each cohere with known mechanisms of RF/MW injury (Belpomme et al., 2015; De Luca et al., 2014; Havas et al., 2010) effectively preclude a psychogenic basis for the problem—were such a diagnosis meaningful. (See below, in the entry for study inconsistency, for provocation studies.) The notion that chronic symptoms can arise from psychogenic sources dates to Freud, who also pioneered the flaws associated with its application (Crews, 2017). The foundation is substantially circular, a mechanism has never been physiologically defined or substantiated (much less documented to be operating in cases where the label is applied), and the label is deployed without the most basic scrutiny of the tacit assumptions (Golomb, 2015b). Historically, many conditions that were presumed psychogenic (such as ulcers, seizures) were recognized as organic as evidence emerged (Golomb, 2015b).

Table 4: Continued.

Not all are affected—a subset of embassy personnel (Stone, 2018) and of RF/MW exposed	How might some people experience symptoms and signs of injury from what seem to be "low levels" of an exposure, seemingly well below levels that other people tolerate? For toxins, we designate an LD50 (Baiomy, Attia, Soliman, & Makrum, 2015; Jagetia & Baliga, 2003; Jagetia, Venkatesh, & Baliga, 2004; Pal & Chatterjee, 2006; Shafiee et al., 2010; Shimoda, Akahane, Nomura, & Kato, 1996) (dose lethal in 50%) or an LD5. This reflects the recognition that for each potentially toxic exposure, there is a range in which some will experience an outcome and others will not. One can also define an SD50 (symptoms in 50%)—or an SD25, or SD5. It would be surprising if a highly useful and lucrative technology were not pushed as far into this intensity range as possible. Genetic variations in a range of free radical detoxification systems, competition for those systems, alterations in gene expression based on prior exposures, differences in vulnerability of the tissue affected (via factors like mitochondrial "heteroplasmy," past injury of that organ), and variations in secondary mechanisms triggered by oxidative stress provide among the mechanisms by which variability is produced. The de facto intensity of the "same" exposure may differ radically (no pun intended) from person to person.[a] A further mode of variability arises from immune activation. Considering a more familiar allergen, one person can eat a jar of peanut butter without a problem, while another is hospitalized for exposure to a crumb of peanut. As above, oxidative stress can modify substances in a fashion that makes them vulnerable to autoimmune attack. Immune or autoimmune activation is a documented feature in a subset of those citing symptoms from RF/MW/EMR (Belpomme et al., 2015).
Effect modification	"Effect modification" refers to differences in effect in different individuals, and it is the rule rather than the exception in biology. Particular considerations are germane when the exposure has potential for prooxidant or antioxidant effects (Golomb, 2018). Many prooxidants can be antioxidant at low doses in some people (via "oxidative preconditioning" in which low-level exposure to prooxidants may upregulate native antioxidant defenses; this can lead to net antioxidant effects in persons whose defenses are not already overwhelmed or maximally upregulated—as above). Conversely, many substances thought of as antioxidants are prooxidant in some settings, often including high dose (Azam, Hadi, Khan, & Hadi, 2003; Bowry, Mohr, Cleary, & Stocker, 1995; Gerster, 1999; Hiramoto, Ohkawa, Oikawa, & Kikugawa, 2003; Hu, Chen, & Lin, 1995; Kontush, Finckh, Karten, Kohlschutter, & Beisiegel, 1996; Lee, Kim, Park, Chung, & Jang, 2003; Palozza, Luberto, Calviello, Ricci, & Bartoli, 1997; Young & Lowe, 2001). So the same exposure can produce even opposite-direction effects in different persons. Exemplifying the principle, statin cholesterol-lowering drugs are net antioxidant in many people (often tested in nonelderly males without metabolic syndrome factors),

Table 4: Continued.

	but are reproducibly prooxidant in a subset, and prooxidant dominance is tied to side effects (Sinzinger, Lupattelli, & Chehne, 2000; Sinzinger, Lupattelli, Chehne, Oguogho, & Furberg, 2001). These side effects, attended by net prooxidant effect (Sinzinger et al., 2000; Sinzinger et al., 2001) arise disproportionately with higher doses and in persons with conditions like older age and metabolic syndrome factors, that are statistically tied to mitochondrial impairment (Golomb & Evans, 2008). Side effects, too, occur disproportionately in women (Golomb & Evans, 2008). Women show higher rates of adverse effects from many drugs and environmental toxins (and many medical procedures); they are also more often affected by EMR (Gruber et al., 2018; Levallois et al., 2002; Röösli, Möser, Baldinini, Meier, & Braun-Fahrlander, 2004; Santini et al., 2002; Schooneveld & Kuiper, 2007).
	There are many potential sources of effect modification from genetics (De Luca et al., 2014), level of exposure, and past and current environment that influence biology. Some exposures may cause mitochondrial injury or oxidative stress or depress concentrations of antioxidants, boosting vulnerability. Others may have protective effects.
Chemical exposures may serve as one source of effect modification	Many drugs and chemical exposures cause oxidative stress, cause mitochondrial injury (which also increases intracellular oxidative stress), depress antioxidant defenses, and/or compete for or inhibit detoxification systems. Through these and other mechanisms, these exposures may magnify harm from RF/MW and vice versa. Preliminary evidence comparing Swedish ES-affected persons versus controls identifies higher levels of some organic pollutants in those with ES (Hardell et al., 2008), though larger studies are needed.
	Chemical exposures that cause oxidative stress compete for or inhibit detoxification systems may magnify harm from RF/MW and vice versa.
	Melatonin and glutathione (and other antioxidants) can be "radioprotective" (Bravard et al., 2002; Jensen & Meister, 1983; Shirazi et al., 2013; Simone, Tamba, & Quintiliani, 1983). (Here the root *radio* refers to radiation, not specifically to radiofrequency radiation.) Other agents or conditions can be "radiosensitizing."
	As might be expected, glutathione depletion can be radiosensitizing, though the status of other antioxidants may be important (Hodgkiss, Stratford, & Watfa, 1989; Koch & Skov, 1994; Vallis, 1991; Vos, van der Schans, & Roos-Verheij, 1986). The tie between low melatonin (assessed by the principal metabolite) and ES in the French study (Belpomme et al., 2015) supports the expectation that melatonin depletion is radiosensitizing as well. Radiosensitization is used therapeutically to enhance killing by radiation of tumor cells (Yi, Ding, Jin, Ni, & Wang, 1994), but its existence there is a reminder that chemicals interact with radiation to modify

Table 4: Continued.

radiation effects. Radiation itself may be radiosensitizing—as potential effects on antioxidant systems, reviewed elsewhere, suggest—and reportedly ultrahigh-frequency radiation is a particularly effective radiosensitizer (Holt, 1995). Oxidative stress is an important, but not the only, means by which radiosensitization occurs (Park et al., 2005), consistent with multiple downstream mechanisms of injury.

Of note, because critical systems that are involved in radiation defense (e.g., melatonin, glutathione, and other antioxidant systems) are also involved in defense against toxicity of chemicals and drugs (Mitchell & Russo, 1987) and because factors that adversely affect antioxidant:oxidant balance may be adverse for oxidative stress–mediated injury from either type of source, it is expected, as it is observed, that there will be overlap between chemical and electrical sensitivity (Belpomme et al., 2015; Golomb, 2015a).

Two illustrations where we can see the radiosensitizing effect occur with ultraviolet (uv) light, since due to its high frequency, the effect is primarily on the skin. Photosensitizing agents and radiation recall are the illustrations.

Photosensitizing or phototoxic or photoallergic agents are agents that magnify damage observed with uv radiation. (For simplicity we use *photosensitizing* to encompass each of these.) In some cases, radiation breaks down a chemical to something toxic. Drugs may also photosensitize, for instance, by augmenting one of the mechanisms of radiation injury, such as oxidative stress or mitochondrial dysfunction (Shea, Wimberly, & Hasan, 1986). Fluoroquinolone antibiotics, which can cause serious problems in a vulnerable subset through oxidative stress and mitochondrial dysfunction (Golomb et al., 2015), are strongly reported to photosensitize and to be phototoxic (Agrawal, Ray, Farooq, Pant, & Hans, 2007; Akter et al., 1998; Bilski, Martinez, Koker, & Chignell, 1996; Boccumini, Fowler, Campbell, Puertolas, & Kaidbey, 2000; Burdge, Nakielna, & Rabin, 1995; Chetelat, Albertini, & Gocke, 1996; Ferguson & Johnson, 1990, 1993; Fujita & Matsuo, 1994; Granowitz, 1989; Kimura, Kawada, Kobayashi, Hiruma, & Ishibashi, 1996; Man, Murphy, & Ferguson, 1999; Nedorost, Dijkstra, & Handel, 1989; Oliveira, Goncalo, & Figueiredo, 2000; Scheife, Cramer, & Decker, 1993; Snyder & Cooper, 1999; Trisciuoglio et al., 2002; Wagai & Tawara, 1991; Wagai, Yamaguchi, Sekiguchi, & Tawara, 1990). Fluoroquinolones have been tied to development of persistent phototoxicity (following withdrawal of the drug; Sailer et al., 2011)—that is, ongoing higher vulnerability to this radiation—consistent with evidence that a vulnerable group experiences persistent damage from fluoroquinolones in which oxidative stress and mitochondrial injury play a role (Golomb et al., 2015). This "vulnerability" may be acquired, as mitochondrial injury can be cumulative, and a serious reaction sometimes follows a previous course of

Table 4: Continued.

	fluoroquinolones with a milder and time-limited reaction or none at all (Golomb et al., 2015). (Mitochondrial injury from radiation can also be cumulative; Prithivirajsingh et al., 2004.) Fluoroquinolones have led to reported "photosensitivity" reactions to fluorescent lighting (Jaffe & Bush, 1999). Statins, which as elsewhere are sometimes prooxidant (Sinzinger et al., 2001) and sometimes mitochondrially toxic (Golomb & Evans, 2008), are also sometimes linked to photosensitivity (Morimoto, Kawada, Hiruma, Ishibashi, & Banba, 1995; Thual, Penven, Chevallier, Dompmartin, & Leroy, 2005). (The information that follows about photosensitivity in Smith-Lemli-Opitz syndrome explains one reason that statins can be prooxidant, though they also have antioxidant mechanisms.)
	Given oxidative mechanisms of radiation injury that apply across the electromagnetic spectrum, it is expected that some agents that photosensitize may sensitize to other forms of radiation, potentially including RF/MW. Others have noted that photosensitizing drugs have played an apparent role in other radiation injury (Dawson, Brown, & Tellefsen, 2009). (Data we have presented, but not published, showed that past use of fluoroquinolones was significantly tied to the development of ES. Past adverse effects to fluoroquinolones, which signify oxidative-mitochondrial injury to a point producing symptoms (at least, they surpassed the symptom threshold for a time), showed a particularly strong connection (Golomb, 2015a).)
	There are also disease conditions tied to the magnified photosensitivity (Murphy, 2001). Where these are tied to depressed antioxidant defenses, or increased mitochondrial injury, they might be predicted to be tied to increased risk of ES development (accounting for radiation exposure). In Smith-Lemli-Opitz syndrome, which many studies have tied to photosensitivity, cholesterol levels are low (Anstey, 1999, 2001, 2006; Anstey, Azurdia, Rhodes, Pearse, & Bowden, 2005; Anstey et al., 1999; Anstey & Taylor, 1999; Azurdia, Anstey, & Rhodes, 2001; Charman et al., 1998; Chignell, Kukielczak, Sik, Bilski, & He, 2006; Eapen, 2007; Martin, Taylor, Trehan, Baron, & Anstey, 2006; "[A new congenital photosensitivity syndrome. Smith-Lemili-Opitz syndrome]," 1999). Cholesterol transports critical fat-soluble antioxidants (Golomb & Evans, 2008).
	In the phenomenon of "radiation recall," injury to tissue initially caused by radiation can be made to reappear by another agent with shared mechanisms of injury (e.g., oxidative stress and mitochondrial injury), such as fluoroquinolone antibiotics, best recognized for skin reactions, since we are able to see these (Cho, Breedlove, & Gunning, 2008; Jain, Agarwal, Laskar, Gupta, & Shrivastava, 2008; Wernicke, Swistel, Parashar, & Myskowski, 2010).

Table 4: Continued.

Hypothesis: One possible vulnerable group	Evidence supports a relationship between genetics of intellectual promise, and a different condition in which oxidative stress and mitochondrial impairment play a critical role: autism spectrum disorder (ASD; Frye, Delatorre et al., 2013; Frye, Melnyk, & Macfabe, 2013; Frye & Rossignol, 2011; Rose et al., 2012; Rossignol & Frye, 2012). (EMR exposure has been considered as a possible factor (Herbert & Sage, 2013a, 2013b.) It was found that gene profiles that increase risk of ASD (polygenic risk) are tied to higher intelligence in the general population (Clarke et al., 2015): "We report that polygenic risk for ASD is positively correlated with general cognitive ability (beta = 0.07, $P = 6 \times 10^{-7}$ . . .), logical memory and verbal intelligence," findings that were replicated in a different sample by positive relation to full-scale IQ (Clarke et al., 2015). This supports a line of reasoning by which impaired cell energy, through oxidative stress and mitochondrial dysfunction, may disproportionately affect the "best and the brightest," on whom society differentially depends—with implications for vulnerability to RF/MW. Many mechanisms tied to high function are tied to high energy demand. Higher energy demand may create greater vulnerability in the setting of impaired energy supply. (It is the chasm between demand and that guides degree of injury.) Many drugs and chemical exposures cause oxidative stress, cause mitochondrial injury (which also increases intracellular oxidative stress), depress antioxidant defenses, and/or compete for or inhibit detoxification systems. Through these and other mechanisms, these exposures may magnify harm from RF/MW and vice versa.
Are provocation studies contributory?	Several so-called provocation studies have been conducted in persons with ES; some focus on symptoms, some on objective markers. In most of those that focus on symptoms, those with ES fail to reliably distinguish between blinded EMR "exposed" and "unexposed" settings (Rubin, Das Munshi, & Wessely, 2005). Major flaws in the designs have been recognized and reviewed by others (Leszczynski, 2015; Schooneveld & Kuiper, 2007); for instance, studies assume that the details of exposure and time course do not need to be individualized, which is contrary to the evidence. But there are further problems. The most fundamental is the assumption that in ES, symptoms serve as a meter. This is invalid. Consider the analogy of sunburn: a form of radiation injury mediated by oxidative stress that affects some but not others at usual exposure levels. Those who are affected "believe" sun exposure is responsible. They would be unlikely to discern when they are being exposed versus not to ultraviolet radiation. (It is their failure to know when significant injury is occurring or has occurred that leaves them in the sun long enough to receive injury.) What is discerned is the inflammation that follows the oxidative stress that may emerge only late in exposure or after the sun exposure has been "withdrawn." A blinded sham-exposed study would likely also produce inability to discern sham from active treatment.

Table 4: Continued.

	People do not sense the EMR, but the effects produced by it and studies show that those with ES respond to different EMR sources. In RF/MW-affected persons, as in diplomats, the effects can arise after hours of exposure or hours after a short exposure—oxidative stress can cause apoptosis and can then trigger inflammation (Reutelingsperger & van Heerde, 1997) or can cause blood-brain barrier damage allowing brain swelling (see above). Progression of these mechanisms may not peak for hours or, in some cases, even a couple of days. Recovery from effects can take still longer. For such a study to have a chance to succeed, it would be essential to pretest and individualize both the control/negative exposure condition and the active/positive exposure condition (including exposure and time course) in each individual to define a condition that will be effective in that person—if such conditions can be successfully defined and if cumulative effects do not alter the condition from one trial to the next. For some people, the background EMR at the facility, or its parking lot or lobby, or the exposure during transit to the facility may obviate the ability to define a negative exposure condition for that individual. It would be better to bring the EMR exposure to a place where the affected party is stable and asymptomatic. And the specific EMR and timing must be individualized to produce a positive condition in a suitable time course. To be valid, such a study must also protect against the possibility of physiological conditioning effects. These are distinct from nocebo effects and arise because the true stimulus produces actual physiological harm. It is known, for instance, that chemotherapy patients may vomit when they enter the room in which they have received chemotherapy. (Chemotherapy agents like EMR also cause toxicity via oxidative stress (Abraham, Kolli, & Rabi, 2010; Brea-Calvo, Rodriguez-Hernandez, Fernandez-Ayala, Navas, & Sanchez-Alcazar, 2006; Husain, Whitworth, Somani, & Rybak, 2001; Shokrzadeh et al., 2014) and mitochondrial injury (Nicolson & Conklin, 2008). The fact that symptoms also occur with expectation of chemotherapy does not mean that the chemotherapy itself lacks toxicity (or that perceived adverse effects are due to a nocebo effect); rather, expectation produces symptoms because the exposure *is* toxic. Expectation of the noxious exposure may, via conditioning processes, produce symptoms ordinarily produced by the noxious exposure. (This is potentially evolutionarily adaptive, serving to encourage persons to avoid settings in which the toxic exposure is expected.) To ensure against conditioned effects arising with expectation, a set of negative exposure visits at the test site before (and between) each positive exposure visit may be required to ensure extinction of physiologically conditioned expectation effects. In essence, the setting that optimizes prospects to identify a real effect, if present, is that in which the participant believes there will not be an active exposure.

Table 4: Continued.

	N-of-1 studies that focus on physiological effects of EMR have proven somewhat more able to identify EMR effects in those with ES, or subsets of them for which that physiological marker is affected. Just as symptoms vary, so physiological changes may do so, so outcomes suited to one person may not apply for all. Physiological markers changed with blinded EMR exposure in a published study of a female physician with ES. She could not discern when the exposure was present or not, but measurable changes occurred and symptoms arose with the positive condition (McCarty et al., 2011). Symptoms were significantly more intense with pulsed (but not continuous) radiation than sham exposure (McCarty et al., 2011). An *N*-of-1 test was reportedly conducted in a former Miami organized crime prosecutor who developed ES and chemical intolerance, with seizures an important part of his clinical profile, following a significant chemical exposure. An EEG was undertaken, turning on and off a TV, with the party blinded to the stimulus (blindfolded and with headphones to prevent him hearing when the TV was turned on or off). When the TV was shielded, no effect on the EEG was seen. With an unshielded television, EEG changes including seizure activity occurred when the television was turned on, and he experienced physical twitching (Bell, 2017). (This particular marker is unlikely to be generally useful, as seizure activity is not a usual part of the clinical profile in those affected by RF/MW.) A provocation study focused in a group of individuals showed changes in heart rate variability (Havas et al., 2010), an index of autonomic function that is tied to hard outcomes like sudden death and coronary artery disease (Hayano, 1990; Singer, Martin, Magid, & et al, 1988). Moreover, three of the four participants who characterized their ES as "intense" (though only persons in this group) exhibited a striking heart rate increase of between 45 and 90 beats per minute virtually immediately with the microwave exposure, associated with marked increase in sympathetic response. Declines in parasympathetic response with RF/MW exposure were seen for 23 of 25 tested people, in all groups, including, though less so, those with no ES.
	In general, assessments of objectively measurable quantities of relevance, including both differences in affected vs unaffected persons irrespective of current exposure (Belpomme et al., 2015; De Luca et al., 2014), and changes occurring with exposure (Havas et al., 2010), provide a more promising approach than real-time assessments of subjective outcomes for understanding this condition.

Table 4: Continued.

Financial conflict of interest is a major source of apparent disparities in results	One key source of disparities in study results is financial conflicts of interest. When present, financial conflicts strongly predict that study results will conform to the financial interests of authors or funders (Barnes & Bero, 1998; Bero, Oostvogel, Bacchetti, & Lee, 2007; Friedman & Richter, 2004; Golomb, 2008; Heres et al., 2006; Smith, 2005, 2006). An analysis examined why some review articles on passive smoking concluded it was harmful while others concluded it was not. The only identified factor that predicted which conclusion was industry conflict by authors—which was often undisclosed (Barnes & Bero, 1998). Financial conflicts have been a concern specifically in relation to RF/MW, for both studies and regulatory decisions (Adlkofer & Richter, 2011; Alster, 2015; Hardell, 2017; Huss et al., 2007; Leszczynski, 2015). In an analysis of studies looking at cell phone effects as a function of funding source, "Studies funded exclusively by industry reported the largest number of outcomes, but were least likely to report a statistically significant result" (So, they report everything that wasn't affected?) "The odds ratio was 0.11 (95% confidence interval, 0.02–0.78), compared with studies funded by public agencies or charities." Analogous to findings for a relation of industry funding to failure to find tobacco-related problems (Barnes & Bero, 1998), "the finding was not materially altered in analyses adjusted for the number of outcomes reported, study quality, and other factors" (Huss et al., 2007). It has been generally assumed that the disproportionately product-favorable results from industry-funded studies (including less evidence of product harm) arise by virtue of choices, selecting study design, exposure specifics, subjects, and outcomes to support the desired result. (These can in fact influence outcomes. See below.) But where harms of lucrative products are concerned, there is precedent for industry-funded studies going beyond those factors to hide even large and lethal harms, even for prespecified or primary outcomes—via means that have the appearance, at least, of fraud ("Did GSK trial data mask Paxil suicide risk?" 2008; Harris, 2010). Special circumstances led the apparent shenanigans in those cases to be uncovered. Whether frank manipulation of data to hide harms of lucrative products is the rule or the exception in industry-funded studies is simply not known. Because a robust body of evidence documents a strong relation of industry conflicts to outcomes, deliberations and standards should be based exclusively on studies in which such conflicts of interest are absent. (Industry-funded studies can be used for hypothesis generation.) This obviates one major source of apparent inconsistency in studies, but it eliminates inconsistencies due to this factor only as far as it is possible to discern when financial conflicts are operating.

Table 4: Continued.

Study outcomes may appear different without "inconsistency": Details matter, to see an effect	Design features can influence outcomes and may be selected to do so. Details of RF/MW exposure that may influence outcomes include the following (some relevant features have doubtless been missed): • Radiation frequency or frequencies (Belyaev, Sheheglow, Alipov, & Ushakov, 2000; Chen, Yang, Tao, & Yang, 2006; Gupta, Mesharam, & Krishnamurthy, 2018), • Radiation intensity (Adams & Williams, 1976) • Radiation waveform (Adams & Williams, 1976) • Polarization (Belyaev et al., 2000; Pall, 2018; Panagopoulos, Johansson, & Carlo, 2015), • Pulsed versus continuous radiation (Lai, Horita, Chou, & Guy, 1987; Pall, 2018) • Pulse width (Bonnafous et al., 1999) • Time between pulses (Belyaev et al., 2006)/repetition rate (1988) • Pulse waveform (Bolen, 1988; Wood, Armstrong, Sait, Devine, & Martin, 1998), • Pulse intensity (Elder & Chou, 2003), • Exposure duration (Lai & Singh, 1995; Robison, Pendleton, Monson, Murray, & O'Neill, 2002) • Exposure intermittency (Ivancsits, Diem, Pilger, Rudiger, & Jahn, 2002) on every timescale • Environmental conditions: temperature, humidity, air currents (Adams & Williams, 1976; Laszlo et al., 2006) • Concurrent (or preceeding) exposures to other radiation (Adams & Williams, 1976; Bua et al., 2018; Kostoff & Lau, 2017), which can cause synergistic effects (Adams & Williams, 1976) • Concurrent (or preceeding) chemical exposures or environment (Bua et al., 2018; Kostoff & Lau, 2017) • State of health of the animal or subject (Adams & Williams, 1976) • Species (Adams & Williams, 1976) • Size of the subject relative to wavelength (Adams & Williams, 1976) • Genetics of the animal (Belyaev et al., 2000; De Luca et al., 2014) • Antioxidant/nutrient status of the animal or subject (Ceyhan et al., 2012; Gajski & Garaj-Vrhovac, 2009; Guney et al., 2007; Gurler, Bilgici, Akar, Tomak, & Bedir, 2014; Koyu et al., 2009; Li et al., 2014; Oksay et al., 2012; Oktem et al., 2005; Oral et al., 2006; Sokolovic et al., 2013; Zhang et al., 2011; Zhang et al., 2014) • Orientation of the animal or subject relative to the radiation source (Adams & Williams, 1976) • Portion of the body irradiated (Adams & Williams, 1976) • Time between exposure and assessment of effect (Belyaev et al., 2000) • Effect measured • Metric used to measure effect

Table 4: Continued.

Radiation that is pulsed (i.e., polarized), is applied intermittently, is more intense, and is applied for a longer time may be more likely to produce problems, for instance.
Even for studies nominally examining the "same" RF/MW exposure, different choices may be made. A range of choices are illustrated in this text: "There are 124 different channels/frequencies that are used in GSM900 mobile communication. They differ by 0.2 MHz in the frequency range between 890 and 915 MHz. The test mobile phone was programmed to use channel 124 with the frequency of 915 MHz. The signal included all standard GSM modulations. No voice modulation was applied. A GSM signal is produced as 577 μs pulses (time slots), with an interpulse waiting time of 4039 μs (seven time slots). The test phone was programmed to regulate output power in the pulses in the range of 0.02–2 W (13–33 dBm). This power was kept constant during exposure at 33 dBm, as monitored online using a power meter (Bird 43, USA)" (Belyaev et al., 2006).
Studies that examine symptoms as a function of distance from cell towers and base stations suggest that in important real-world settings, more intense RF/MW exposure is generally a greater problem (Altpeter et al., 1995; Navarro, Sanchez Del Pino, Gomez, Peralta, & Boveris, 2002; Oberfeld et al., 2004; Santini et al., 2002), though there may be an intensity range below which this ceases to be the case.
In some conditions, nonmonotonic effects of radiation have been reported (Chiang et al., 1989; Pall, 2018), and they are arguably expected for agents in the antioxidant-prooxidant spectrum (high-dose antioxidants are often prooxidant; low-dose prooxidants, via oxidative preconditioning, may be antioxidant). Opposite-direction effects on a critical mechanism can produce opposite-direction effects in a resulting outcome. Thus, lower doses of vitamin E fluidize, and higher concentrations stabilize membranes (Packer & Fuchs, 1993); low vitamin E benefits and higher vitamin E harm vasodilatory function in cholesterol-fed rabbits (Keaney et al., 1994); "low tocopherol concentrations have stronger antiinflammatory effects in PUVA-induced erythema than higher concentrations" (Fuchs & Packer, 1993); low doses are tied to lower mortality in people, higher doses to higher all-cause mortality (Miller et al., 2005). For statins, an agent class that can produce prooxidant or antioxidant effects, bidirectional effects have been shown on many outcomes (Golomb et al., 2015). Such bidirectional effects have been shown for many outcomes with RF/MW (Bergman, 1965). It is common that where a lower amount of something may be favorable (or neutral), a higher amount may be the adverse, with a transition zone in which subject characteristics and covariables matter a lot in determining the direction. There are instances in which this directionality is flipped (Au, Cantelli-Forti, Hrelia, & Legator, 1990); for instance, sometimes a sufficient concentration leads an adaptive protection to be triggered.

Table 4: Continued.

	Beyond characteristics of the radiation, the subject may be exposed to it differently; for example, in animal studies, there may be whole-body radiation (Bilgici, Akar, Avci, & Tuncel, 2013) or head-only exposure (Burdelya et al., 2012; de Gannes et al., 2009), triggering a different spectrum of responses. And with in vitro exposure, even fewer of the variables that might contribute to effects are present. The environment in which exposure occurs may differ in ways that influence toxicity of radiation—for instance, differences in temperature may produce different effects (Laszlo et al., 2006), or concurrent or background electromagnetic exposure (Bua et al., 2018) or chemical exposures (Del Vecchio et al., 2009; Kostoff & Lau, 2017). Amphetamine use represents one exposure that has been reported to magnify problems with RF/MW (Bolen, 1988).
	Characteristics of the "subjects" may differ. In animal and in vitro studies, they may differ in species, strain, genetic features, cell type cell preparation, and cell density, for instance (Belyaev, Sheheglov, Alipor, & Ushakov, 2000; Del Vecchio et al., 2009).
	As above, "effect modification" refers to the phenomenon by which effects, including adverse effects, are not equal in all subgroups. This is a major issue in biology, particularly for exposures mediated by oxidative stress and cell energy impairment. Findings with statin cholesterol-lowering drugs illustrate how massive the disparity may be as a function of participant group. Like RF/MW, these agents have the potential for toxicity through prooxidant and mitochondrial adverse mechanisms (Golomb & Evans, 2008; Sinzinger et al., 2001). RF/MW disproportionately affects sleep and hearing (through its special extra features), but muscle and tendon problems are sometimes reported (Aschermann, 2009; Lamech, 2014; Schooneveld & Kuiper, 2007). Fluoroquinolones disproportionately affect tendons through their extra mechanisms. Statins can do so too, though more rarely (Esenkaya & Unay, 2011; Hoffman, Kraus, Dimbil, & Golomb, 2012; Marie & Noblet, 2009; "Tendon disorders due to statins," 2010). Statins disproportionately affect muscle. The most feared muscle complication is rhabdomyolysis, massive breakdown of muscle that can overwhelm the kidneys and lead to kidney failure and death, which is also reported with fluoroquinolones though more rarely (Eisele, Garbe, Zeitz, Schneider, & Somasundaram, 2009; George, Das, Pawar, & Badyal, 2008; Gupta, Guron, Harris, & Bell, 2012; Hsiao et al., 2005; Khammassi, Abdelhedi, Mohsen, Ben Sassi, & Cherif, 2012; Korzets, Gafter, Dicker, Herman, & Ori, 2006; Petitjeans et al., 2003; Qian, Nasr, Akogyeram, & Sethi, 2012; Sanjith, Raodeo, Clerk, Pandit, & Karnad, 2012).

Table 4: Continued.

	Statins were commonly hailed as so safe they should be put in the water supply (Brown, 2001; Dales, 2000; Haney, 1999; Roberts, 2004). But analysis of insurance claims data show that (focusing on the one adverse effect) while the rate of rhabdomyolysis was rare overall, it was common in identifiable vulnerable subgroups. Hospitalized rhabdomyolysis, per year of treatment, occurred in fewer than 1 in 22,000 on statin monotherapy. However, the rate was far higher for older persons with diabeties also on a fibrate (a second class of cholesterol-lowering drug); if they were on the statin agent whose clearance was most affected by fibrates, rhabdomyolysis occurred in about 1 in 10 per year of treatment (Graham et al., 2004). So depending on characteristics of the exposure, co-exposures, and the subject, rates of a problem—and ability for science to show the problem—can vary widely. (The particular statin agent that caused the worst problems was pulled from the market, but the conceptual point stands.) Risks of harm with exposures are not distributed equally. A problem that appears very rare overall or in one test group, often apparently not increased relative to unexposed, can be frankly common in another. If the groups most at risk are not studied or their presence is seriously diluted, serious harms can be missed. Studies that fail to detect a harm do not invalidate those that show one—and are not of equal importance where a purpose is to establish that harms can occur.
Rates of problems	Though a minority of embassy personnel were reportedly affected (Stone, 2018), the fraction is not small (Golden & Rotella, 2018). The fraction of U.S. diplomats in Cuba (and now China) reporting effects is higher than the fraction of civilians citing similar severity problems with RF/MW exposure, though in neither group can the exposure of those affected be presumed to have been typical. Table 3 suggests that once persons are symptomatic, the profile of symptoms is similar. The reportedly high prevalence of Frey-compatible effects and what seem a comparatively large number of diplomats in Cuba affected suggest exposures of a more intense or more damaging character considering that intensity, frequency, pulse waveform, pulse duration, duration, polarization, intercurrent exposures, and many other factors influence injury from RF/MW (Belyaev et al., 2000).
Natural history	Both diplomats (Associated Press in Washington, 2017) and RF/MW-affected individuals (Conrad & Friedman, 2013; Schooneveld & Kuiper, 2007) have shown variable time course to onset of symptoms after apparent inciting exposure and variable time course and completeness of recovery with time away from the exposure. Doctors submitting the Bamberg Appeal to the Prime Minister of Germany noted, "The symptoms occur in temporal and spatial relationship to exposure. . . . Some of the health disturbance disappears immediately the exposure ceases (removal of DECT telephone, temporary moving away from home, permanently moving away, using shielding)" (Waldman-Selsam, 2004). An intervention study from Japan, involving the "intervention" of removing a cellular phone base station on a condominium, affirms

Table 4: Continued.

	improvement with removal of the exposure. One hundred seven of 122 inhabitants were interviewed and had medical examinations at two time points while the base station was in operation and three months after it was removed. "The health of these inhabitants was shown to improve after the removal of the antennas, and the researchers could identify no other factors that could explain this health improvement. . . . The results of these examinations and interviews indicate a connection between adverse health effects and electromagnetic radiation from mobile phone base stations" (Shinjyo & Shinjyo, 2014). Studies in Russia of occupationally affected persons report that even with treatments that target mechanism of RF/MW injury, for those at least moderately affected, placing them back in the setting of exposure leads to a progressive course (Sadchikova & Glotova, 1973).
	Natural history could differ for diplomats who may have been exposed to a more intense stimulus or one with more injurious characteristics—suggested by what appear to be a comparatively high number affected and a high prevalence of Frey effects. With a powerful exposure, depressed defenses are not equally required to produce injury. There is not a basis to know if affected diplomats will have heightened vulnerability to "usual" RF/MW exposures going forward, though this bears assessing.

[a]An illustration from a common drug, and a common food: "Grapefruit juice increased the mean peak serum concentration (Cmax) of unchanged simvastatin about 9-fold (range, 5.1-fold to 31.4-fold; $P < .01$) and the mean area under the serum simvastatin concentration-time curve [AUC (0-infinity)] 16-fold (range, 9.0-fold to 37.7-fold; $P < .05$)" (Lilja, Kivisto, & Neuvonen, 1998). Thus, just one comparatively innocuous interacting factor, grapefruit juice (which inhibits an enzyme involved in simvastatin metabolism), led some to have a 38-fold greater blood "amount" of a drug, than that same person would have had without the juice. Potential differences are magnified comparing different persons with or without juice, and more so factoring in impact of other exposures. Other risk-multiplying factors are tied to the individual. The same serum level can produce a radically different impact from person to person; relevant factors include genetic differences in muscle and factors that reduce energy supply or increase energy demand to muscle (Golomb, 2014; Golomb & Evans, 2008; Golomb & Koperski, 2013; Oh, Ban, Miskie, Pollex, & Hegele, 2007; Sinzinger & O'Grady, 2004; Vladutiu et al., 2006). Thus, what is the "same" exposure before it hits two people can become a radically different exposure once it interacts with individuals' biology.

exposure-related illnesses, genetic influences on phase I or phase 2 detoxification, as well as factors that inhibit or compete for detoxification systems, play a documented role in who develops health effects (Cherry et al., 2002; Ishikawa et al., 2004; Molden, Skovlund, & Braathen, 2008; Page & Yee, 2014; Rowan et al., 2009; Steele, Lockridge, Gerkovich, Cook, & Sastre, 2015). (Phase II detoxification encompasses protections against oxidative damage.)

Table 5 briefly addresses the range of RF/MW sources that have been presumptively tied to problems. It observes that RF/MW/microwave radiation is known to have been used on the U.S. embassy in Moscow; there is precedent for use on diplomats (Gwertzman, 1976; Schumaker, 2013). That instance, though with presumably differing details of exposure, led to (disputed) reports of health effects in embassy staff and shielding efforts by the United States. Since the exposing device can be outside the building—and typically has been, for persons affected by RF/MW-emitting utility meters (Lamech, 2014)—failure of the FBI to find devices in sweeps of diplomats' rooms remains compatible with this explanation.

4 Discussion

4.1 Recap of Findings. Health effects reported by U.S. and Canadian diplomats (and family members) in Cuba and China, and the circumstances surrounding inciting episodes, are consistent with effects of RF/MW. Reports of perceived sounds fit known characteristics reported for the Frey effect (microwave auditory effect). Sounds were heard by some but not other diplomats during inciting episodes; sounds differed in character from person to person; sounds included chirping, ringing, and grinding; and sounds were heard predominantly at night. Sounds were localized with laserlike specificity in some of the cases and, within that localization, seemed to follow people. Prominence of auditory symptoms, including hearing loss, tinnitus, and ear pain in diplomat reports, typify reports of injury from pulsed RF/MW. Presence of variable additional symptoms of protean character that differ markedly from person to person, with a relative emphasis on sleep disturbance, headaches, and cognitive problems, plus presence in smaller subsets of vision, balance, and speech problems, are also characteristic. Affected persons in both groups report sensory symptoms of pressure and vibrations. Persons in both groups show evidence of brain injury. Reports in both indicate that some persons had prior head injury, and brain injury may be a predisposing factor for as well as a consequence of RF/MW injury (Heuser & Heuser, 2017; Stone, 2018). Both show varying rates of symptom persistence. How subsequent natural history will compare, for diplomat symptoms that *might* follow more intense discrete exposure (a more intense exposure may produce problems in persons who need not have relative vulnerability), versus follow repeated less intense ones (producing symptoms, evidence suggests, selectively in

Table 5: RF/MW Source Considerations.

What kinds of RF/MW sources affect civilians?	In the UCSD survey, smart meters were the dominant inciting trigger (about 50% of those 70% or so who recognized a triggering episode), with cell phones, Wi-Fi introduction or new routers, medical radiation, and other factors also reported (Golomb, 2015a). The range of apparent triggers has been vast, with RF/MW, and particularly pulsed RF/MW, commonly implicated. Considering those who have communicated with us, a couple from Scotland became affected several decades ago, after they moved to a rural area but across from a radar factory. Though they moved away, both remain "electrosensitive" decades later. Others became affected when a cell tower was placed next to their home. Gro Harlem Brundtland reports becoming sensitized following exposure to a malfunctioning microwave oven in an episode that also reportedly blinded her for a year (Woolston, 2010; www.es-uk, 2012). An Australian veteran reports that he became affected during his military service, working with radiofrequency radiation (radar workers in the military were among the first groups in whom such problems were recognized many decades ago). One who communicated with us became sensitized in association with a job placing radio collars on wildlife. An architect who contacted us was sensitized after several months working closely with Bluetooth-enabled lighting devices. Parents reported to us the onset of ES in their children with Wi-Fi introduced to the school; accommodations were denied, forcing parents to remove their children from school and move elsewhere and forcing some teachers from their job ("Math teacher asks school to protect children from Wi-Fi," 2015; "Math teacher raises concerns about WIFI comparing the effects to a concussion," 2014). In Sweden and the United Kingdom, a controversial radio system, TETRA, reportedly caused health problems in some police officers, severe insomnia in a Swedish officer resolved when the officer's managers noted the connection and placed the officer in a room without the exposure (www.es-uk, 2012). Some U.S. firefighters were affected after municipalities placed cell towers on roofs of fire stations (International Association of Fire Fighters Division of Occupational Health Safety and Medicine, 2006): "Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn't recall how to start the procedure over again. Prior to the installation of the tower on his station, this medic had reportedly not made a single mistake in 20 years" (Foster, 2017). The International Association of Fire Fighters Division of Occupational Health, Safety and Medicine crafted a position paper (International Association of Fire Fighters Division of Occupational Health Safety and Medicine, 2006), and firefighters were exempted in the recent proposed California bill, SB-649 (Foster, 2017; "State of California Senate Bill 649 (SB-649): Wireless Telecommunications Bill," 2017), that sought to bypass local control in placing of 5G cell towers (Foster, 2017).

Table 5: Continued.

	These were not nocebo effects; many developed symptoms prior to identifying the source of the problem or, in some cases, even being aware that the exposure existed at that time. Many had no idea the exposure had the potential to produce problems. They were blindsided by the onset of new problems. The causes were identified by their spatial and temporal relationship to onset, worsening, and abatement.
	Reports of problems from commercial sources of RF/MW have emerged from many nations including Russia (Sadchikova & Glotova, 1973), Korea (Cho et al., 2016), Japan (Kato & Johansson, 2012), Taiwan (Tseng, Lin, & Cheng, 2011), Turkey (Durusoy et al., 2017), Israel (Tachover, 2013), Australia (Lamech, 2014), New Zealand (www.esnztrust), France (Belpomme et al., 2015), England (Bergqvist et al., 1997; Eltiti et al., 2007), Ireland (Bergqvist et al., 1997; IDEA, www.iervn.com), Spain (Bigorra, 2016; Navarro et al., 2003; Oberfeld et al., 2004), Italy (Bergqvist et al., 1997; De Luca et al., 2014), the Netherlands (Schooneveld & Kuiper, 2007), Switzerland (Altpeter et al., 1995; Schreier et al., 2006), Austria (Bergqvist et al., 1997; Hutter, Moshammer, Wallner, & Kundi, 2006; Leitgeb, 1998; Schröttner & Leitgeb, 2008), Germany (Bergqvist et al., 1997; Hensinger & Wilke, 2016), Denmark (Bergqvist et al., 1997; EHS Foreningen, 2018), Sweden (Gruber et al., 2018; Johansson, 2015) where Ericsson designer Per Segerbäck was seriously affected (Nordström, 2004), Norway (www.felo.no) afflicting three-time Prime Minister Gro Harlem Brundtland; Finland (Hagstrom et al., 2013) reportedly affecting former Nokia chief technology officer Matti Niemela (Nikka, 2014), the United States (Carpenter, 2014; Heuser & Heuser, 2017; Levallois et al., 2002; Woolston, 2010), where affected former Silicon Valley techies Peter Sullivan (Harkinson, 2017) and Jeromy Johnson (Johnson, n.d.) strive to bring attention to the problem; and Canada, where Frank Clegg, formerly President of Microsoft Canada, Inc, now CEO of Canadians for Safe Technology—spearheads the effort toward recognition (Clegg, 2013).
Past RF/MW use and diplomats	Exposure of diplomats to RF/MW is not a new phenomenon. The U.S. embassy in Moscow was reportedly radiated with microwaves from 1953 to 1988 (other sources give earlier or later end dates), spawning U.S. efforts to shield the embassy (Gwertzman, 1976; Schumaker, 2013). The Soviets claimed the purpose was to jam U.S. listening devices (Gwertzman, 1976).
	Based on reports of past embassy staff, a number of personnel and their offspring developed health effects, some developed white blood cell count elevations, and a couple developed hematological malignancies (Schumaker, 2013). Elevated white blood cell counts (Aschermann, 2009), as well as depressed ones (Adams & Williams, 1976), have elsewhere been reported in association with RF/MW, as have hematological malignancies (Dolk et al., 1997; Hocking & Gordon, 2003), including a recent report of an occupational relationship of RF/MW to "hemolymphatic" malignancies in the military setting: "The PF [percentage frequency] of HL [hemolymphatic]

Table 5: Continued.

	cancers in the case series was very high, at 40% with only 23% expected for the series age and gender profile, confidence interval CI95%: 26–56%, $p < 0.01$, 19 out of 47 patients had HL cancers. We also found high PF for multiple primaries. As for the three other cohort studies, in the Polish military sector, the PF of HL cancers was 36% in the exposed population as compared to 12% in the unexposed population, $p < 0.001$. In a small group of employees exposed to RF/MW in Israeli defense industry, the PF of HL cancers was 60% versus 17% expected for the group age and gender profile, $p < 0.05$. In Belgian radar battalions the HL PF was 8.3% versus 1.4% in the control battalions as shown in a causes of deaths study and HL cancer mortality rate ratio was 7.2 and statistically significant. Similar findings were reported on radio amateurs and Korean war technicians. Elevated risk ratios were previously reported in most of the above studies" (Peleg, Nativ, & Richter, 2018). There was also a news report of a "blood disorder" in a Cuban diplomat, but its character was unspecified (Robles & Semple, 2017a).
	A controversial Johns Hopkins study was commissioned to assess the health of Moscow embassy personnel but was never published in peer-reviewed literature. Staff from other Eastern European embassies were used as controls (Elwood, 2012), a problematic control group as these are the embassies most likely to have been subjected to similar exposures. Indeed a Freedom of Information Act request reportedly yielded claims of exposure from employees at other embassies (Elwood, 2012). A reanalysis asserted that Russian and Eastern European diplomats, if combined, exhibited a significant increase, relative to expectation from the general US population, in three cancer types (Elwood, 2012; Goldsmith, 1995) that have each been associated with RF/MW exposure in other studies: hematological malignancy (Peleg et al., 2018), brain cancer (Hardell & Carlberg, 2013, 2015; Hardell, Carlberg, & Hansson Mild, 2011; Hardell, Carlberg, Soderqvist, & Mild, 2013), and breast cancer (Balekouzou et al., 2017; West et al., 2013). Some complaints, such as vision problems, concentration problems, memory loss, depression, and "other symptoms" were greater in the Moscow than the comparator group, in either men or women or, for vision and concentration problems, in each men and women. A reanalysis concluded that the Lilienfeld evidence in the context of other literature "support the RF sickness syndrome as a medical entity" (Johnson Liakouris, 1998).
Current RF/MW source possibilities in diplomats	The source of proposed EMR/RF/MW (probably pulsed) affecting diplomats is not a principal focus of this article.
	For the diplomats in Cuba, causative RF/MW could in principle emanate from monitoring and surveillance devices, as has been speculated for microwaving of the U.S. embassy in Moscow (Gwertzman, 1976); from efforts to jam our listening devices, as claimed by the Soviets (Gwertzman, 1976); or from electronic weaponry, or conceivably from innocent communications sources of the type that affect some civilians (but presumably of higher typical pulse intensity, or shorter pulse duration, or in the setting of other exposures that amplify oxidative stress, or with some other feature that amplifies the fraction affected).

Table 5: Continued.

	Weaponry or surveillance would seem perhaps the most likely, given the apparent preferential involvement of CIA operatives under diplomatic cover (Golden & Rotella, 2018).
Room sweep by FBI yielded no devices. (Lederman, Weissenstein, & Lee, 2017)	The source of the historical microwave exposure on the U.S. embassy in Moscow was also outside the embassy building. It reportedly originated from the building next door and later from the building across the street (Gwertzman, 1976).
	Smart meters (or banks of them), outside the room, were the number one reported instigating cause of symptoms in the UCSD survey, with other causes, including base stations or cell towers outside the home. Pulsed RF/MW-producing devices, including so-called "Through the wall" (TTW) surveillance technology, need not be in the room. The exposure can be short term or intermittent; it need not be continuous. For this reason, devices in whatever their location need not remain present after health effects have been produced.

persons more vulnerable to free radical injury from RF/MW, at a level to which they will likely have subsequent exposure), is not known.

4.2 Fit with Literature. Evidence for health effects of RF/MW is not new (Adams & Williams, 1976; Bergman, 1965; Bolen, 1988; Raines, 1981). A 1971–1972 naval report bearing over 2300 citations, many from Russia and eastern Europe, already documented health effects of microwave/RF/MW, emphasizing "non-ionizing radiation at these frequencies" (Glaser, 1972). Contrary to claims by industry-affiliated parties, copious evidence documents that radiation that is not "ionizing" can also cause health effects. Entire sections of the 1971–1972 report were devoted to each of a number of the symptoms that diplomats are now reporting, including insomnia, headache, fatigue, cognitive problems, and dizziness (Glaser, 1972). Injury from nonionizing radiation occurs also without measurable heating: nonthermal radiation (Avendano, Mata, Sanchez Sarmiento, & Doncel, 2012; Leszczynski, Joenvaara, Reivinen, & Kuokka, 2002; Markova, Hillert, Malmgren, Persson, & Belyaev, 2005). Indeed, oxidative stress, which mediates nonthermal effects, also mediates thermal effects, and melatonin, which defends against oxidative RF/MW injury, also defends against so-called thermal injury (Bekyarova, Tancheva, & Hristova, 2009; Maldonado et al., 2007; Sener, Sehirli, Satiroglu, Keyer-Uysal, & Yegen, 2002a, 2002b; Tunali, Sener, Yarat, & Emekli, 2005). Moreover, other sources of heat do not produce the same so-called thermal damage that RF/MW does (Bolen, 1988): what are deemed thermal effects may be among the manifestations of oxidative injury. While a low percentage of individuals experience overt symptoms from usual RF/MW, the absolute number may be vast: the fraction with electrosensitivity/electromagnetic illness has been estimated at between 1% and 5%, and is apparently rising (Hillert, Berglind, Arnetz, & Bellander, 2002; Johansson, 2006; Levallois, Neutra, Lee, & Hristova, 2002; Schreier, Huss, & Roosli, 2006; Schröttner & Leitgeb, 2008).

4.3 Limitations. Features of diplomats' experiences rely on media reports and one published neurological evaluation. We did not examine diplomats; however, in conditions with highly distinctive characteristics, the history is often the most important factor in the diagnosis, and diplomats' reports bear highly distinctive characteristics. The close matching of these distinctive characteristics to those of persons with health problems arising in apparent relation to pulsed RF/MW provides a basis for concern that RF/MW exposures may underlie diplomats' symptoms and health conditions.

A tremendous number of physicians and scientists and entities and scientific studies and government reports, in many nations and over many decades, have identified that RF/MW causes symptoms consistent with the spectrum now described for diplomats. Scientific skepticism about RF/MW health effects is well represented in the literature but is of the

industry-fueled stripe (think tobacco): effects of conflicts of interest on research results (as well as on funding, regulatory agencies, legislation and academics) regarding RF/MW, have been repeatedly documented and decried (Alster, 2015; Hardell, 2017; Huss, Egger, Hug, Huwiler-Müntener, & Röösli, 2007; Kostoff & Lau, 2017; Leszczynski, 2015), and evidence of this influence parallels evidence of the potent impact of conflict of interest in medicine more generally (Golomb, 2008). In one illustrative analysis, studies of health effects of cell phones that were funded exclusively by industry were least likely to report a significant effect. Relative to studies funded exclusively by public agencies or charities, the odds ratio was 0.11 (95% CI 0.02–0.78) (Huss et al., 2007)—that is, the odds were about a tenth as great for a significant finding in a study in purely industry-funded studies. The finding was not materially altered when analysis was adjusted for factors like study quality.

Richard Smith, then editor in chief of the *British Medical Journal*, penned an article "Conflicts of Interest: How Money Clouds Objectivity." Responding to evidence tying study results on a different lucrative product (tobacco) to conflicts of interest (often undisclosed), he suggested, "far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies" (Smith, 2006).

5 Conclusion and Implications

Numerous highly specific features of diplomats' experiences and symptoms fit the hypothesis of RF/MW injury. If doubts remain, earplugs could be issued to diplomats for use in candidate episodes (e.g. strange noise plus ear pain); these should mute perceived noise from sonic sources (caveat: a sound like crickets chirping may in fact be crickets chirping), but not microwave ones—which may even be intensified. Monitoring for culpable radiation sources must sensitively capture pulsed RF/MW, including that which may be used only on an intermittent basis. It should encompass the 2.4 to 10,000 MHz range in which the Frey effect has been reported. Perhaps attention to diplomats' plight can ignite awareness of the many others affected by similar problems. Meanwhile, research documenting compatible health effects of RF/MW in a subgroup may inform those caring for diplomats and those in pursuit of causative devices.

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BIOLOGICAL EFFECT OF MILLIMETER RADIOWAVES

Kiev VRACHEBNOYE DELO in Russian No 3, 1977 pp 116-119

[Article by N. P. Zalyubovskaya, Khar'kov Scientific Research Institute of Microbiology, Vaccines and Sera imeni Mechnikov]

[Text] Morphological, functional and biochemical studies conducted in humans and animals revealed that millimeter waves caused changes in the body manifested in structural alterations in the skin and internal organs, qualitative and quantitative changes of the blood and bone marrow composition and changes of the conditioned reflex activity, tissue respiration, activity of enzymes participating in the processes of tissue respiration and nucleic metabolism. The degree of unfavorable effect of millimeter waves depended on the duration of the radiation and individual characteristics of the organism.

The ubiquitous propagation of radiowaves, radio broadcasting and television is contributing to the appearance of a new physical factor -- electromagnetic waves of the radio-frequency range. In recent years it has been established that radiowaves of different ranges have an unfavorable influence on the organism. The literature data (A. G. Subbota, 1970; N. V. Tyagin, 1971; B. A. Chukhlovin, 1973; M. I. Yakovleva, 1973; Yu. D. Dumanskiy et al, 1975) testify that long stay in conditions of the effect of radiowaves (the dm and cm ranges) leads to change of the functions of the nervous, cardiovascular and other systems of the organism, with the development of a characteristic complex of symptoms which permit speaking of a special nosological form of disease -- radiowave disease (M. N. Sadchikova, 1973). However, in the literature there is almost no information about the biological effect of radio frequencies of the millimeter range, although that range is widely used in technology and the question of its biological activity has acquired special urgency.

The goal of the present investigations consisted in study of the physiological and biochemical processes lying at the basis of the changes which occur in animals as a result of the effect of radiowaves in the range of 5-8 mm, at a density of the flow of power of 1 milliwatt/cm^2. The investigations were conducted on rats of the Wistar line and mice of the CBA line, irradiated for 15 minutes daily in the course of 60 days in the volume resonator of an experimental installation working on the basis of a type OV-12 generator.

Study of the morphological, functional and biochemical indicators, which play an essential role in the formation of reactions of the organism, disclosed various disorders in the experimental animals.

As is known, the energy of millimeter waves, because of its weak penetrating ability, is absorbed primarily and mainly by the skin. Our investigations have shown that in the skin of irradiated animals deformation of the receptor apparatus and well-expressed changes of a reactive character were observed. In the skin layer properly speaking appeared bunches of nerve fibers with hypertrophy of a portion of the fiber and sections with demyelinization. In the dermis, among the collagen fibers were small trunks of various thickness, the neural conductors of which were fragmented in separate cases, and phenomena of demyelinization were observed in the surface layers.

As the results of histomorphological analysis showed, in the functionally active structures of tissue of the myocardium, liver, kidneys and spleen disorders of the hemodynamics were established, with disruption of the permeability of the vesicular membranes, the appearance of micronecroses and subsequent tissue dystrophy. Moreover, qualitative and quantitative shifts were revealed in the erythrocytic and leukocytic composition of the blood of irradiated animals, indicating suppression of the hemopoietic function of the bone marrow and lymphatic system. Noted in the composition of the red blood was eosinophilia, neutrophilia and lymphopenia, and lowering of the hemoglobin level and reduction of the number of erythrocytes were observed, which was determined to a considerable degree by the retention of erythrocytes in the bone marrow. In the latter occurred an increase of the number of erythroblastic cells and decrease of cells of the leukoblastic series.

Under the effect of millimeter waves of low intensity the degree of affection depends on the general condition of the organism and evidently is not so great, as the observed disorders are in the main reversible.

A characteristic feature of the biological effect of radiowaves was changes of the state of various sections of the central and vegetative nervous systems which involve directly or indirectly disorders of the principal functions of the organisms (M. I. Yakovlev, 1973).

As a result of investigations conducted by us on animals irradiated with millimeter waves, disorders of conditioned reflex activity have been established: weakening of the stimulatory process, reduction of the size of the latent period in response to different conditioned stimuli (light, noise or pain) and disinhibition of differentiation reactions. Disorders of the stimulatory and inhibitory processes displayed in animals during the repeated effects of millimeter radiowaves can be considered suppression of the function of the central nervous system, although the developed inhibition can be linked with protective-compensatory reaction of the organism in response to irradiation.

In the blood plasma of irradiated animals the content of 17-oxycorticosteroids increased (22.64 ± 2.18 mkg per 100 ml of plasma of the irradiated and 14.98 ± 2.01 mkg of the unirradiated. Along with that, in the adrenal cortex of

rats irradiated by millimeter waves the ascorbic acid level dropped 30%. The functional changes established in the content of 17-ocs in the blood plasma and of ascorbic acid in the adrenal cortex of irradiated animals indicate the influence of millimeter radiowaves on the central components of the hypothalamus-hypophysis system -- the adrenal glands with involvement of a number of humoral components.

The conducted investigations showed that in animals subjected to the effect of millimeter radiowaves there was a variation of the content and ratio of catecholamines: in the blood the concentration increased, in the hypothalamus the adrenaline content increased and the noradrenaline level dropped, in the cerebral cortex there was a slight redistribution of catecholamines, in the adrenal glands the adrenaline content doubled and the noradrenaline level dropped by 11% in comparison with that in unirradiated animals. The adrenaline concentration in the adrenal glands remained elevated by 60% 10 days after the irradiation ceased. The obtained results indicate well-expressed changes of metabolism of catecholamines under the influence of millimeter waves both in the hormonal and in the sympathetic components of the sympathetic-adrenal system and also reflect changes of the functional activity of its hormonal and mediator components.

The main mass of the energy in tissues and organs of animal organisms, as is known, is released during the biological oxidation of organic substances, in which case the greater part of it is accumulated in the form of macroergs. The processes of bioenergetics, occurring mainly in the mitochondria with the direct participation of respiratory enzymes which accomplish the terminal stage of biological oxidation, are of universal importance and assure the functional activity of organs and tissues, the synthesis of proteins and nucleic acids, the formation of some intermediate products of exchange, etc.

The conducted investigations showed that the irradiation of animals by millimeter waves caused changes of the processes of oxidative phosphorylation in the liver, kidneys, heart and brain of the animals. The irradiation inhibited the oxygen consumption rate by the mitochondria of those organs in the active phosphorylating state and slowed down the rate of respiration upon exhaustion of the ATP. In the liver and kidneys of irradiated animals the intensity of phosphorylation decreased by 64%, the values of the respiratory controls decreased by 26 and 28% respectively and the changes were less expressed in the heart and brain.

The established disorders of the process of conjugate oxidative phosphorylation in the mitochondria of irradiated animals testify to suppression of energy exchange and can be a result of changes occurring in the electron transport chain. The expressed hypothesis was confirmed by the results of investigations of the activity of enzymes participating in the processes of tissue respiration. In the mitochondria of the livers of irradiated animals the succinate dehydrogenase activity increased by 34% and the cytochromoxidase activity decreased by 37%. Those data testify to destruction of the cytochrome chain.

Very essential in the system of enzymes of cell energy supply is the role of the ATPases regulating the processes of formation and use of the energy of macroergs (V. P. Skulachev, 1969). The conducted investigations revealed in the mitochondria of the livers of irradiated animals an increase of ATPase activity by 63% as compared with similar indicators for the unirradiated. In that case in the liver and spleen of animals irradiated many times by millimeter waves there was a decrease of the content of adenylnucleotides by 61 and 68% respectively.

Investigation of the influence of millimeter waves on the state of nucleic exchange showed that in the liver, spleen, kidneys, lungs and heart there was a reduction of the content of nucleic acids and suppression of the rate of ^{14}C-thymidine in DNA and ^{14}C-uridine in RNA. In a comparison of the results of quantitative determination of nucleic acids it was established that the rate of inclusion of the predecessor in RNA and its content in the organs changes less than the DNA. The change of the nucleic acids concentration was more expressed in the liver, spleen and kidneys than in the heart and lungs. Together with reduction of the nucleic acids content, the quantity of acid-soluble products in the liver and spleen of irradiated animals increased by 35 and 43% and the activity of ribonuclease and DNAase increased 50%.

Under the influence of radiowaves the protein spectrum of the blood serum changed (the albumin content decreased and the number of globulins increased, which led to decrease of the value of the albumin-globulin coefficient) and the number of free amino acids decreased by 22%. An indicator of the reduced level of protein synthesis in the irradiated animals also was the established reduction of the rate of inclusion of ^{14}C-methionine in proteins of the liver, spleen, lymph nodes and thymus. The presented data testify to substantial changes in the protein metabolism which occur under the influence of multiple irradiation of animals by millimeter radiowaves. Evidently the reduction of of the general energy level occurring in the organism under the influence of millimeter radiowaves had an effect on the formation of macroergs and caused a suppression of all functions of the organism, including suppression of synthetic processes but especially of nucleoprotein metabolism, which is very energy-consuming.

The conducted experimental investigations were compared with observations of the state of health of 97 persons working with generators of the millimeter range on the basis of systematic conducting of biochemical analyses. The obtained data confirmed the existence of an influence of radiowaves on the state of metabolic processes in the organism, in particular, changes of the indicators of protein and carbohydrate metabolism were revealed and disturbances of the indicators of immuno-biological reactivity and of the blood system were established.

Thus the conducted investigations indicate high biological activity and an unfavorable influence of millimeter radiowaves on the organism. The expressness of the biological reactions increased with increase of the period of irradiation and depended on individual characteristics of the organism.

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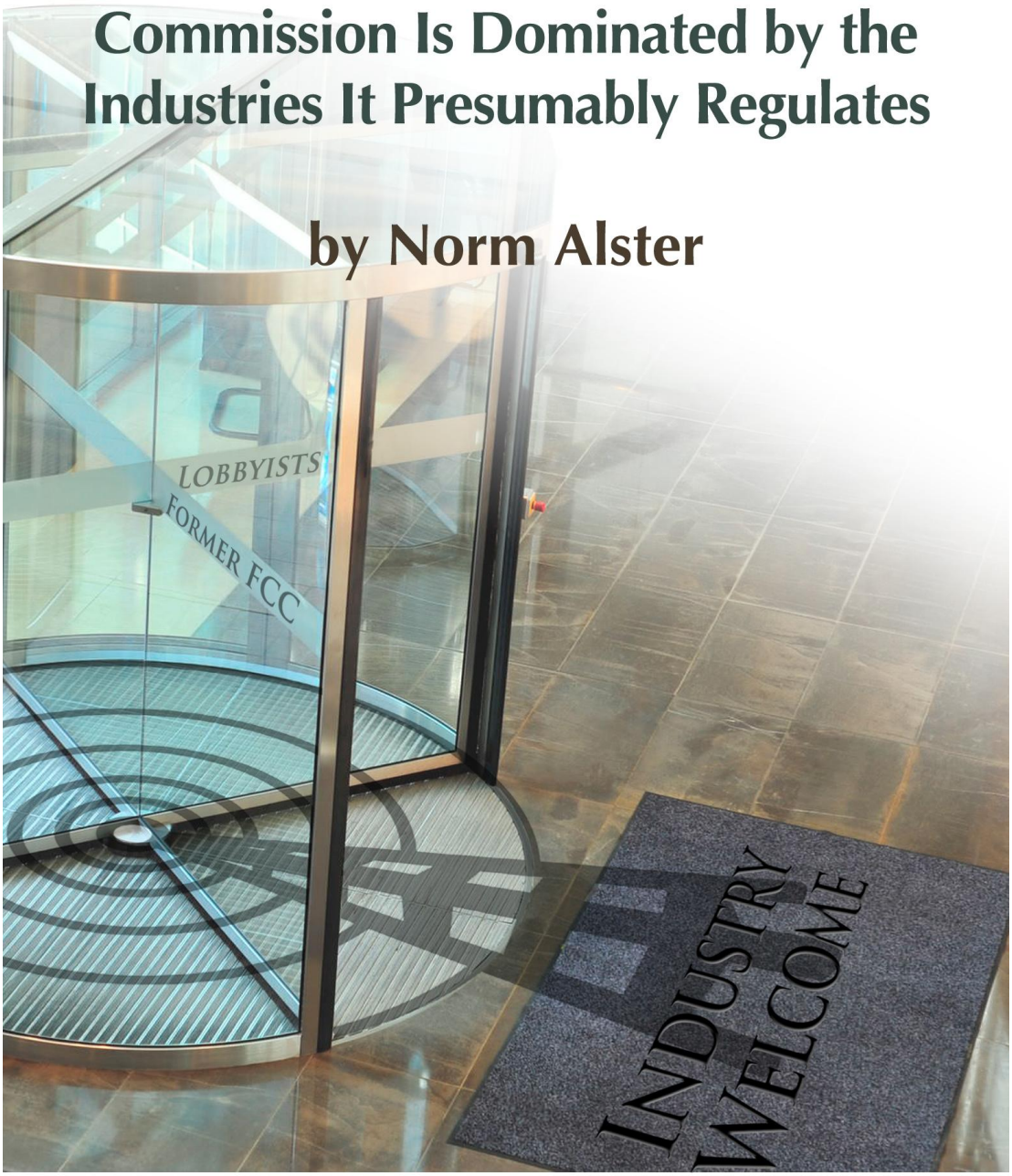
Captured Agency:

How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

by Norm Alster



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How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates

By Norm Alster

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Chapter One: The Corrupted Network

Renee Sharp seemed proud to discuss her spring 2014 meeting with the Federal Communications Commission.

As research director for the non-profit Environmental Working Group, Sharp doesn't get many chances to visit with the FCC. But on this occasion she was able to express her concerns that lax FCC standards on radiation from wireless technologies were especially hazardous for children.

The FCC, however, should have little trouble dismissing those concerns.

Arguing that current standards are more than sufficient and that children are at no elevated risk from microwave radiation, wireless industry lobbyists don't generally have to set up appointments months in advance. They are at the FCC's door night and day.

Indeed, a former executive with the Cellular Telecommunications Industry Association (CTIA), the industry's main lobbying group, has boasted that the CTIA meets with FCC officials "500 times a year."[1]

Sharp does not seem surprised. "There's no question that the government has been under the influence of industry. The FCC is a captured agency," she said.[2]

Captured agency.

That's a term that comes up time and time again with the FCC. Captured agencies are essentially controlled by the industries they are supposed to regulate. A detailed look at FCC actions—and non-actions—shows that over the years the FCC has granted the wireless industry pretty much what it has wanted. Until very recently it has also granted cable what it wants. More broadly, the FCC has again and again echoed the lobbying points of major technology interests.

Money—and lots of it—has played a part. The National Cable and Telecommunications Association (NCTA) and CTIA have annually been among Washington's top lobbying spenders. CTIA alone lobbied on at least 35 different Congressional bills through the first half of 2014. Wireless market leaders AT&T and Verizon work through CTIA. But they also do their own lobbying, spending nearly $15 million through June of 2014, according to data from the Center for Responsive Politics (CRP). In all, CTIA, Verizon, AT&T, T-Mobile USA, and Sprint spent roughly $45 million lobbying in 2013. Overall, the Communications/Electronics sector is one of Washington's super heavyweight lobbyists, spending nearly $800 million in 2013-2014, according to CRP data.

But direct lobbying by industry is just one of many worms in a rotting apple. The FCC sits at the core of a network that has allowed powerful moneyed interests with limitless access a variety of ways to shape its policies, often at the expense of fundamental public interests.

As a result, consumer safety, health, and privacy, along with consumer wallets, have all been overlooked, sacrificed, or raided due to unchecked industry influence. The cable industry has consolidated into giant local monopolies that control pricing while leaving consumers little choice over content selection. Though the FCC has only partial responsibility, federal regulators have allowed the Internet to grow into a vast hunting grounds for criminals and commercial interests: the go-to destination for the surrender of personal information, privacy and identity. Most insidious of all, the wireless industry has been allowed to grow unchecked and virtually unregulated, with fundamental questions on public health impact routinely ignored.

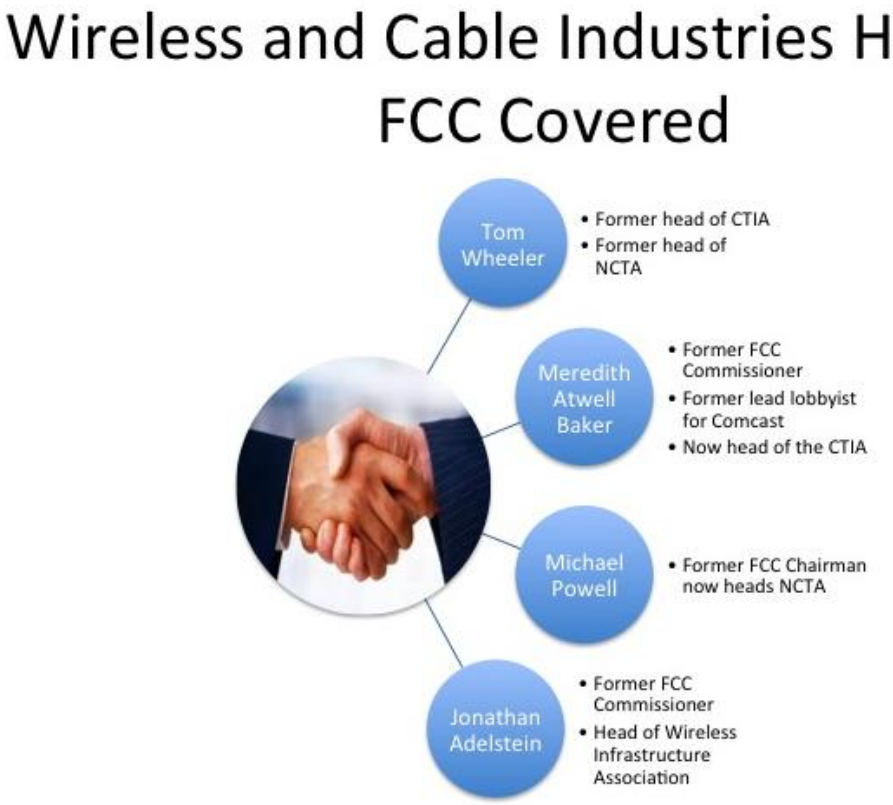
Industry controls the FCC through a soup-to-nuts stranglehold that extends from its well-placed campaign spending in Congress through its control of the FCC's Congressional oversight committees to its persistent agency lobbying. "If you're on a committee that regulates industry you'll be a major target for industry," said Twaun Samuel, chief of staff for Congresswoman Maxine Waters.[3] Samuel several years ago helped write a bill aimed at slowing the revolving door. But with Congress getting its marching orders from industry, the bill never gained any traction.

Industry control, in the case of wireless health issues, extends beyond Congress and regulators to basic scientific research. And in an obvious echo of the hardball tactics of the tobacco industry, the wireless industry has backed up its economic and political power by stonewalling on public relations and bullying potential threats into submission with its huge standing army of lawyers. In this way, a coddled wireless industry intimidated and silenced the City of San Francisco, while running roughshod over local opponents of its expansionary infrastructure.

On a personal level, the entire system is greased by the free flow of executive leadership between the FCC and the industries it presumably oversees. Currently presiding over the FCC is Tom Wheeler, a man who has led the two most powerful industry lobbying groups: CTIA and NCTA. It is Wheeler who once supervised a $25 million industry-funded research effort on wireless health effects. But when handpicked research leader George Carlo concluded that wireless radiation did raise the risk of brain tumors, Wheeler's CTIA allegedly rushed to muffle the message. "You do the science. I'll take care of the politics," Carlo recalls Wheeler saying.[4]

Wheeler over time has proved a masterful politician. President Obama overlooked Wheeler's lobbyist past to nominate him as FCC chairman in 2013. He had, after all, raised more than $700,000 for Obama's presidential campaigns. Wheeler had little trouble earning confirmation from a Senate whose Democrats toed the Presidential line and whose Republicans understood Wheeler was as industry-friendly a nominee as they could get. And while Wheeler, at the behest of his Presidential sponsor, has taken on cable giants with his plans for net neutrality and shown some openness on other issues, he has dug in his heels on wireless.

Newly ensconced as chairman of the agency he once blitzed with partisan pitches, Wheeler sees familiar faces heading the industry lobbying groups that ceaselessly petition the FCC. At CTIA, which now calls itself CTIA - The Wireless Association, former FCC commissioner Meredith Atwell Baker is in charge.



And while cell phone manufacturers like Apple and Samsung, along with wireless service behemoths like Verizon and AT&T, are prominent CTIA members, the infrastructure of 300,000 or more cellular base stations and antenna sites has its own lobbying group: PCIA, the Wireless Infrastructure Association. The President and CEO of PCIA is Jonathan Adelstein, another former FCC commissioner. Meanwhile, the cable industry's NCTA employs former FCC chairman Michael Powell as its president and CEO. Cozy, isn't it?

FCC commissioners in 2014 received invitations to the Wireless Foundation's May 19th Achievement Awards Dinner. Sounds harmless, but for the fact that the chief honoree at the dinner was none other than former wireless lobbyist but current FCC Chairman Tom Wheeler. Is this the man who will act to look impartially at the growing body of evidence pointing to health and safety issues?

The revolving door also reinforces the clout at another node on the industry-controlled influence network. Members of congressional oversight committees are prime targets of

industry. The cable industry, for example, knows that key legislation must move through the Communications and Technology Subcommittee of the House Energy and Commerce Committee. Little wonder then that subcommittee chairman Greg Walden was the second leading recipient (after Speaker John Boehner) of cable industry contributions in the last six years (through June 30, 2014). In all, Walden, an Oregon Republican, has taken over $108,000 from cable and satellite production and distribution companies.[5] But he is not alone. Six of the top ten recipients of cable and satellite contributions sit on the industry's House oversight committee. The same is true of senators on the cable oversight committee. Committee members were six of the ten top recipients of campaign cash from the industry.[6]

Cable & Satellite Campaign Contributions

Top House Recipients Funded

Recipient	Amount
John A. Boehner	$135,425
Greg Walden	$108,750
Bob Goodlatte	$93,200
John Conyers Jr.	$84,000
Mike Coffman	$82,137
Fred Upton	**$73,500**
Lee Terry	**$65,916**
Henry A. Waxman	**$65,000**
Cory Gardner	**$64,500**
Anna G. Eshoo	**$60,500**

Cellular Industry Campaign Contributions

Top House Recipients Funded

Recipient	Amount
Henry A. Waxman	**$41,500**
Scott H. Peters	$40,300
Greg Walden	**$35,750**
Fred Upton	**$32,250**
Bob Goodlatte	$31,250
Lee Terry	**$29,600**
Anna G. Eshoo	**$27,000**
Doris O. Matsui	**$25,500**
John Shimkus	**$24,000**
Peter J. Roskam	$21,100

Cable & Satellite Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$320,500**
Kirsten E. Gillibrand	$194,125
Mitch McConnell	$177,125
Harry Reid	$175,600
Charles E. Schumer	$175,450
Mark L. Pryor	**$172,950**
Michael F. Bennet	$159,000
Richard Blumenthal	**$148,800**
Claire McCaskill	**$138,185**
Mark Udall	$136,625

Cellular Industry Campaign Contributions

Top Senate Recipients Funded

Recipient	Amount
Edward J. Markey	**$155,150**
Mark R. Warner	$74,800
Harry Reid	$73,600
Mark L. Pryor	**$71,900**
Roy Blunt	**$57,400**
John McCain	$56,261
Charles E. Schumer	$53,300
Roger F. Wicker	$51,300
Barbara Boxer	$49,578
Kelly Ayotte	$43,333

The compromised FCC network goes well beyond the revolving door and congressional oversight committees. The Washington social scene is one where money sets the tone and throws the parties. A look at the recent calendar of one current FCC commissioner shows it would take very disciplined and almost saintly behavior on the part of government officials to resist the lure of lavishly catered dinners and cocktail events. To paraphrase iconic investigative journalist I.F. Stone, if you're going to work in Washington, bring your chastity belt.

All that free liquor, food and conviviality translates into the lobbyist's ultimate goal: access. "They have disproportionate access," notes former FCC commissioner Michael Copps. "When you are in a town where most people you see socially are in industry, you don't have to ascribe malevolent behavior to it," he added.[7]

Not malevolent in motive. But the results can be toxic. And blame does not lie solely at the feet of current commissioners. The FCC's problems predate Tom Wheeler and go back a long way.

Indeed, former Chairman Newton Minow, enduringly famous for his 1961 description of television as a "vast wasteland," recalls that industry manipulation of regulators was an issue even back then. "When I arrived, the FCC and the communications industry were both regarded as cesspools. Part of my job was to try to clean it up."[8]

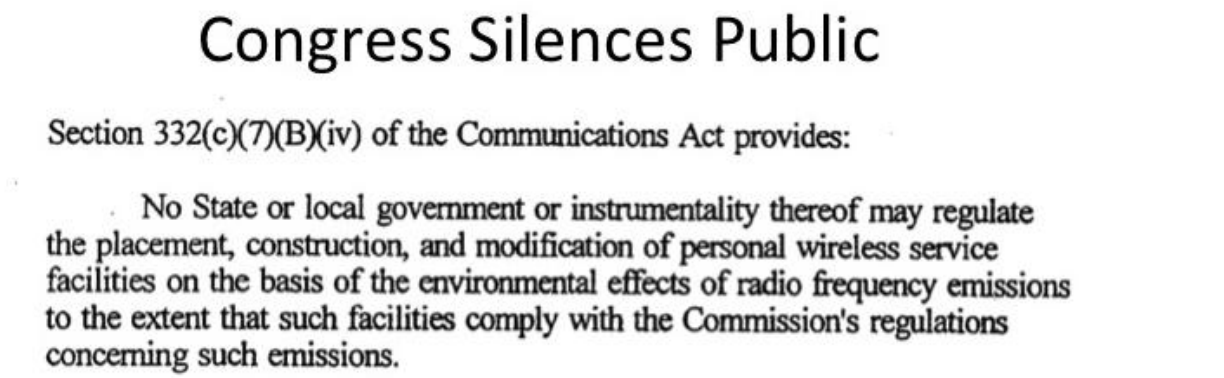
More than 50 years later, the mess continues to pile up.

Chapter Two: Just Don't Bring Up Health

Perhaps the best example of how the FCC is tangled in a chain of corruption is the cell tower and antenna infrastructure that lies at the heart of the phenomenally successful wireless industry.

It all begins with passage of the Telecommunications Act of 1996, legislation once described by South Dakota Republican senator Larry Pressler as "the most lobbied bill in history." Late lobbying won the wireless industry enormous concessions from lawmakers, many of them major recipients of industry hard and soft dollar contributions. Congressional staffers who helped lobbyists write the new law did not go unrewarded. Thirteen of fifteen staffers later became lobbyists themselves.[9]

Section 332(c)(7)(B)(iv) of the Act remarkably—and that adverb seems inescapably best here—wrests zoning authority from local governments. Specifically, they cannot cite health concerns about the effects of tower radiation to deny tower licenses so long as the towers comply with FCC regulations.



In preempting local zoning authority—along with the public's right to guard its own safety and health— Congress unleashed an orgy of infrastructure build-out. Emboldened by the government green light and the vast consumer appetite for wireless technology, industry has had a free hand in installing more than 300,000 sites. Church steeples, schoolyards, school rooftops, even trees can house these facilities.

Is there any reason to believe that the relatively low level radiofrequency emissions of these facilities constitute a public health threat? Certainly, cell phones themselves, held close to the head, have been the focus of most concern on RF emissions. Since the impact of RF diminishes with distance, industry advocates and many scientists dismiss the possibility that such structures pose health risks.

But it's not really that simple. A troubling body of evidence suggests exposure to even low emission levels at typical cellular frequencies between 300 MHz and 3 GHz can have a wide range of negative effects.

In a 2010 review of research on the biological effects of exposure to radiation from cell tower base stations, B. Blake Levitt and Henry Lai found that "some research does exist to warrant caution in infrastructure siting."[10] They summarized the results on one 2002 study that compared the health of 530 people living at various distances within 300 meters of cell towers with a control group living more than 300 meters away. "Results indicated increased symptoms and complaints the closer a person lived to a tower. At <10 m, symptoms included nausea, loss of appetite, visual disruptions, and difficulties in moving. Significant differences were observed up through 100 m for irritability, depressive tendencies, concentration difficulties, memory loss, dizziness, and lower libido."[11]

A 2007 study conducted in Egypt found similar results. Levitt and Lai report, "Headaches, memory changes, dizziness, tremors, depressive symptoms, and sleep disturbance were significantly higher among exposed inhabitants than controls."[12]

Beyond epidemiological studies, research on a wide range of living things raises further red flags. A 2013 study by the Indian scientists S. Sivani and D. Sudarsanam reports: "Based on current available literature, it is justified to conclude that RF-EMF [electro magnetic fields] radiation exposure can change neurotransmitter functions, blood-brain barrier, morphology, electrophysiology, cellular metabolism, calcium efflux, and gene and protein expression in certain types of cells even at lower intensities."[13]

The article goes on to detail the effects of mobile tower emissions on a wide range of living organisms: "Tops of trees tend to dry up when they directly face the cell tower antennas. . . . A study by the Centre for Environment and Vocational Studies of Punjab University noted that embryos of 50 eggs of house sparrows were damaged after being exposed to mobile tower radiation for 5-30 minutes. . . . In a study on cows and calves on the effects of exposure from mobile phone base stations, it was noted that 32% of calves developed nuclear cataracts, 3.6% severely."[14]

Does any of this constitute the conclusive evidence that would mandate much tighter control of the wireless infrastructure? Not in the estimation of industry and its captured agency. Citing other studies—often industry-funded—that fail to establish health effects, the wireless industry has dismissed such concerns. The FCC has typically echoed that position.

Keep in mind that light regulation has been one factor in the extraordinary growth of wireless—CTIA says exactly that in a Web post that credits the Clinton Administrations light regulatory touch.

July 25, 2013

CTIA BLOG

CTIA is an international nonprofit trade association that has represented the wireless communications industry since 1984.

But our position as the world's leader was no accident. It started with the Clinton Administration that had the foresight to place a "light regulatory touch" on the wireless industry, which was in its infancy at the time. That light touch has continued through multiple Administrations.

Obviously, cellular technology is wildly popular because it offers many benefits to consumers. But even allowing for that popularity and for the incomplete state of science, don't some of these findings raise enough concern to warrant some backtracking on the ham-fisted federal preemption of local zoning rights?

In reality, since the passage of the 1996 law, the very opposite has occurred. Again and again both Congress and the FCC have opted to stiffen—rather than loosen—federal preemption over local zoning authority. In 2009, for example, the wireless industry convinced the FCC to impose a "shot clock" that requires action within 90 days on many zoning applications. "My sense is that it was an industry request," said Robert Weller, who headed up the FCC's Office of Engineering and Technology when the shot clock was considered and imposed.[15]

And just last November, the FCC voted to further curb the rights of local zoning officials to control the expansion of antenna sites Again and again, Congress and the FCC have extended the wireless industry carte blanche to build out infrastructure no matter the consequences to local communities.

The question that hangs over all this: would consumers' embrace of cell phones and Wi-Fi be quite so ardent if the wireless industry, enabled by its Washington errand boys, hadn't so consistently stonewalled on evidence and substituted legal intimidation for honest inquiry? (See Appendix for online study of consumer attitudes on wireless health and safety.)

Document searches under the Freedom of Information Act reveal the central role of Tom Wheeler and the FCC in the tower siting issue. As both lobbyist and FCC chairman, Wheeler has proved himself a good friend of the wireless industry.

In January of 1997, CTIA chieftain Wheeler wrote FCC Wireless Telecommunications Bureau Chief Michele C. Farquhar citing several municipal efforts to assert control over siting. Wheeler, for example, asserted that one New England state had enacted a law requiring its Public Service Commissioner to issue a report on health risks posed by wireless facilities.[16] He

questions whether such a study—and regulations based on its results—would infringe on FCC preemption authority.

FCC bureau chief Farquhar hastily reassured Wheeler that no such study could be consulted in zoning decisions. "Therefore, based on the facts as you have presented them, that portion of the statute that directs the State Commissioner to recommend regulations based upon the study's findings would appear to be preempted,"[17] the FCC official wrote to Wheeler. She emphasized that the state had the right to do the study. It just couldn't deny a siting application based on anything it might learn.

The FCC in 1997 sent the message it has implicitly endorsed and conveyed ever since: study health effects all you want. It doesn't matter what you find. The build-out of wireless cannot be blocked or slowed by health issues.

Now let's fast forward to see Wheeler on the other side of the revolving door, interacting as FCC chairman with a former FCC commissioner who is now an industry lobbyist.

A March 14, 2014 letter[18] reveals the chummy relationship between Wheeler and former commissioner Jonathan Adelstein, now head of PCIA, the cellular infrastructure lobbying group. It also references FCC Chairman Wheeler seeking policy counsel from lobbyist Adelstein:

Wheeler Still Willing to Help

From: Jonathan Adelstein [mailto:adelstein@pcia.com]
Sent: Friday, March 14, 2014 12:24 PM
To: [redacted]
Cc: Renee Gregory; Jonathan Campbell
Subject: How to Spur Wireless Broadband Deployment

Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!).

Thanks for asking how we think the FCC can help spur wireless broadband deployment. The infrastructure proceeding perfectly tees up many of the top issues the FCC needs to address. As you requested, I've summarized briefly in the attached letter some of the key steps you can take now.

"Tom – It was great to see you the other night at the FCBA event, and wonderful to see how much fun you're having (if that's the right word). I know I enjoyed my time there (thanks to your help with Daschle in getting me that role in the first place!)."

"Thanks for asking how we think the FCC can help spur wireless broadband deployment," the wireless lobbyist writes to the ex-wireless lobbyist, now running the FCC.

Adelstein's first recommendation for FCC action: *"Amend its rules to categorically exclude DAS and small deployments* [Ed. note: these are compact tower add-ons currently being widely deployed] *from environmental and historic review."* Adelstein outlined other suggestions for further limiting local antenna zoning authority and the FCC soon did its part. Late last year, the agency proposed new rules that largely (though not entirely) complied with the antenna industry's wish list.

James R. Hobson is an attorney who has represented municipalities in zoning issues involving the FCC. He is also a former FCC official, who is now of counsel at Best, Best and Krieger, a Washington-based municipal law practice. "The FCC has been the ally of industry," says Hobson. Lobbyist pressure at the FCC was intense even back in the 70s, when he was a bureau chief there. "When I was at the FCC, a lot of my day was taken up with appointments with industry lobbyists." He says of the CTIA that Wheeler once headed: "Their reason for being is promoting the wireless industry. And they've been successful at it."[19]

The FCC's deferential compliance has allowed industry to regularly bypass and if necessary steamroll local authorities. Violation of the FCC-imposed "shot clock," for example, allows the wireless license applicant to sue.

The FCC's service to the industry it is supposed to regulate is evidently appreciated. The CTIA web site, typically overflowing with self-congratulation, spreads the praise around in acknowledging the enabling contributions of a cooperative FCC. In one brief summation of its own glorious accomplishments, CTIA twice uses the word "thankfully" in describing favorable FCC actions.

In advancing the industry agenda, the FCC can claim that it is merely reflecting the will of Congress. But the agency may not be doing even that.

Remember the key clause in the 96 Telecom Act that disallowed denial of zoning permits based on health concerns? Well, federal preemption is granted to pretty much any wireless outfit on just one simple condition: its installations must comply with FCC radiation emission standards. In view of this generous carte blanche to move radiation equipment into neighborhoods, schoolyards and home rooftops, one would think the FCC would at the very least diligently enforce its own emission standards. But that does not appear to be the case.

Indeed, one RF engineer who has worked on more than 3,000 rooftop sites found vast evidence of non-compliance. Marvin Wessel estimates that "10 to 20% exceed allowed radiation standards."[20] With 30,000 rooftop antenna sites across the U.S. that would mean that as many as 6,000 are emitting radiation in violation of FCC standards. Often, these emissions can be 600% or more of allowed exposure levels, according to Wessel.

Antenna standards allow for higher exposure to workers. In the case of rooftop sites, such workers could be roofers, painters, testers and installers of heating and air conditioning

equipment, to cite just a few examples. But many sites, according to Wessel, emit radiation at much higher levels than those permitted in occupational standards. This is especially true of sites where service providers keep adding new antenna units to expand their coverage. "Some of these new sites will exceed ten times the allowable occupational radiation level," said Wessel.[21] Essentially, he adds, this means that nobody should be stepping on the roof.

"The FCC is not enforcing its own standard," noted Janet Newton, who runs the EMF Policy Institute, a Vermont-based non-profit. That group several years ago filed 101 complaints on specific rooftop sites where radiation emissions exceeded allowable levels. "We did this as an exercise to hold the FCC's feet to the fire," she said. But the 101 complaints resulted in few responsive actions, according to Newton.[22]

Former FCC official Bob Weller confirms the lax—perhaps negligible is the more appropriate word—FCC activity in enforcing antenna standards. "To my knowledge, the enforcement bureau has never done a targeted inspection effort around RF exposure," he said.[23] Budget cuts at the agency have hurt, limiting the FCC's ability to perform field inspections, he added. But enforcement, he adds, would do wonders to insure industry compliance with its limited regulatory compliance requirements. "If there were targeted enforcement and fines issued the industry would pay greater attention to ensuring compliance and self-regulation," he allowed.

Insurance is where the rubber hits the road on risk. So it is interesting to note that the rating agency A.M. Best, which advises insurers on risk, in 2013 topped its list of "emerging technology-based risks" with RF Radiation:

> *"The risks associated with long-term use of cell phones, although much studied over the past 10 years, remain unclear. Dangers to the estimated 250,000 workers per year who come in close contact with cell phone antennas, however, are now more clearly established. Thermal effects of the cellular antennas, which act at close range essentially as open microwave ovens can include eye damage, sterility and cognitive impairments. While workers of cellular companies are well trained on the potential dangers, other workers exposed to the antennas are often unaware of the health risks. The continued exponential growth of cellular towers will significantly increase exposure of these workers and others coming into close contact with high-energy cell phone antenna radiation,"* A.M. Best wrote.[24]

So what has the FCC done to tighten enforcement? Apparently, not very much. Though it does follow up on many of the complaints filed against sites alleged to be in violation of standards it takes punitive actions very rarely. (The FCC did not provide answers to written questions on details of its tower enforcement policies.)

The best ally of industry and the FCC on this (and other) issues may be public ignorance.

An online poll conducted for this project asked 202 respondents to rate the likelihood of a series of statements.[25] Most of the statements were subject to dispute. Cell phones raise the risk of certain health effects and brain cancer, two said. There is no proof that cell phones are harmful, another declared. But among the six statements there was one statement of indisputable fact: "The U.S. Congress forbids local communities from considering health effects when deciding whether to issue zoning permits for wireless antennae," the statement said.

Though this is a stone cold fact that the wireless industry, the FCC and the courts have all turned into hard and inescapable reality for local authorities, just 1.5% of all poll respondents replied that it was "definitely true."

Public ignorance didn't take much cultivation by the wireless industry on the issue of local zoning. And maybe it doesn't matter much, considering the enormous popularity of wireless devices. But let's see how public ignorance has been cultivated and secured—with the FCC's passive support—on the potentially more disruptive issue of mobile phone health effects.

Chapter Three: Wireless Bullies and the Tobacco Analogy

Issues of cable and net neutrality have recently attracted wide public attention (more on that in Chapter Six). Still, the bet here remains that future judgment of the FCC will hinge on its handling of wireless health and safety issues.

And while the tower siting issue is an egregious example of an industry-dominated political process run amuck, the stronger health risks appear to reside in the phones themselves. This is an issue that has flared up several times in recent years. Each time, industry has managed to beat back such concerns. But it's worth noting that the scientific roots of concern have not disappeared. If anything, they've thickened as new research substantiates older concerns.

The story of an FCC passively echoing an industry determined to play hardball with its critics is worth a further look. The CTIA's own website acknowledges the helpful hand of government's "light regulatory touch" in allowing the industry to grow.[26]

Former congressman Dennis Kucinich ventures one explanation for the wireless industry's success in dodging regulation: "The industry has grown so fast its growth has overtaken any health concerns that may have gained attention in a slow growth environment. The proliferation of technology has overwhelmed all institutions that would have attempted safety testing and standards," Kucinich said.[27]

But the core questions remain: Is there really credible evidence that cell phones emit harmful radiation that can cause human health problems and disease? Has the FCC done an adequate job in protecting consumers from health risks? Or has it simply aped industry stonewalling on health and safety issues?

Before wading into these questions, some perspective is in order.

First, there's simply no denying the usefulness and immense popularity of wireless technology. People depend on it for safety, information, entertainment and communication. It doesn't take a keen social observer to know that wireless has thoroughly insinuated itself into daily life and culture.

The unanswered question, though, is whether consumers would embrace the technology quite so fervently if health and safety information was not spun, filtered and clouded by a variety of industry tactics.

To gain some insight into this question, we conducted an online survey of 202 respondents, nearly all of whom own cell phones, on Amazon's Mechanical Turk Web platform (see Appendix). One striking set of findings: many respondents claim they would change behavior—reduce wireless use, restore landline service, protect their children—if claims on health dangers of wireless are true.

It is not the purpose of this reporter to establish that heavy cell phone usage is dangerous. This remains an extremely controversial scientific issue with new findings and revised scientific conclusions repeatedly popping up. Just months ago, a German scientist who had been outspoken in denouncing the view that cell phones pose health risks reversed course. In an April 2015 publication, Alexander Lerchl reported results confirming previous research on the tumor-promoting effects of electromagnetic fields well below human exposure limits for mobile phones. "Our findings may help to understand the repeatedly reported increased incidences of brain tumors in heavy users of mobile phones," the Lerchl team concluded.[28] And in May 2015, more than 200 scientists boasting over 2,000 publications on wireless effects called on global institutions to address the health risks posed by this technology.

But the National Cancer Institute still contends that no cell phone dangers have been established. A representative of NCI was the sole known dissenter among the 30 members of the World Health Organization's International Agency for Research on Cancer (IARC) when it voted to declare wireless RF "possibly carcinogenic."[29] If leading scientists still can't agree, I will not presume to reach a scientific conclusion on my own.

IARC RF working group: Official press release

International Agency for Research on Cancer

World Health Organization

PRESS RELEASE
N° 208

31 May 2011

IARC CLASSIFIES RADIOFREQUENCY ELECTROMAGNETIC FIELDS AS POSSIBLY CARCINOGENIC TO HUMANS

Lyon, France, May 31, 2011 -- The WHO/International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as **possibly carcinogenic to humans (Group 2B)**, based on an increased risk for **glioma**, a malignant type of brain cancer, associated with wireless phone use.

But let's at least look at some of the incriminating clues that health and biology research has revealed to date. And let's look at the responses of both industry and the FCC.

The most widely cited evidence implicating wireless phones concerns gliomas, a very serious type of brain tumor. The evidence of elevated risk for such tumors among heavy cell phone users comes from several sources.

Gliomas account for roughly half of all malignant brain tumors, which are relatively rare. The annual incidence of primary malignant brain tumors in the U.S. is only 8.2 per 100,000 people, according to the International Radio Surgery Association.

Still, when projected over the entire U.S. population, the public health impact is potentially very significant.

Assuming roughly four new glioma cases annually in the U.S. per 100,000 people, yields over 13,000 new cases per year over a total U.S. population of 330 million. Even a doubling of that rate would mean 13,000 new gliomas, often deadly, per year. A tripling, as some studies have found, could mean as many as 26,000 more new cases annually. Indeed, the respected online site Medscape in January 2015 reported results of Swedish research under the headline: *Risk for Glioma Triples With Long-Term Cell Phone Use*.[30]

And here's some eye-opening quantitative perspective: the wars in Iraq and Afghanistan, waged now for more than a decade each, have together resulted in roughly 7,000 U.S. deaths.

Preliminary—though still inconclusive—research has suggested other potential negative health effects. Swedish, Danish and Israeli scientists have all found elevated risk of salivary gland tumors. One Israeli studied suggested elevated thyroid cancer risk. Some research has found that men who carry their phones in their pockets may suffer sperm count damage. One small study even suggests that young women who carry wireless devices in their bras are unusually vulnerable to breast cancer.

And while industry and government have never accepted that some portion of the population is unusually sensitive to electromagnetic fields, many people continue to complain of a broad range of symptoms that include general weakness, headaches, nausea and dizziness from exposure to wireless.

Some have suggested that the health situation with wireless is analogous to that of tobacco before court decisions finally forced Big Tobacco to admit guilt and pay up. In some ways, the analogy is unfair. Wireless research is not as conclusively incriminating as tobacco research was. And the identified health risks with wireless, significant as they are, still pale compared with those of tobacco.

But let's not dismiss the analogy outright. There is actually a very significant sense in which the tobacco-wireless analogy is uncannily valid.

People tend to forget that the tobacco industry—like the wireless industry—also adopted a policy of tone-deaf denial. As recently as 1998, even as evidence of tobacco toxicity grew overwhelming, cigarette maker Phillip Morris was writing newspaper advertorials insisting there was no proof smoking caused cancer.

It seems significant that the responses of wireless and its captured agency—the FCC—feature the same obtuse refusal to examine the evidence. The wireless industry reaction features stonewalling public relations and hyper aggressive legal action. It can also involve undermining the credibility and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that look a lot like 20th century Big Tobacco tactics. It is these hardball tactics—along with consistently supportive FCC policies—that heighten suspicion the wireless industry does indeed have something to hide.

Begin with some simple facts issuing from meta-analysis of cellular research. Dr. Henry Lai, emeritus professor of bioengineering at the University of Washington, has reviewed hundreds of published scientific papers on the subject. He wanted to see how many studies demonstrated that non-ionizing radiation produces biological effects beyond the heating of tissue. This is critical since the FCC emission standards protect only against heating. The assumption behind these standards is that there are no biological effects beyond heating.

But Dr. Lai found that just over half—actually 56%—of 326 studies identified biological effects. And the results were far more striking when Dr. Lai divided the studies between those that were industry-funded and those that were independently funded. Industry-funded research identified biological effects in just 28% of studies. But fully 67% of non-industry funded studies found biological effects (Insert Slide—Cell Phone Biological Studies).

A study conducted by Swiss and British scientists also looked at how funding sources affected scientific conclusions on the possible health effects of cell phone usage. They found that of studies privately funded, publicly funded and funded with mixed sponsorship, industry-funded studies were "least likely to report a statistically significant result."[31] "The interpretation of results from studies of health effects of radiofrequency radiation should take sponsorship into account," the scientists concluded.[32]

So how does the FCC handle a scientific split that seems to suggest bias in industry-sponsored research?

In a posting on its Web site that reads like it was written by wireless lobbyists, the FCC chooses strikingly patronizing language to slight and trivialize the many scientists and health and safety experts who've found cause for concern. In a two page Web post titled "Wireless Devices and Health Concerns," the FCC four times refers to either "some health and safety interest groups," "some parties," or "some consumers" before in each case rebutting their presumably groundless concerns about wireless risk.[33] Additionally, the FCC site references the World Health Organization as among those organizations who've found that "the weight of scientific

evidence" has not linked exposure to radiofrequency from mobile devices with "any known health problems."

Yes, it's true that the World Health organization remains bitterly divided on the subject. But it's also true that a 30 member unit of the WHO called the International Agency for Research on Cancer (IARC) was near unanimous in pronouncing cell phones "possibly carcinogenic" in 2011. How can the FCC omit any reference to such a pronouncement? Even if it finds reason to side with pro-industry scientists, shouldn't this government agency also mention that cell phones are currently in the same potential carcinogen class as lead paint?

Now let's look a bit more closely at the troublesome but presumably clueless crowd of "some parties" that the FCC so cavalierly hastens to dismiss? Let's begin with **Lennart Hardell**, professor of Oncology and Cancer Epidemiology at the University Hospital in Oreboro, Sweden.

Until recently it was impossible to gain any real sense of brain tumor risk from wireless since brain tumors often take 20 or more years to develop. But the cohort of long-term users has been growing. In a study published in the International Journal of Oncology in 2013, Dr. Hardell and Dr. Michael Carlberg found that the risk of glioma—the most deadly type of brain cancer—rose with cell phone usage. The risk was highest among heavy cell phone users and those who began to use cell phones before the age of 20.[34]

Indeed, those who used their phones at least 1640 hours (which would be roughly 30 minutes a day for nine years) had nearly three times the glioma incidence. Drs. Hardell and Carlberg also found that gliomas tend to be more deadly among heavy wireless callers.[35]

Perhaps of greatest long-term relevance, glioma risk was found to be four times higher among those who began to use mobile phones as teenagers or earlier. These findings, along with the established fact that it generally takes decades for tumors induced by environmental agents to appear, suggest that the worst consequences of omnipresent wireless devices have yet to be seen.

In a 2013 paper published in *Reviews on Environmental Health*, Drs. Hardell and Carlberg argued that the 2011 finding of the IARC that identified cell phones as a "possibly carcinogenic" needs to be revised. The conclusion on radiofrequency electromagnetic fields from cell phones should now be "cell phones are not just a possible carcinogen." They can now be "regarded as carcinogenic to humans" and the direct cause of gliomas (as well as acoustic neuromas, a less serious type of tumor).[36] Of course, these views are not universally accepted.

The usual spin among industry supporters when presented with research that produces troubling results is along the lines of: "We might pay attention if the results are duplicated." In fact, the Hardell results were echoed in the French CERENAT study, reported in May of 2014. The CERENAT study also found higher risk among heavy users, defined as those using their phones at least 896 hours (just 30 minutes a day for five years). "These additional data support

previous findings concerning a possible association between heavy mobile phone use and brain tumors," the study concluded.[37]

Cell phones are not the only wireless suspects. Asked what he would do if he had policy-making authority, Dr. Hardell swiftly replied that he would "ban wireless use in schools and pre-schools. You don't need Wi-Fi," he noted.[38] This is especially interesting in view of the FCC's sharply hiked spending to promote and extend Wi-Fi usage, as well as its consistent refusal to set more stringent standards for children (more on all this later). But for now let's further fill out the roster of the FCC's unnamed "some parties."

Martin Blank is a Special Lecturer in Physiology and Cellular Biophysics at Columbia University. Unlike Dr. Hardell, who looks at broad epidemiological effects over time, Dr. Blank sees cause for concern in research showing there is biological response at the cellular level to the type of radiation emitted by wireless devices. "The biology tells you unequivocally that the cell treats radiation as a potentially damaging influence," Dr. Blank said in a late 2014 interview.[39]

"The biology tells you it's dangerous at a low level," he added. Though some results have been difficult to replicate, researchers have identified a wide range of cellular responses including genetic damage and penetration of the blood brain barrier. Dr. Blank specifically cited the "cellular stress response" in which cells exposed to radiation start to make proteins.

It is still not clear whether biological responses at the cellular level translate into human health effects. But the research seems to invalidate the basic premise of FCC standards that the only biological effect of the type of radiation produced by wireless devices is tissue heating at very high power levels. But the standards-setting agencies "ignore the biology," according to Dr. Blank. He describes the FCC as being "in industry's pocket."[40]

Sweden's Lund University is annually ranked among the top 100 universities in the world. **Leif Salford** has been chairman of the Department of Neurosurgery at Lund since 1996. He is also a former president of the European Association for Neuro-Oncology. In the spring of 2000, Professor Salford told me that wireless usage constituted "the world's largest biological experiment ever."[41]

He has conducted numerous experiments exposing rats to cellular-type radiation. Individual experiments have shown the radiation to penetrate the blood-brain barrier, essential to protecting the brain from bloodstream toxins. Professor Salford also found that rats exposed to radiation suffered loss of brain cells. "A rat's brain is very much the same as a human's. They have the same blood-brain barrier and neurons. We have good reason to believe that what happens in rat's brains also happens in humans," he told the BBC in 2003. Dr. Salford has also speculated that mobile radiation could trigger Alzheimer's disease in some cases but emphasized that much more research would be needed to establish any such causal relationship. Does this man deserve to be dismissed as one of a nameless and discredited group of "some parties?"

And what about the **American Academy of Pediatrics (AAP),** which represents 60,000 American doctors who care for children? In a December 12, 2012 letter to former Ohio Congressman Dennis Kucinich, AAP President Dr. Thomas McInerny writes: "Children are disproportionately affected by environmental exposures, including cell phone radiation. The differences in bone density and the amount of fluid in a child's brain compared to an adult's brain could allow children to absorb greater quantities of RF energy deeper into their brains than adults."[42]

In a subsequent letter to FCC officials dated August 29, 2013, Dr. McInerny points out that "children, however, are not little adults and are disproportionately impacted by all environmental exposures, including cell phone radiation." Current FCC exposure standards, set back in 1996, "do not account for the unique vulnerability and use patterns specific to pregnant women and children," he wrote. (Insert slide: A Plea from Pediatricians). Does an organization representing 60,000 practitioners who care for children deserve to be brushed off along with "some health and safety interest groups?"

So what is the FCC doing in response to what at the very least is a troubling chain of clues to cellular danger? As it has done with wireless infrastructure, the FCC has to this point largely relied on industry "self-regulation." Though it set standards for device radiation emissions back in 1996, the agency doesn't generally test devices itself. Despite its responsibility for the safety of cell phones, the FCC relies on manufacturers' good-faith efforts to test them. Critics contend that this has allowed manufacturers undue latitude in testing their devices.

Critics further contend that current standards, in place since cell phones were barely in use, are far too lax and do not reflect the heavy usage patterns that have evolved. Worse still, industry is allowed to test its own devices using an imprecise system that makes no special provision for protecting children and pregnant women. One 2012 study noted that the procedure widely used by manufacturers to test their phones "substantially underestimates" the amount of RF energy absorbed by 97% of the population, "especially children." A child's head can absorb over two times as much RF energy. Other persons with smaller heads, including women, are also more vulnerable. The authors recommend an alternative computer simulation technique that would provide greater insight into the impact of cellular radiation on children and on to the specific RF absorption rates of different tissues, which vary greatly.[43]

Acting on recommendations of the General Accounting Office, the FCC is now reconsidering its standards for wireless testing and allowed emissions. On the surface, this may seem to represent an effort to tighten standards to promote consumer health and safety. But many believe the FCC's eventual new standard will actually be weaker, intensifying any health risk from industry's self-reported emission levels. "They're under great pressure from industry to loosen the criteria," notes Joel Moskowitz, director of the Center for Family and Community Health at UC Berkeley's School of Public Health.[44] One fear is that the FCC could measure the allowed radiation absorption level (SAR) over a wider sample of tissue, effectively loosening the

standard allowable energy absorption. One FCC official, who asked that his name not be used, contended that a decision had not yet been made to loosen the standard.

But to this point, there is little evidence the FCC is listening to anyone beyond its familiar friends in the wireless industry. Carl Blackman, a scientist at the Environmental Protection agency until retiring in 2014, notes that the FCC does rely to some degree on an inter-agency governmental group for advice on health matters. The group includes, for example, representatives from the EPA and the FDA.

Blackman served on that advisory group and he says that it has been divided. Though some government advisers to the FCC find evidence of wireless health risks convincing, others remain skeptical, said Blackman. Root of the skepticism: even though numerous researchers have found biological and health effects, the mechanism for action by non-ionizing radiation on the human body has still not been identified. "I don't think there's enough of a consensus within the Radio Frequency Inter-agency Working Group for them to come out with stricter standards," he says.[45]

But political pressures also figure mightily in all this. The EPA, notably, was once a hub of research on RF effects, employing as many as 35 scientists. However, the research program was cut off in the late 80s during the Regan presidency. Blackman says he was personally "forbidden" to study health effects by his "supervisory structure."[46] He termed it "a political decision" but recognized that if he wanted to continue to work at the EPA he would have to do research in another area.

Blackman is cautious in imputing motives to the high government officials who wanted his work at EPA stopped. But he does say that political pressure has been a factor at both the EPA and FCC: "The FCC people were quite responsive to the biological point of view. But there are also pressures on the FCC from industry." The FCC, he suggests, may not just be looking at the scientific evidence "The FCC's position—like the EPA's—is influenced by political considerations as well."[47]

Still, the FCC has ultimate regulatory responsibility and cannot indefinitely pass the buck on an issue of fundamental public health. Remarkably, it has not changed course despite the IARC classification of cell phones as possibly carcinogenic, despite the recent studies showing triple the glioma risk for heavy users, despite the floodtide of research showing biological effects, and despite even the recent defection of core industry booster Alex Lerchl. It is the refusal of both industry and the FCC to even acknowledge this cascade of warning signs that seems most incriminating.

Of course, industry behavior goes well beyond pushing for the FCC's willful ignorance and inaction. Industry behavior also includes self-serving public relations and hyper aggressive legal action. It can also involve undermining the credibility of and cutting off the funding for researchers who do not endorse cellular safety. It is these hardball tactics that recall 20th century Big Tobacco tactics. It is these tactics that heighten suspicion that the wireless industry does

indeed have a dirty secret. And it is those tactics that intensify the spotlight on an FCC that so timidly follows the script of the fabulously wealthy, bullying, billion-dollar beneficiaries of wireless.

Chapter Four: You Don't Need Wires To Tie People Up

So let's look a little more deeply at some of the actions of an industry group that boasts of 500 meetings a year with the FCC. Lobbying is one thing. Intimidation is another. CTIA has shown its skill at—and willingness to use—both.

Outright legal bullying is a favored tactic. The City of San Francisco passed an ordinance in 2010 that required cell phone manufacturers to display more prominently information on the emissions from their devices. This information was already disclosed—but often buried—in operator manuals and on manufacturer websites. The idea was to ensure that consumers saw information already mandated and provided.

Seeing this as a threat to its floodtide of business, the industry sued the City of San Francisco. The City, fearing a prolonged legal fight with an industry that generates hundreds of billions of dollars in annual revenue, backed down.

On May 12, 2015, Berkeley, California's City Council unanimously passed a similar ordinance. Joel Moskowitz, director of the Center for Family and Community Health at the University of California-Berkeley's School of Public Health, has been involved in the effort. Berkeley, he says, didn't want to run into the same legal threats that paralyzed San Francisco. So it tried to draft the most inoffensive and mild language possible. The proposed Cell Phone Right to Know ordinance: "To assure safety, the Federal Government requires that cell phones meet radio frequency (RF) exposure guidelines. If you carry or use your phone in a pants or shirt pocket or tucked into a bra when the phone is ON and connected to a wireless network, you may exceed the federal guidelines for exposure to RF radiation. This potential risk is greater for children. Refer to the instructions in your phone or user manual for information about how to use your phone safely."[48]

Sounds pretty inoffensive, no? Not to the CTIA, which indicated that it was prepared to sue, according to Berkeley City Attorney Zach Cowan.[49] (On June 8th, CTIA did indeed sue the City of Berkeley.)

Well, from the industry point of view, why not throw around your weight? Smash mouth legal tactics have been highly successful thus far as industry has managed to throttle several efforts to implicate manufacturers in cases where heavy users suffered brain tumors.

But one current case has advanced in district court in Washington to the point where the judge allowed plaintiffs to present expert witness testimony. The industry response: file a legal action seeking to invalidate long-held court methods for qualifying expert witnesses.

This is a very rich industry that does not hesitate to outspend and bully challengers into submission. Meanwhile, amidst the legal smoke and medical confusion, the industry has

managed to make the entire world dependent on its products. Even tobacco never had so many hooked users.

Such sustained success in the face of medical doubt has required industry to keep a lid on critics and detractors. Many scientists who've found real or potential risk from the sort of microwave radiation emanating from wireless devices have learned there is a price to be paid for standing up to the industry juggernaut. A few prominent examples:

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In 1994, University of Washington researchers Henry Lai and N.P. Singh found that rats exposed to microwave radiation suffered DNA damage to their brain cells. This was a scary finding since DNA damage can lead to mutations and possibly cancer.

The reaction from industry was swift. Motorola was at that time the U.S. market leader in cell phones. In a memorandum obtained by the journal Microwave News, Motorola PR honcho Norm Sandler outlined how the company could "downplay the significance of the Lai study." One step: "We have developed a list of independent experts in this field and are in the process of recruiting individuals willing and able to reassure the public on these matters," Sandler wrote. After outlining such measures, he concluded that Motorola had "sufficiently war-gamed" the issue. The practices of lining up industry-friendly testimony and "war-gaming" researchers who come up with unfavorable results have been persistent themes with this industry.

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After Lai's results were published, Motorola decided to sponsor further research on microwaves and DNA damage. Oftentimes, lab results cannot be reproduced by other

researchers, particularly if experiments are tweaked and performed a bit differently. Non-confirming studies raise doubt, of course, on the original work.

Motorola lined up Jerry Phillips, a scientist at the Veteran's Administration Medical Center in Loma Linda, California, and Phillips tested the effect of radiation at different frequencies from those tested by Lai and Singh. Nevertheless, Phillips found that at some levels of exposure, DNA damage increased, while at other levels it decreased. Such findings were "consistent" with the sorts of effects produced by chemical agents, Phillips said in an interview.[50] In some cases, the radiation may have activated DNA repair mechanisms, reducing the overall microwave effect. But what was important, Phillips explained, is that there were *any* biological effects at all. The wireless industry has long contended—and the FCC has agreed—that there is no evidence that non-ionizing radiation at the frequencies and power levels used by cell phones is biologically active.

Understanding the potential impact of "biological effect" findings, Motorola again turned to damage control, said Phillips. He recalls receiving a phone call from a Motorola R&D executive. "I don't think you've done enough research,'" Phillips recalls being told. The study wasn't ready for publication, according to the Motorola executive. Phillips was offered more money to do further research without publishing the results of what he'd done.

But Phillips felt he'd done enough. Despite warnings for his own boss to "give Motorola what it wants," Phillips went ahead and published his findings in 1998. Since then, Phillips' industry funding has dried up. Meanwhile, as many other researchers report, government funding to do independent research on microwave radiation has dried up, leaving the field at least in the U.S. to industry-funded scientists. "There is no money to do the research," Said Phillips. "It's not going to come from government because government is controlled by industry."[51]

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Om P. Gandhi is Professor of Electrical and Computer Engineering at the University of Utah and a leading expert in dosimetry—measurement of non-ionizing radiation absorbed by the human body. Even before cell phones were in wide use, Professor Gandhi had concluded that children absorb more emitted microwave radiation. "The concentration of absorbed energy is 50 to 80% greater," he explained.[52]

These conclusions were not acceptable to Professor Gandhi's industrial sponsors. In 1998, he recalls, an executive from a cell phone manufacturer—which he did not want to identify—told him directly that if he did not discontinue his research on children his funding would be cut off. Professor Gandhi recalled replying: "I will not stop. I am a tenured professor at the University of Utah and I will not reject my academic freedom." Professor Gandhi also recalled some of his thought process: "I wasn't going to order my students to alter their results so that I can get funding." His industry sponsors cancelled his contract and asked for a return of funds.

Professor Gandhi believes that some cell phone users require extra protection because their heads are smaller and more absorptive. “Children, as well as women and other individuals with smaller heads absorb more concentrated energy because of the proximity of the radiating antenna to the brain tissue,” he said. And yet the FCC has not acted to provide special protection for these groups. Asked why not, Professor Gandhi conceded that he doesn’t know. He does note, however, that recent standards-setting has been dominated by industry representatives.[53]

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While the mobile industry refuses to admit to even the possibility that there is danger in RF radiation, giant insurance companies see things differently. Several insurers have in recent years issued reports highlighting product liability risk with cell phones. This is important because it is evidence that where money is on the line professionals outside the industry see the risk of legal liability.

Legal exposure could be one reason—perhaps the central one—the industry continues to stonewall. Should legal liability be established, one key question will be how much wireless executives knew—and at what point in time. Meanwhile, the combination of public relations denials, legal intimidation and the selective application of pressure on research follows a familiar pattern. “The industry is basically using the tobacco industry playbook,” UC Berkeley’s Moskowitz said in a recent radio interview.[54]

That playbook has thus far been highly successful in warding off attention, regulation and legal incrimination.

Chapter Five: $270 Billion . . . and Looking for Handouts

The FCC's network of corruption doesn't just shield industry from needed scrutiny and regulation on matters of public health and safety. Sometimes it just puts its hand directly into the public pocket and redistributes that cash to industry supplicants.

Such is arguably the case with the Universal Service Fund. Originally established to extend telephone service to rural and urban areas that industry would find difficult or uneconomical to wire, the USF is now shifting from subsidizing landline phone service to subsidizing the extension of broadband Internet. USF monies also support the Lifeline program, which subsidizes cell phone service to low-income consumers, and the E-Rate program, which subsidizes Internet infrastructure and service to schools and libraries.

Since 1998, more than $110 billion has been allocated to Universal Service programs, notes Charles Davidson, director of the Advanced Communications Law & Policy Institute at New York Law School. The FCC has allocated over $40 billion to the E-Rate program alone.

Who pays the freight for these high-cost programs? You do.

Technically, landline and wireless phone companies are assessed for the Universal Service fund's expenditures. But the FCC also allows those companies to pass on such charges to their subscribers, which they do. Both landline and wireless subscribers pay a monthly Universal Service charge that is tacked on to their phone bills. That charge has been rising and recently amounted to a 16% surcharge on interstate calls.

Consumers who pay for these programs might be interested to learn that both the E-Rate and Lifeline programs have been riddled with fraud. Government watchdogs have repeatedly found the programs to be inefficient and prone to inflated and fraudulent claims. But the programs have been a windfall for tech and telecom industry beneficiaries. Wherever the FCC presides, it seems, these industries reap a windfall.

The General Accounting Office (GAO) has issued several reports citing fraud, waste and mismanagement, along with inadequate FCC oversight of the subsidy program. Bribery, kickbacks and false documentation can perhaps be expected in a handout program mandated by Congress and only indirectly supervised by the FCC.

But the scope of fraud has been impressive. The most striking corruption has marred the E-Rate program, which subsidizes Internet hardware, software and service for schools and libraries, and the Lifeline cell phone subsidies.

In recent years, several school districts have paid fines to settle fraud cases involving bribery, kickbacks, non-competitive bidding of contracts and false documentation in the E-Rate

program. More eye opening perhaps are the settlements of fraud claims by tech giants like IBM, Hewlett Packard and AT&T. The HP case, for example, involved some colorful bribery allegations, including gifts of yachts and Super Bowl tickets. HP settled for $16 million. An HP official and a Dallas Independent School District official both received jail sentences.

The Lifeline program has also been riddled with fraud. A Wall Street Journal investigation of the five top corporate beneficiaries of Lifeline showed that 41% of more than 6 million subsidy claimants "couldn't demonstrate their eligibility or didn't respond to requests for certification."[55] AT&T, Verizon, and Sprint Nextel were three of the major Lifeline beneficiaries.

The FCC has initiated several efforts to clean up USF programs and seems honestly determined to bring greater accountability and efficiency to its subsidy efforts. Nevertheless, problems with fraud persist, as reported recently by the FCC's own top investigator.

Congress established the FCC's Office of Inspector General in 1989 to "provide objective and independent investigations, audits and reviews of the FCC's programs and operations." Here's what the FCC's internal investigative unit said in a September 30, 2014 report to Congress about its Office of Investigation (OI): "*The bulk of the work of OI involves investigating and supporting civil and criminal investigations/prosecutions of fraud in the FCC's federal universal service program*."[56]

Fraud—as pervasive and troubling as it has been—is just one of the problems with the programs of universal service. It may not even be the fundamental problem. More fundamental issues concern the very aim, logic and efficiency of programs to extend broadband and wireless technology at public expense. Though the aims of extending service to distant impoverished areas seem worthy on the surface, there are many reasons to think the major beneficiaries of these programs are the technology companies that win the contracts.

Lobbyists have long swarmed over the FCC looking to get an ever-growing piece of the USF honeypot. An FCC report on meetings with registered lobbyists details a 2010 meeting with representatives of the International Society for Technology in Education and other education lobbyists. Topics discussed, according to the FCC report, included "the need to raise the E-Rate's annual cap."[57]

The CTIA, leaving no stone unturned in its efforts to pump up member revenues, last year responded to a House hearing on the USF by grousing that "current USF-supported programs skew heavily toward support of wireline services. . . . The concentration of USF monies to support wireline services is inconsistent with technological neutrality principles and demonstrated consumer preferences," CTIA wrote..[58] An industry that generates hundreds of billions of dollars in equipment and service revenues annually bellies up for a bigger slice of the $8 billion a year USF.

The grousing has paid off. The FCC recently announced that it will raise spending on E-Rate from what had been a cap of $2.4 billion a year to $3.9 billion. A significant portion of new outlays will go to Wi-Fi—yet another wireless industry victory at the FCC. But the CTIA is by no means the only industry group pressing the FCC.

Leading the roster of active lobbyists on E-Rate issues is the Software and Information Industry Association. Beginning in 2006, SIAA led all lobbyists with 54 mentions of E-Rate in its filings, according to the Center for Responsive Politics. SIAA board members include executives from tech heavyweights Google, Oracle and Adobe Systems.

Tech business leaders—many of them direct beneficiaries of FCC programs—made a direct pitch to FCC Chairman Wheeler last year to hike E-Rate funding. "The FCC must act boldly to modernize the E-Rate program to provide the capital needed to upgrade our K-12 broadband connectivity and Wi-Fi infrastructure within the next five years," the executives wrote.[59]

There were dozens of corporate executive signees to this letter, including the CEOs of many Fortune 500 giants. But let's just consider the participation of three: top executives of Microsoft, Google and HP all joined the call to expand E-Rate subsidies. Consider the simple fact that these three tech giants alone had revenues of $270 billion—more than a quarter of a trillion dollars—in a recent four-quarter period. Together, they produced nearly $40 billion in net income. And yet their top executives still thought it necessary to dun the FCC—and really, they were surreptitiously hitting up the public—for ramped-up spending on what was then a $2.4 billion a year program.

Is that greed? Arrogance? Or is it simply behavior conditioned by success in repeatedly getting what they want at the public trough? Almost never mentioned in these pleas for higher subsidies is the fact that ordinary American phone subscribers are the ones footing the bill for the E-Rate program—not the FCC or the telecom industry.

Much of the added spending, as noted, will go towards the installation of wireless networks. And yet Wi-Fi does not have a clean bill of health. When Lennart Hardell, professor of Oncology and Cancer Epidemiology at the University Hospital in Orebro, Sweden, was asked what he would do if given policy authority over wireless health issues, he replied swiftly that he would "ban wireless use in schools and pre-school." Noting that there are wired alternatives, Professor Hardell flatly stated: "You don't need Wi-Fi."[60] And yet the FCC, prodded by an industry ever on the lookout for incremental growth opportunities, is ignoring the health of youngsters to promote expanded Wi-Fi subsidies in schools across the U.S.

And what about the merit of the program itself? Overlooking the fraud and lobbying and Wi-Fi safety issues for a moment, shouldn't schools and libraries across the country be equipped with the best electronic gear, accessing the Internet at the fastest speeds? Doesn't the government owe that to its younger citizens, especially those disadvantaged by the long-referenced digital divide?

Well, maybe. But answers to these questions hinge on even more fundamental question: Do students actually learn more or better with access to the latest high-speed electronic gadgetry?

It would be foolish to argue that nobody benefits from access to high-speed Internet. But the benefits are nowhere near as broad or rich as corporate beneficiaries claim. Some researchers, for example, have concluded that computers don't seem to have positive educational impact—they may even have negative impact—when introduced into the home or freely distributed to kids from low income backgrounds.

Duke University researchers Jacob Vigdor and Helen Ladd studied the introduction of computers into North Carolina homes. They found that the academic performance of youngsters given computers actually declined. *"The introduction of home computer technology is associated with modest but statistically significant and persistent negative impacts on student math and reading test scores,"* the authors wrote in a National Bureau of Economic Research Working Paper.[61] The impact was actually most negative on the poorer students.

A study in the Journal of International Affairs examined the impact of the global One Laptop Per Child Program (OLPC), which has distributed millions of computers to children around the world. Researchers Mark Warschauer and Morgan Ames conclude: *"The analysis reveals that provision of individual laptops is a utopian vision for the children in the poorest countries, whose educational and social futures could be more effectively improved if the same investments were instead made on more proven and sustainable interventions. Middle- and high-income countries may have a stronger rationale for providing individual laptops to children, but will still want to eschew OLPC's technocratic vision. In summary, OLPC represents the latest in a long line of technologically utopian schemes that have unsuccessfully attempted to solve complex social problems with overly simplistic solutions*."[62]

Access to computers in the home may not work educational magic. But what about computers in the classroom? Don't they have educational value there?

The anecdotal evidence is mixed at best. Consider how students in Los Angeles, newly equipped with flashy iPads at a mind-boggling taxpayer cost of more than $1 billion, went about using the new tools to improve their educational performance. "Instead of solving math problems or doing English homework, as administrators envisioned, more than 300 Los Angeles Unified School District students promptly cracked the security setting and started tweeting, posting to Facebook and playing video games."[63]

But let's cut through the self-serving corporate claims and the troubling anecdotes to hear from someone who actually has had extensive and unique field experience. Kentaro Toyama was co-founder of Microsoft's research lab in India. Over more than five years he oversaw at least a dozen projects that sought to address educational problems with the introduction of computer technology. His conclusion: "The value of technology has been over-hyped and over-sold."

The most important factor in improving schools, says Toyama, now the W.K Kellogg Associate Professor of Community Information at the University of Michigan, is good teachers. Without good, well-trained teachers, adequate budgets and solid school administration, technology does little good. "Technology by itself never has any kind of positive impact," he said.[64]

The only schools in his experience that benefited from increased technology investment were those where "the teachers were very good, the budgets adequate." The richer schools, in essence. But as both Vigdor and Warschauer found, the introduction of technology has by itself little if any positive effect. For a public conditioned to believe in the virtues of new technology, such testimony is a bracing dose of cold reality.

But what about cost? Doesn't technology in the schools more efficiently replace alternative investments? Cost reductions are often the most persuasive argument for technology, Toyama agrees. But even these have been overstated. The costs of introducing new technology run far beyond initial hardware and software investments, said Toyama. In reality, the total costs of ownership—including maintenance, training, and repair—typically run to five or ten times the initial cost, according to Toyama. He said of the investment in technology for cost benefits: "I would say that in the long run—and even in the medium run and the short-run—that's probably the worst and most misguided conclusion to come to."[65]

He adds: "The inescapable conclusion is that significant investments in computers, mobile phones and other electronic gadgets in education are neither necessary nor warranted for most school systems. In particular, the attempt to use technology to fix underperforming class rooms . . . is futile. And for all but wealthy, well-run schools, one-to-one computer programs cannot be recommended in good conscience."[66]

But that doesn't keep industry lobbyists from recommending them. And it hasn't kept the FCC for spending scores of billions subsidizing technology to the very groups least likely to benefit from it.

Unmoved by the arguments of researchers and educators like Vigdor, Warschauer, and Toyama, the FCC keeps moving to increase technology subsidies. Ignoring research that disputes the value of technology in closing the so-called "digital divide," the FCC has even pioneered a new slogan: "the Wi-Fi gap."

In announcing that it was lifting E-Rate's annual budget from $2.4 billion to $3.9 billion and stepping up investment in wireless networking, FCC chairman Wheeler exulted that "10 million students are going to experience new and better opportunities."[67] The impact on consumer pocketbooks (and potentially on youngsters' health from daily Wi-Fi exposure) were not mentioned.

The two Republican members of the FCC did at least recognize the pocketbook impact. "It always seems easier for some people to take more money from the American people via higher taxes and fees rather than do the hard work," said Commissioner Michael O'Reilly.[68]

The subsidized provision of high-speed Internet service is yet another pet project of the FCC. Julius Genachowski, chairman from 2009 to 2013, championed the transition of the USF from landline phone service to broadband. Universal broadband Internet connections would begin to absorb the monies collected from consumers to extend basic phone service.

As with government subsidies for cell phone service, classroom technology, and Wi-Fi, there are basic questions about the wisdom of subsidizing broadband. Charles Davidson and Michael Santorelli of the New York Law School found that spending billions to extend broadband is a flawed approach since there are many largely ignored reasons people choose not to adopt

broadband. “Everybody is pushing broadband non-stop,” noted Davidson, director of the Law School’s Advanced Communications Law and Policy Institute. “I think the FCC is focused on the wrong set of issues,” he said.[69]

Already, he explained, over 98% of Americans have access to wired or wireless broadband. The issue is not one of supply. It’s one of demand. Many people—for a variety of reasons—don’t really care about broadband, he contends. Price is one issue. Also powerful factors—but given almost no attention—are privacy and security concerns. “In our view, they should be focused on barriers to meaningful broadband utilization: privacy and security,” said Davidson.[70]

But consumer privacy (more on this subject in Chapter Seven) has no well-funded lobby with limitless access to the FCC.

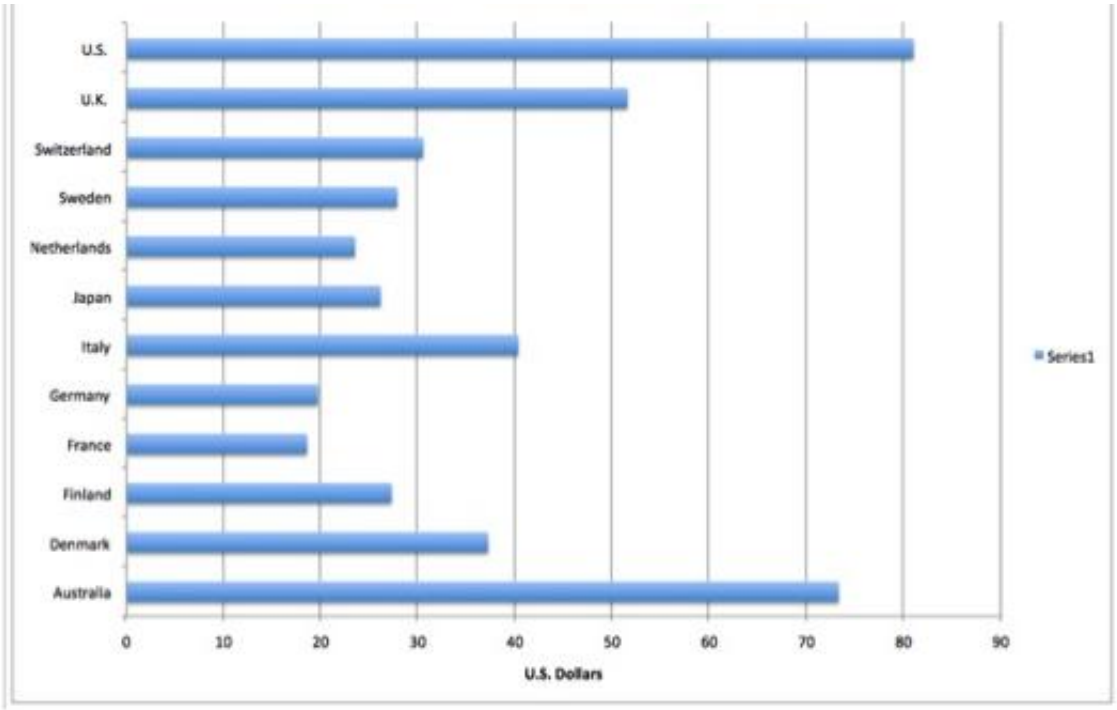
Chapter Six: The Cable Connection

The network has also been active in diluting FCC control of the cable television industry. Over the years, cable has devolved into major de facto local monopolies. Comcast and Time Warner Cable, whose merger proposal was dropped in April, are dominant forces in both cable television and broadband Internet subscriptions. Somehow, though, they have managed to steer clear of one another in specific markets, giving each pricing power where it faces little local competition.

It's interesting that cable companies annually rank in consumer polls among the "most hated" or "most disliked" American corporations. Indeed, Comcast and Time Warner Cable often top the "most hated" list.[71] Why would these companies—providers of the TV programming that has so expanded consumer options in recent decades—be so widely scorned? After all, the U.S. has been a leader in developing both cable technology and diverse television programming.

The problem is that it hasn't been anything close to a leader in bringing down subscriber prices. Industry consultants typically measure pricing by the metric of average revenue per subscriber. Industry trackers at IHS compared the price of U.S. pay television (which includes satellite services) to those in more than 60 other countries. U.S. prices were the highest, with only Australia even coming close. The average revenue per subscriber in the U.S. in 2013 was $81. But in France it was just $18.55. In Germany it was $19.68. In Japan it was just over $26.

Pay TV Monthly Revenue Per Person:



And U.S. cable prices have risen in recent years at rates three or more times the rate of inflation. This has been going on for some time. From 1995 to 2013 cable rates increased at a 6.1% annual clip. The Consumer Price Index, by contrast, rose by just 2.4% annually. Former FCC commissioner Michael Copps says the FCC shares a major part of the blame. "The FCC is as culpable for allowing that as much as the companies for imposing it," he said.[72]

One area where the FCC has contributed to the problem is in its traditional rubber-stamping of merger agreements. The proposed Comcast/Time Warner Cable deal has been shelved, largely because of Justice Department reservations. But a long run of earlier FCC-sanctioned deals allowed Comcast and Time Warner Cable to grow to the market dominance—and attendant pricing power—they currently command.

Lofty monthly cable bills pinch consumers. But it's more than that. Subscribers paying $80 a month are often paying for a lot of channels they don't watch and don't want. The FCC has never required cable operators to charge for what consumers actually want to watch. Kevin Martin, who chaired the FCC from 2005 to 2009, pushed to "debundle" programming in hopes of lowering bills. But the issue was never resolved. Only recently have viable competitive alternatives to cable's "bundled" packages become available. The satellite service Dish, for example, months ago introduced its Sling offering that enables consumers to opt for smaller and cheaper packages.

In fairness to cable operators, it should be pointed that programmers often require operators to take unwanted or fledgling channels along with their stars. New York cable operator Cablevision Systems filed suit against Viacom in 2013, charging that in order to get popular channels like MTV and Nickelodeon it was also forced to take low-rated channels like Nicktoons and VH1 Soul. But the simple truth is that no matter who is to blame, the cable consumer pays high prices, typically for some programming he doesn't want. As it often does when powerful interests pursue dubious practices, the FCC has for the most part idly stood by.

Still, the FCC isn't entirely to blame. Some factors in the growth of the cable giants cannot be laid at its doorstep. Local municipalities often granted monopoly or duopoly status in granting franchises to cable network builders. With the huge capital investments required to cable metropolitan areas, this once seemed to make sense.

And over the years, the cable giants have used a variety of tactics to weaken what little local competition they may have had. Active lobbyists on the local level, the cable giants have managed to convince a growing number of states to outlaw municipal systems that could threaten private corporate incumbents. The FCC for many years declined to tangle with the states in this matter, partly due to the opposition of Republican commissioners. But the Wheeler-led Commission did vote recently to override state laws that limit the build-out of municipal cable systems.

Still, many years of industry subservience will be difficult to swiftly undo. One linchpin merger shows how FCC decision-making has been thoroughly undermined by the revolving door, lobbying, and carefully targeted campaign contributions. All conspired in Comcast's pivotal 2011 buyout of NBC Universal, a deal which reinforced Comcast's domination of both cable and broadband access. This deal also set the stage for the recent headline-grabbing acrimony over the issue of net neutrality.

In 2011, mighty Comcast proposed to acquire NBC Universal. A series of mergers including the 1986 acquisition of Group W assets and the 2002 acquisition of AT&T's cable assets had already vaulted Comcast into cable market leadership. In bidding for NBC Universal, a huge step towards vertical integration, Comcast was once again raising the stakes. NBC Universal would give Comcast a treasure trove of programming, including valued sports content like NFL football and the Olympics.

Suddenly, the issue was not just cable subscriber base size—where Comcast had already bought its way to dominance. NBC Universal would also allow Comcast to consolidate its growing power as a broadband Internet provider. And with NBC Universal's programming assets, Comcast would gain new leverage when negotiating prices to carry the competing programming content of rivals. This would prompt a new round of debate over net neutrality. Couldn't a programming-rich Comcast slow down rival services—or charge them more to carry their programming?

To short-circuit any potential opposition to the merger, Comcast assembled a superstar cast of lobbyists. As Susan Crawford reports in her 2013 book, "Comcast hired almost eighty former government employees to help lobby for approval of the merger, including several former chiefs of staff for key legislators on congressional antitrust committees, former FCC staffers and Antitrust Division lawyers, and at least four former members of Congress.[73] Such "profligate hiring," Crawford observes, pretty much silenced the opposition to the deal. If Comcast had already retained one member of a lobbying firm, the firm could not under conflict of interest rules object to the deal. And Comcast had locked up key lobbying shops. Money was both weapon and silencer.

Of course, Comcast had always been a big spender on lobbying, with outlays exceeding $12 million every year since 2008. Lobbying costs peaked in 2011 at $19.6 million, according to the Center for Responsive Politics.

For its part, the FCC had a long history of approving most media mergers. So it was hardly a great surprise when the agency, after exacting some relatively minor concessions from Comcast, rubber-stamped the deal. Comcast would thus broaden its footprint as local monopoly distributor of cable. And with its new programming assets, it would enhance its leverage in negotiating deals to carry its rivals' programming. It would also fortify its position of growing strength as broadband Internet gatekeeper.

The most telling footnote to the deal would come just four months later. FCC Commissioner Meredith Atwell Baker, who voted to approve the merger in January 2011, left the FCC to become a top-tier Comcast lobbyist in May. It was the ultimate—and perhaps most telling—glide of the revolving door.

Baker's was a high-profile defection. But it was neither the first nor the last. Comcast had successfully convinced other FCC officials to take their expertise and government contacts to the cable giant. Comcast has long been a master at spinning the revolving door to its own advantage. "Comcast has been very good at hiring everyone who is very smart," said Crawford.[74]

Approval of the NBC Universal deal was another in the long string of FCC merger approvals that made Comcast a nationwide monopolist that could dictate both pricing and viewer programming choice.

But the deal may have had another unintended consequence. It set the stage for Comcast's subsequent battles on net neutrality. "Those mergers gave additional oomph to the issue of net neutrality," noted former commissioner Copps. Speaking specifically of Comcast's buyout of NBC Universal, IHS senior analyst Eric Brannon agreed. "That merger laid the grounds for net neutrality."

In allowing Comcast to acquire major programming assets, the deal would sharpen questions about the power of gatekeepers like Comcast to control the flow of traffic from rival Web services. So in bowing to lobbyist pressure, the FCC would bring on itself a whole new set of pressures by focusing public attention on the issue of net neutrality.

With activists rounding up comments from the public and hip TV personalities like HBO's John Oliver also beating the drums, net neutrality quickly grew into a popular issue that won the support of President Obama, and by proxy, his hand-picked appointee Tom Wheeler. When the FCC ruled in February of 2015 that it would seek Title II authority to regulate the Internet and presumably block any favoritism by broadband gatekeepers, it seemed to finally cast its lot with the public against steamrolling corporate interests

The issue had simmered for years but reached full boil when movie purveyor Netflix, which had argued that its service was slowed down by Comcast, signed a side deal ensuring better download speeds for its wares. This triggered an outburst of public concern that Comcast was now in position to operate "fast" and "slow" lanes, depending on whether a rival programmer could afford to ensure that Comcast provide adequate download speed.

With nearly 4 million comments—many supplied or encouraged by public interest groups—filed to the FCC, net neutrality was a bankable political issue. And there's no question, net neutrality attracted public interest because it gave cable viewers—long furious at the treatment by the monopolists who send them monthly bills—issues of both viewing pleasure and economics.

But it also fed into the longstanding sentimental but increasingly unrealistic view of the Internet as the last bastion of intellectual freedom. Internet romanticists have long seen the Web as a place that somehow deserves special rules for breaking the stranglehold of traditional media and offering exciting new communications, information retrieval and shopping efficiencies.

Yes, the Internet is a modern marvel. This is beyond dispute. But some of the favors it has won from government over the years have had unfortunate unintended consequences.

In the 1990s, for example, net access providers were repeatedly exempted as an "infant industry" from paying access charges to the Baby Bells even though they had to connect users through local phone networks. The long distance companies were then paying as much as $30 billion a year for the privilege. But the Internet was exempted.

As the late 90s approached, the Internet was no longer an infant industry. Still, the exemption from access charges was extended. That exemption essentially allowed AOL in the late 90s to offer unlimited unmetered online time, a key factor in boosting usage and siphoning advertisers from print media. Why buy an ad in print that might get viewed with the transitory flip of a page when you can get round-the-clock attention online?[75] FCC decisions to grant the Internet access-charge exemptions arguably accelerated the decline of print media and much of the quality journalism print advertising could once support.

Meanwhile, retailers on the Internet were making inroads into brick and mortar retail business with the help of a Supreme Court-sanctioned exemption from collecting sales tax.[76] This judicial coddling of the Internet was the death knell for many smaller mom and pop local businesses, already challenged to match online pricing. And that's not all. The special favors continue virtually every year, as Congress proposes and/or passes legislation to extend special tax exemptions to Internet services.

Well, maybe tax breaks aren't such a bad idea for such an innovative and transformational emerging technology. For all its faults, the Internet—gateway to all goods, repository of all things, wizardly guide to all knowledge, enabler of universal self-expression—is undeniably cool.

But let's not deny that the combination of tax advantages and deregulation was toxic. Allow an industry to emerge with advantages over useful existing industries that largely play by the rules—well, maybe that can be rationalized. But then fail to hold the upstart industry to the same rules, allowing it more leeway to trample fundamental rights because it has the technical capacity to do so. Well, then you have a cruel Faustian bargain.

With the see-no-evil deregulatory gospel loosing all constraints, the Web would devolve into a playground for corporate snoops and criminals. For all its wonders, the Internet comes at a cost: the loss of control over personal data, the surrender of personal privacy, sometimes even the confiscation of identity.

Perhaps the most favorable consequence of net neutrality—and one that has gotten surprisingly little attention—is that it could set the stage for privacy reform. (More on this in Chapter Seven). The FCC can now choose to exercise its Title II powers to enforce privacy standards over broadband Internet. Privacy is one area where the FCC has done a pretty good job in the past.

Worth remembering, though, is that the hard-fought public victory over Net Neutrality may be transitory. AT&T and others have threatened to go to court to upend the FCC rules. And there's a fair chance a Republican Congress will legislate against Title II.

Meanwhile, though, one supreme irony has begun to unfold in the marketplace.

Modern-day laissez fair ideologues love to invoke the wisdom of markets as represented by the "mysterious hand" of Adam Smith. Unfortunately, in the absence of effective regulation, the putatively wise "mysterious hand" generally seems to work its magic for those with huge financial resources and the political access it buys.

In the current cable situation, however, the mysterious hand may actually be working in consumer-friendly ways. Years of regulation that favored the cable companies have now backfired as the market reacts to monopolistic pricing and content control.

Whereas cable giants have commanded premium monthly subscriber prices to deliver packages of largely unwatched channels, the market is now beginning to burst with new "debundled" options that are whittling away at cable's vast subscriber base.

Satellite service Direct TV, as noted, now offers its streaming video Sling TV package of popular networks that includes live sports and news. Amazon, Apple, CBS, HBO, Netflix, Sony, and others offer a variety of streaming video options that allow viewers to cut the cable cord. Suddenly, consumers have the cherry-picking capability that bundled—and expensive—cable packages have never allowed.

In this case, at least, the unintended consequences of the FCC's pro-industry policies may be producing an unexpected pro-consumer twist.

Chapter Seven: What about Privacy?

Has any issue gotten as much lip service—and as little meaningful action?

For all the various congressional bills, corporate self-regulatory schemes and presidential Privacy Bill of Rights proposals, the simple truth remains that no personal information is safe on the Internet. Data brokers have built a multi-billion dollar business exchanging information used to build profiles of Net users. Your shopping and surfing habits, your health history, your banking data, your network of social ties, perhaps even your tax filings are all potentially exposed online. Both legal and criminal enterprises amass this information. And it doesn't go away.

At any given moment people you don't know somehow know where you are. They may very well know when you made your last bank deposit, when you had your last asthma attack or menstrual period. Corporations encourage and pay for every bit of information they can use or sell. Creepy? Perhaps, but as Jeff Chester, president of the Center for Digital Democracy points out: "The basic business model that drives online is advertising."[77]

The FCC largely escapes blame on this one. It is the Federal Trade Commission that has had primary responsibility for protecting Internet privacy. The FCC does have some limited authority, which, some critics say, could have been exercised more vigorously. But for the most part the FCC is not to blame for the rampant online abuse of personal privacy and identity.

The FCC does however have privacy authority over the phone, cable and satellite industries. Until recently, at least, the FCC has kept privacy issues at bay among the companies in these industries. "The FCC has generally taken privacy very seriously," noted Harold Feld, a senior vice president at the non-profit Public Knowledge.[78]

But dynamics now in place suggest that privacy may be the next great testing ground for the FCC. A new chance, perhaps, to champion public interest. Even before the opportunity for privacy enforcement under Title II regulatory powers, the FCC faces new challenges from phone companies, now itching to monetize their vast consumer data stashes the way Net companies have. The commonly used term is "Google envy."

"Until now, ISPs (Internet Service Providers) have mostly not gotten into hot water on privacy—but that's changing," observed Jonathan Mayer, a fellow at the Center for Internet and Society.[79] Verizon and AT&T, major providers of mobile Internet access, have each introduced "super cookies" that track consumer behavior even if they try to delete older, less powerful, forms of cookies. AT&T is actually charging its customers an extra $30 a month *not* to be tracked.

Showdowns loom.

In adopting Title II to enforce net neutrality, the FCC has made broadband Internet access a telecom service subject to regulation as a "common carrier." This reclassification means that the FCC could choose to invoke privacy authority under Title II's Section 222. That section, previously applied to phone and cable companies, mandates the protection of consumer information. Such information—called CPNI for Customer Proprietary Network Information—has kept phone companies from selling data on whom you call, from where you call and how long you spend on the phone. Consumers may have taken such protection for granted on their phone calls. But they have no such protection on their Internet activity—which, as noted, has been a multi-billion dollar safe house hideaway for corporate and criminal abusers of personal privacy.

Now, though, the FCC could put broadband Internet communications under Section 222 protection. To Scott Cleland, a telecom industry consultant who has often been ahead of the analytic pack, this would be a momentous decision.

When the smoke clears—and it hasn't yet—the FCC could make consumer identifiers like IP addresses the equivalent of phone numbers. Suddenly, the Internet companies that have trafficked in all that personal data would be subject to the same controls as the phone and cable companies.

Cleland argues that the risk for privacy abuses extends beyond broadband access providers like Comcast and Verizon to Internet giants like Google and Facebook that have until now flourished with all that personal data. "They are at risk and they are going to live under the uncertainty their business model could be ruled illegal by the FCC," Cleland said.[80]

Much has been written about the legal challenges broadband access providers intend to mount against the FCC's new rules. But Cleland argues that a very different type of legal action could engulf companies that have benefited from the use and sale of private data. Trial lawyers, he argues, will see opportunity in rounding up massive class action suits of Internet users whose privacy has been violated. What sorts of privacy abusers face legal action? Anyone who has "collected CPNI via some type of cookie," according to Cleland.

"Right now, edge providers like Google, Facebook and Twitter are at risk of being sued by trial lawyers," he said.[81]

Sounds great for consumers who care about privacy on the Internet and how it has been abused. But the FCC, Cleland was reminded, has never been a consumer advocate. "Bingo," replied Cleland. That's what makes the FCC's potential move into privacy protection so important and so surprising, he suggests.

There are other signs that the FCC under Tom Wheeler might actually become more consumer-friendly on the issue of data privacy. While Wheeler has brought some former associates from lobbying groups to the FCC, he has also peppered his staff with respected

privacy advocates. Indeed, he named Gigi Sohn, longtime president of the non-profit Public Knowledge, as Counsellor to the Chairman in April.

Another appointee with a privacy background is Travis LeBlanc, head of the FCC's Enforcement Bureau. In previous employment in California's Office of the Attorney General, LeBlanc was active in enforcing online privacy. LeBlanc has stated an interest in privacy and has already taken action against two firms that exposed personal information—including social security numbers—on unprotected Internet servers.

But many aspects of LeBlanc's approach to regulating Internet privacy under Title II remain unclear. Unfortunately, the FCC declined repeated requests to make LeBlanc available for an interview. (It also declined to answer written questions on its enforcement intentions in both privacy and cell tower infrastructure emissions.)

It remains to be seen if LeBlanc and his superiors at the FCC are really willing to take on privacy enforcement. Such a stance would require great courage as the entire Internet infrastructure is built around privacy abuse. It is also questionable whether the FCC would have the courage to challenge Google—a rare corporate ally in the battles over Net Neutrality.

Chapter Eight: Dependencies Power the Network of Corruption

As a captured agency, the FCC is a prime example of institutional corruption. Officials in such institutions do not need to receive envelopes bulging with cash. But even their most well-intentioned efforts are often overwhelmed by a system that favors powerful private influences, typically at the expense of public interest.

Where there is institutional corruption, there are often underlying dependencies that undermine the autonomy and integrity of that institution. Such is the case with the FCC and its broader network of institutional corruption.

As noted earlier, the FCC is a single node on a corrupt network that embraces Congress, congressional oversight committees and Washington social life. The network ties the public sector to the private through a frictionless revolving door—really no door at all.

Temptation is everywhere in Washington, where moneyed lobbyists and industry representatives throw the best parties and dinners. Money also allows industry to control other important factors, like the research agenda. All of this works together to industry's advantage because—as with other instances of institutional corruption—there are compromising dependencies. Policy makers, political candidates and legislators, as well as scientific researchers are all compromised by their dependence on industry money.

Dependency #1 – So much of the trouble here comes back to the core issue of campaign finance. Cable, cellular and educational tech interests know where to target their funds for maximum policy impact. And the contributions work, seemingly buying the silence of key committee congressmen—even those with past records as progressives. Key recipients of industry dollars include Massachusetts Senator Ed Markey and, until he retired, California Democrat Henry Waxman. Though they have intermittently raised their voices on such issues as data privacy and cellular health and safety, neither has shown any great inclination to follow through and take up what would have to be a long and tough fight on these issues.

Dependency #2 – Democrats might be expected to challenge industry now and then. They traditionally have done so, after all. But this is the post-*Citizens United* era where the Supreme Court has turned government into a giant auction house.

Bid the highest price and you walk home with the prize—your personal congressman, legislative loophole, even an entire political party.

Such is the case with technology industries and the Democrats. The communications/electronics industry is the third largest industry group in both lobbying and campaign contributions, according to the Center for Responsive Politics. In just 2013 and 2014, this industry sector spent well over $750 million on lobbying.[82]

Only the finance/insurance/real estate and health industries outspend the tech sector on lobbying. But those industry groups lean Republican. Over 62% of the finance/insurance/real estate campaign contributions go to the GOP. Health contributions lean Republican 57% to 43%. But the technology group leans sharply to Democrats, who got 60% of contributions in the 2013-2014 election cycle.[83] The two next largest industry groups—energy/natural resources and agribusiness—also lean heavily Republican. So of the top five industry groups whose money fuels and often tilts elections four are strongly Republican. The Democrats need the tech industry—and they show that dependence with consistent support, rarely raising such public interest issues as wireless health and safety and Internet privacy.

Dependency #3 – Spectrum auctions give the wireless industry a money-making aura. In recent Congressional testimony, an FCC official reminded legislators that the FCC has over the years been a budget-balancing revenue-making force.[84] Indeed, the auctions of electromagnetic spectrum, used by all wireless communications companies to send their signals, have yielded nearly $100 billion in recent years. The most recent auction to wireless providers produced the unexpectedly high total of $43 billion. No matter that the sale of spectrum is contributing to a pea soup of electromagnetic "smog" whose health consequences are largely unknown. The government needs money and Congress shows its appreciation with consistently pro-wireless policies.

Dependency #4 – Science is often the catalyst for meaningful regulation. But what happens when scientists are dependent on industry for research funding? Under pressure from budget cutters and deregulators, government funding for research on RF health effects has dried up. The EPA, which once had 35 investigators in the area, has long since abandoned its efforts.[85] Numerous scientists have told me there's simply no independent research funding in the U.S. They are left with a simple choice: work on industry-sponsored research or abandon the field.

Chapter Nine: A Modest Agenda for the FCC

Nobody is proposing that cell phones be banned. Nor does anyone propose the elimination of the Universal Service program or other radical reforms. But there are some steps—and most are modest—that the FCC can take now to right some of the wrongs that result from long years of inordinate industry access and influence:

1. Acknowledge that there may be health risks in wireless communications. Take down the dismissive language. Maturely and independently discuss the research and ongoing debate on the safety of this technology.

2. In recognition of this scientific uncertainty, adopt a precautionary view on use of wireless technology. Require prominent point-of-sale notices suggesting that users who want to reduce health risks can adopt a variety of measures, including headphones, more limited usage and storage away from at-risk body parts.

3. Back off the promotion of Wi-Fi. As Professor Lennart Hardell has noted, there are wired alternatives that do not expose children to wireless risk.

4. Petition Congress for the budgetary additions needed to expand testing of emissions on antenna sites. It was Congress after all that gave industry carte blanche for tower expansion so long as they comply with FCC standards. But there is evidence of vast non-compliance and Congress needs to ensure that tower infrastructure is operating within the law.

5. Acknowledge that children and pregnant women may be more vulnerable to the effects of RF emissions and require special protection.

6. Promote cable debundling as a way to lighten consumer cable bills, especially for those customers who don’t care about high-cost sports programming.

7. Apply more rigorous analysis to properly assess the value of technology in education. Evidence continues to pile up that technology in education is not as valuable as tech companies claim. Pay less attention to tech CEOs—pay more attention to the researchers who’ve actually studied the impact of trendy technology fixes on learning

8. Take over enforcement of personal privacy rights on the Internet. Of all the basic suggestions here, this would require the most courage as it would involve challenging many of the entrenched powers of the Internet.

Chapter Ten: Stray Thoughts

Some concluding thoughts:

Why do so many of the most dubious FCC policies involve technology?

In large part, of course, because the FCC has authority over communications and that is a sector that has been radically transformed—along with so many others—by technology.

Let's be clear, though. The problem is not technology, which unarguably brings countless benefits to modern life. The problem is with the over-extension of claims for technology's usefulness and the worshipful adulation of technology even where it has fearful consequences. Most fundamentally, the problem is the willingness in Washington—for reasons of both venality and naïveté—to give technology a free pass.

Personally, I don't believe that just because something can be done it should heedlessly be allowed. Murder, rape and Ponzi schemes are all doable—but subject to prohibition and regulation. Government regulators have the responsibility to examine the consequences of new technologies and act to at least contain some of the worst. Beyond legislators and regulators, public outrage and the courts can also play a role—but these can be muffled indefinitely by misinformation and bullying.

There are precedents for industries (belatedly perhaps) acting to offset the most onerous consequences of their products. In responding to a mix of litigation, public demand and regulatory requirement, the auto industry, for example, has in the last 50 years substantially improved the safety and environmental footprint of its products.

Padded instrument panels, seat belts, air bags, and crumple zones have all addressed safety issues. Environmental concerns have been addressed with tightened emissions and fuel consumption standards. The response to new safety challenges is ongoing. Before side air bags were widely deployed, sedan drivers side-swiped by much larger SUVs were at vastly disproportionate risk of death and dismemberment.[86] But the deployment of side air bags has "substantially" reduced the risk of collision deaths.[87] Overall, auto fatality rates per 100,000 persons have dropped by nearly 60% in the U.S. since 1966.[88] Today, automakers continue to work on advanced safety features like collision avoidance.

It can be argued that most of these safety improvements came decades after autos were in wide usage and only in response to outrage at Ralph Nader's 1965 revelations on the auto industry.[89] No matter the catalysts. The simple truth remains that the auto industry—and its regulators—have for the last half-century been addressing safety and environmental issues.

But with the overwhelming application of money and influence, information and communications technologies have almost totally escaped political scrutiny, regulatory control, and legal discipline.

Should the Internet have been allowed to develop into an ultra-efficient tool for lifting personal information that includes financial records, health histories and social security numbers? Should wireless communications be blindly promoted even as new clues keep suggesting there may be toxic effects? Should local zoning authorities and American citizens be stripped of the right to protect their own health? Should education be digitized and imposed just because technology companies want to develop a new market and lock in a younger customer base?

All these questions can perhaps be rolled up in one: do we all just play dead for the corporate lobbyists and spinners who promote the unexamined and unregulated application of their products?

Finally, a word about the structure of the FCC. With five commissioners—no more than three from the same party—the structure seems to make some kind of sense.

But in practice, it works out poorly. The identification of commissioners by party tends to bring out the worst in both Republicans and Democrats. Instead of examining issues with clear-sighted independence, the commissioners seem to retreat into the worst caricatures of their parties. The Republicans spout free market and deregulatory ideology that is most often a transparent cover for support of business interests. The Democrats seems satisfied if they can implement their pet spending programs—extension of broadband wireless to depressed urban and rural schools, cell phone subsidies for low income clients. The result is a Commission that fulminates about ideology and spends heavily to subsidize powerful interests.

Perhaps one solution would be to expand the Commission to seven by adding two public interest Commissioners. The public interest only rarely prevails at the FCC. So it would represent vast improvement if both Republican and Democrat commissioners had to vie for support of public interest representatives in order to forge a majority. The public interest, in other words, would sometimes carry the swing votes.

It's very hard to believe, though, that Congress would ever approve such a plan. It simply represents too much of a threat to the entrenched political power of the two parties. Why would they ever agree to a plan that dilutes that power?

It's also worth noting that the public interest is not always easy to define. Sometimes there are arguably conflicting definitions. Still, an FCC with public interest commissioners is an idea worth consideration. It would at least require party apologists to defend how they so consistently champion the moneyed interests that have purchased disproportionate access and power in Washington.

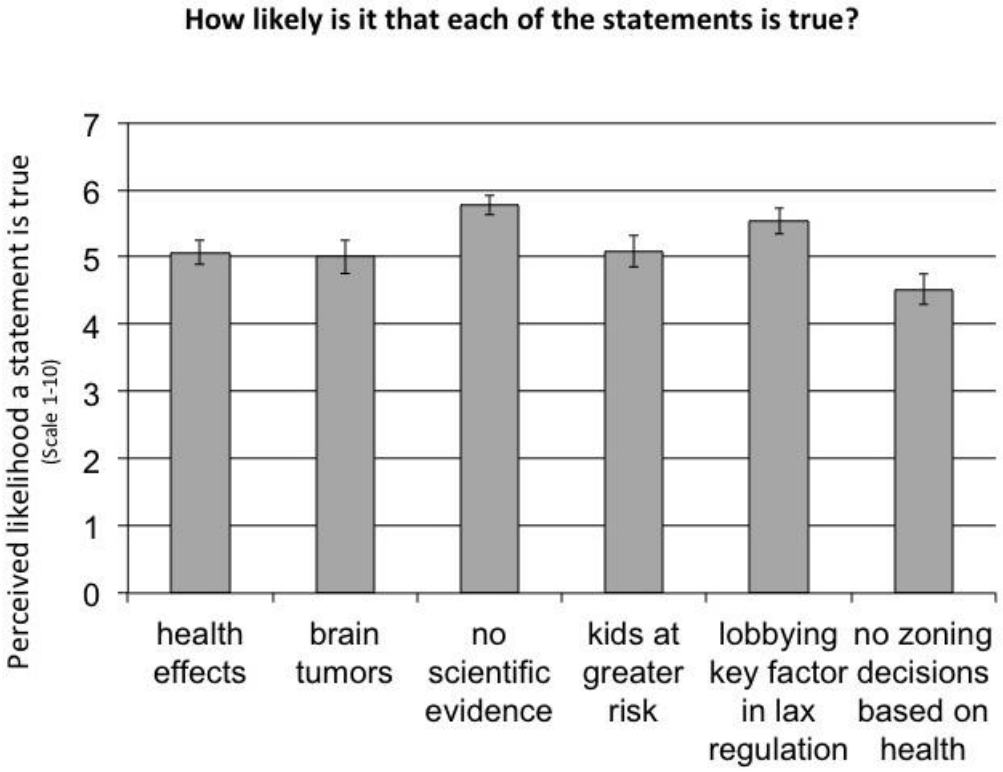
Appendix—Survey of Consumer Attitudes

What does the public believe about the science and politics of wireless health research? Under what conditions would people change wireless usage patterns? Is the FCC currently trusted to protect public health? How would confirmation of health risks affect trust in the FCC?

These are some of the questions Ann-Christin Posten[90] and Norm Alster[91] hoped to answer with an April 2015 online survey of 202 respondents. Participants were recruited through Amazon's Mechanical Turk online platform. All were U.S. residents and had achieved qualifying approval rates in prior Mechanical Turk surveys.

Participants were asked how likely they believed the following statements to be true:

> Statement 1. Prolonged and heavy cell phone use can have a variety of damaging effects on health.
>
> Statement 2. Prolonged and heavy cell phone use triples the risk of brain tumors.
>
> Statement 3. There is no scientific evidence that proves that wireless phone usage can lead to cancer or a variety of other problems.
>
> Statement 4. Children and pregnant women are especially vulnerable to radiation from wireless phones, cell towers and Wi-Fi
>
> Statement 5. Lobbying and campaign contributions have been key factors in keeping the government from acknowledging wireless hazards and adopting more stringent regulation.
>
> Statement 6. The U.S. Congress forbids local communities from considering health concerns when deciding whether to issue zoning permits for wireless antennae.

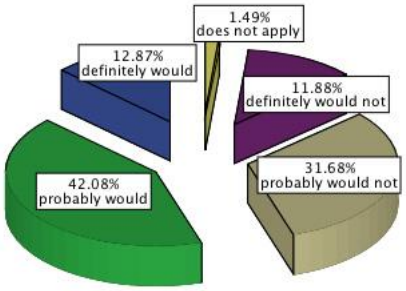


Two findings seem especially interesting:

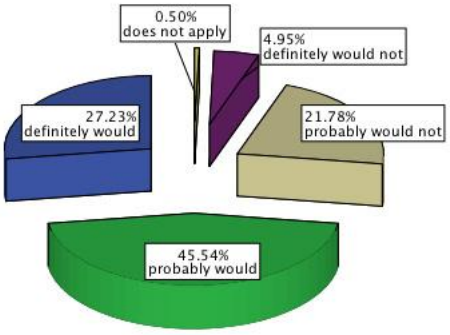
1. Statement 3 received a higher credibility rating than Statements 1 and 2. The different credibility levels are statistically significant. Respondents are more likely to trust in wireless safety than to believe there are general or specific health risks.

2. The only statement that is a matter of uncontested fact is Statement 6 on the outlawing of opposition to antenna sites on health grounds. (All other statements have been both proclaimed and denied.) And yet Statement 6 was least likely to be believed. Just 1.5% of respondents recognized this as an "absolutely true" statement. Over 14% thought this statement was "not true at all." Answers to this question would seem to reflect public ignorance on the political background to wireless health issues.

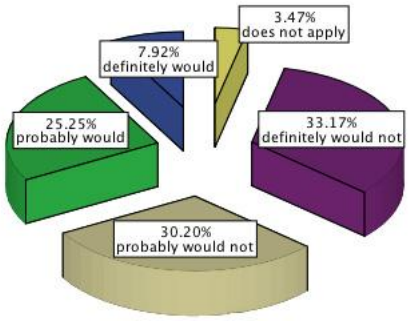
Participants were also asked how they would change behavior if claims of wireless health risks were established as true:



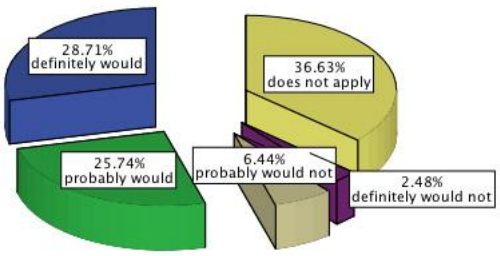
**If statement 1 was true,
I would start using headphones.**



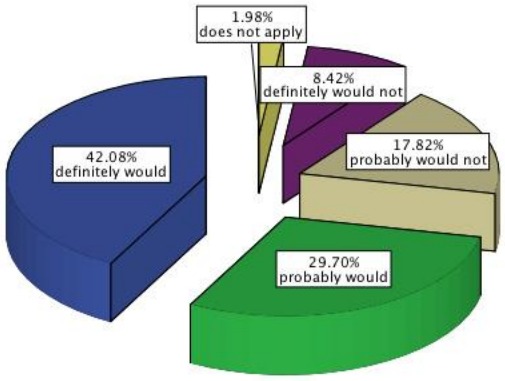
**If statement 1 was true,
I would restrict the amount of time
I spend on the phone.**



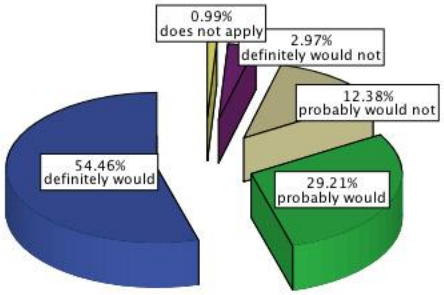
**If statement 1 was true,
I would start up a new land line
account for home use.**



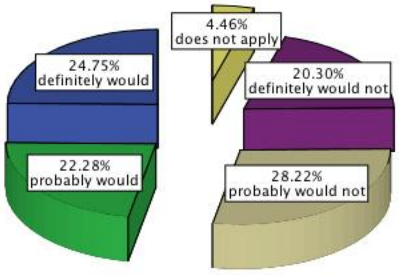
**If statement 1 was true,
I would restrict my children's cell phone use.**



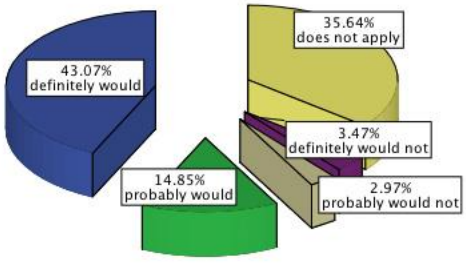
If statement 2 was true,
I would start using headphones.



If statement 2 was true,
I would restrict the amount of time
I spend on the phone.



If statement 2 was true,
I would start up a new land line
account for home use.



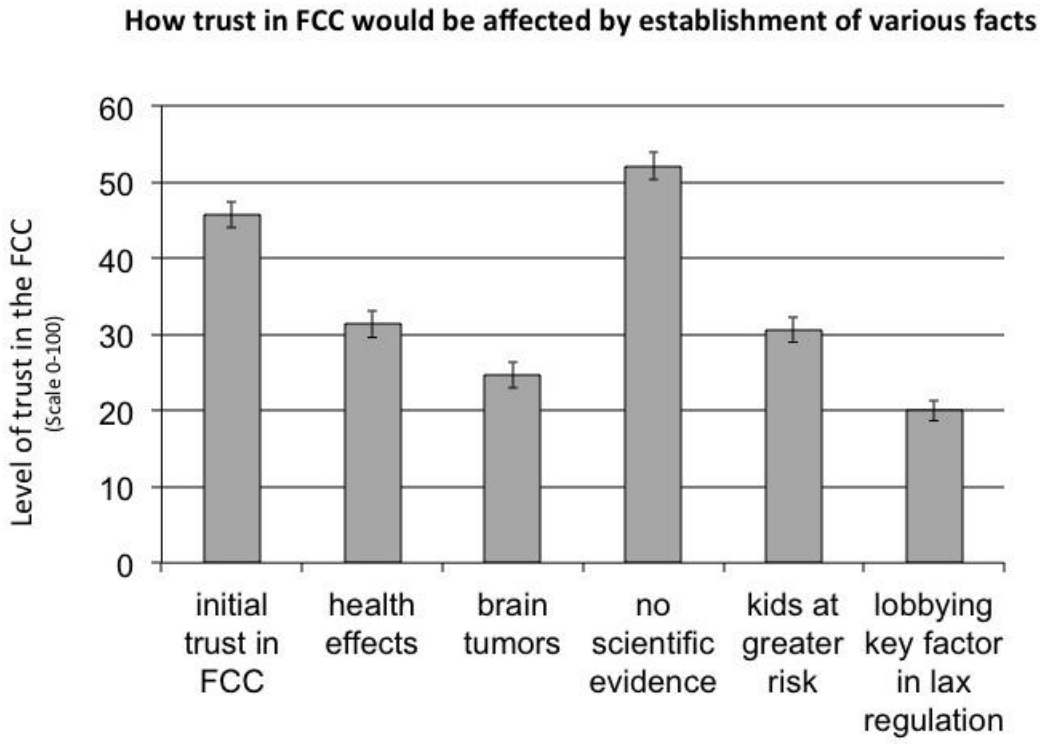
If statement 2 was true,
I would restrict my children's cell phone use.

The greatest impact on behavior came when respondents were asked to assume it is true that prolonged and heavy cell phone use triples the risk of brain tumors. More than half said they would "definitely" restrict the amount of time spent on the phone. Just over 43% would "definitely" restrict their children's phone use. Perhaps most surprisingly, close to 25% would "definitely" start up a new landline phone account. (This last response suggests it may be foolishly premature for the phone giants to exit the landline business just yet.)

The inclination of consumers to change behavior should negative health effects be confirmed suggests the stakes are enormous for all companies that derive revenue from wireless usage.

This survey points to—but cannot answer—some critical questions: Do wireless companies better protect themselves legally by continuing to deny the validity of all troublesome research? Or should they instead be positioning themselves to maintain consumer trust? Perhaps there is greater financial wisdom in listening to the lawyers right now and denying all chance of harm. If so, however, why would anyone seriously concerned about health listen to the industry—or to its captured agency? That's a question the FCC will eventually need to answer.

Trust could eventually become a central issue. Respondents were initially asked to describe their level of trust in the wireless industry and in the FCC as its regulator. Not surprisingly, establishment of any of the presumed health risks—or confirmation of inordinate industry pressure—resulted in statistically significant diminution of trust in both the industry and the FCC.



On a scale of 1 to 100, the FCC had a mean baseline trust level of 45.66. But if the tripling of brain tumor risk is established as definitely true, that number falls all the way to 24.68. If "lobbying and campaign contributions" have been "key factors" in keeping the government from acknowledging wireless hazards, the trust level in the FCC plummets to 20.02. All results were statistically significant.

It's clear that at this point confirmation of health dangers—or even of behind-the-scenes political pressures—from wireless will substantially diminish public trust in the FCC. Skeptics might argue that this gives the FCC motive to continue to downplay and dismiss further evidence of biological and human health effects. Those of a more optimistic bent might see in these findings reason to encourage an FCC concerned about public trust to shake itself loose from special interests.

Endnotes

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[45] February 2015 interview with Carl Blackman.

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[48] Lawrence Lessig, Roy L. Furman Professor of Law and Leadership at Harvard Law School, helped to draft the Right to Know ordinance and has offered pro bono legal representation to the city of Berkeley. Professor Lessig was director of the Lab at Harvard's Safra Center for Ethics, from which the Project on Public Narrative was spun off in November of 2014.

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[90] Lab Fellow, Edmond J. Safra Center for Ethics, Harvard University.

[91] Investigative Journalism Fellow, Project on Public Narrative at Harvard Law School.

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Medical Resident, West Los Angeles VA Medical Center: 1990 – 1993

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Associate Professor of Family and Preventive Medicine, UC San Diego: July 2004-2012

Health Consultant, RAND: Santa Monica, CAAugust 1996 –2007.

Research Associate Professor, Department of Psychology, Social Science Research Institute, University of Southern California, October 1998 – ?

Robert Wood Johnson Generalist Physician Faculty Scholar: July 2003-2007

Assistant Professor, Dept. of Family and Preventive Medicine, UC San Diego: July 2002-2004

Assistant Professor of Medicine, UC San Diego: April 1998-July 2004

Research Assistant Professor, Dept. of Psychology, USC: June 1995-1998

Attending physician, Emergency Room, West Los Angeles VA Medical Center: 1994-1997

Teaching Assistant, Cell Biology, UCSD Department of Biology: 1987; Physiology of Sensation and Perception, UCSD Department of Psychology: 1987; Endocrinology, UCSD Department of Biology: 1986; Neurobiology, UCSD Department of Biology: 1985; Genetics, UCSD Department of Biology: 1983, 1984

Jet Propulsion Laboratory, Engineer I: 1979

Jet Propulsion Laboratory, Technical Aide A: 1978

LICENSURE California, Issued October 8, 1991

BOARD CERTIFICATION American Board of Internal Medicine, September 1993

AWARDS, HONORS, FELLOWSHIPS

Royal Society of Medicine, Overseas Fellow, May 2010

Robert Wood Johnson Generalist Physician Faculty Scholar Award: 2003 – 2007

Who's Who in America: 2000 – present

Fellow, AHA Council on Epidemiology and Prevention: 2000 – present

Fellow of the American Heart Association: July 2001

Invited Nominator, Edge of Computation Science Prize 2005
http://www.edge.org/3rd_culture/prize05/prize05_index.html

Associate Fellow, American Heart Association Council on Epidemiology and Prevention: elected March 25, 1999

Fellow, 23rd Annual American Heart Association 10-day Seminar on the Epidemiology and Prevention of Cardiovascular Diseases: 1997

Robert Wood Johnson Clinical Scholar: 1994-6 (listed also under Education and Training)

Solomon Scholar Research Award, UCLA: 1993

Solomon Scholar Research Award, UCLA: 1992

Emma Josephine Bradley Bovard Award (for graduating USC senior with best academic record): 1979

Summa cum laude graduate (4.0 GPA Physics, age 19)

Phi Kappa Phi: 1979

Phi Beta Kappa (Junior Inductee): 1978

PROFESSIONAL ACTIVITIES AND AFFILIATIONS (National/ International)

Scientific Advisory board, We Are the Evidence, 2018-present

Scientific Advisory Board, Physicians for Safe Technology, 2018-present

Member, Cochrane Adverse Effects Methods Group, 2008 – present (International)

International Group for Reducing Inappropriate Medication Use and Polypharmacy (IGRIMUP): Invited as the US member, Dec 2012-present

Advisory Board, The Science Network (http://www.tsntv.org/about/advisors.php): 2004 – present

Department of Veterans Affairs Research Advisory Committee on Gulf War Veterans' Illnesses: Scientific Director Jan 2002 – Sep 2003; Chief Scientist: Sep 2003 – 2005; Member 2005-2015 (longest serving member)

Accompanied high-level mission to the Middle East, with Dr. Bernard Rostker (Assistant Secretary of Defense for Personnel and Manpower; then Undersecretary of the Navy), and several other DoD and Congress officials. Purpose: to brief officials from other nations regarding illness in Gulf War veterans and exposures in Persian

Gulf War; and to perform fact collection; itinerary included Kuwait, Saudi Arabia, Egypt, and Israel: Oct 1997 – Nov 1997

PEER REVIEW

Peer Reviews for journals include:

*Major General Medicine Journals: New Engl J Med (2001, 2003, 2006, 2010, **2017**), JAMA (1999, 2008, 2013, 2014), Lancet, Annals of Internal Med (2005 x 2, 2006, 2007, 2008, 2011, 2012, 2014, **2015, 2018**), Arch Int Med now JAMA Int Med (2011, 2012, 2013x2, **2017**), BMJ (1999, 2011, 2012**,** 2013x2, 2014x5, **2015x2, 2016x2, 2017x2, 2018x3**), BMJ Open (2012, 2013x3, 2014, **2015, 2017x2, 2019**), Circulation, JACC (2007 x 2, 2008, 2009), PLoS Medicine (2014), PLoS-ONE (2008, 2011, 2013x2, 2014x2, **2015x3, 2017x2, 2018x3, 2019**).*

*Other Journals: Adv Med Sci (2011), Afr J Agric Res (2011), Am J Cardiovascular Drugs (**2017**), Am J Clin Nutr (2002, 2003), Am J Epi, Am J Med (1999, 2000, **2019**), Am J Kidney Disease (2010), Am J Preventive Med (2010), Am J Primatology, Ann Behav Med (1999), Ann Epi (2006), Ann Med (2011), Ann Surg (2007), Antibiotics (**2019**) Arch of Med and Health Sciences (**2015**), Arch Med Res (2014), Atherosclerosis, Biological Psychiatry (2004, 2013), BMC Cardiovascular Disorders (**2017x3, 2018x2**), BMJ Cases (2008 x 2), BJCP (**2018**) Br J Nutr (**2015x2**), Clin Cardiol (2012, 2013), Clinical Infectious Diseases (**2017**), Clin Lipidology (**2015**), Complex Systems, Contemp Clin Trials (2007x2, 2010), Current Drug Safety (2011), Drug Safety (2010, 2011), EBioMedicine (**2015**), EJON (**2017**), Eur J of Nutrition (**2015**), Eur J Pharmacol (2007), Evolutionary Anthropology, Expert Opinion on Drug Safety (**2017**), Expert Review of Cardiovascular Therapy (**2016**), Health Psychology (2009, 2011, 2012x3), Hypertension (2013), JAMA Ophthalmology (2013), J Affective Disorders (2003, 2005, 2013), J Applied Physiol (**2015**), J Clin Epi (1999, 2000x2, 2001, 2003, 2004), J Env Occup Sci (**2018**), J Gen Internal Med, J Health Psychol (2014), J Human Hypertension (2012, 2013), J of Int Med (**2018**), J Neurol Sci (2012), J Psychiatr Res (**2015x2, 2019**), J Psychosom Res (2013), J Toxicology Env Health (2009), J Women's Health (2007), Marshall J of Med (**2017**), Medical Care, Med J Australia (2012), Muscle and Nerve, NeuroImage: clinical (**2015**), Neuropsychopharmacology (2006), Neuroscience Letters, Neurotoxicology and Teratology (**2016x2, 2017x2**), Online Journal of Medicine and Medical Science Research (2012), Open Drug Safety (2010, 2011), Open Medicine (2010), Physiological Res (2011, **2015**), Physiology & Behavior (2000), PLoS Comput Biol (2013), Psychiat Letter (2005),, Psychiatric Services (1999), Psychiatry Research (2005), Psychosomatic Med (1999, 2000, 2001x2, 2003), Psychological Reports (2000), QJM (2011, earlier), Social Science and Medicine (**2015x2**), SpringerPlus (**2016**), Ther Adv Drug Safety (2011), Tohoku J Exp Med (2006, 2007)*, *Webmed Central* (2011) others.

Peer Review quality: Received letters from *Annals of Internal Medicine* in three consecutive years stating they rate the quality of their reviews and that I was in the top 10% of reviewers by quality for the prior year (then the editor that provided these letters left). Received a letter again, **2016** after most recent review stating that my reviews were in the top "category" (unspecified) of review quality.

Peer Review participation, Books: Oxford University Press

Peer review, grants, national and international:

National Institute for Health Research, Research for Patient Benefit Programme (UK), (2011)

DoD, Gulf War, Consortium Review panel (2012)

UCSD Clinical Translational Research Institute (CTRI) grant review (**2017**)

EXPERT PANEL PARTICIPATION

National Lipid Association, Statin Adverse Effects meeting for position paper, Atlanta Oct 5-6 2013 (participated remotely). (I removed myself from the document which did not meet my standards for rigor or impartiality.).

Panelist, NIH Contract Review, Use of Biological Samples from WHI, May 2008.

Department of Veterans Affairs, Research Advisory Committee on Gulf War Illnesses: Jan 2002 – present.

Panelist, NIH (NHLBI) Program Project Review. February 2007.

Grant Review, International Coenzyme Q10 Association, 2007.

Panelist, NIH (NHLBI) Review Panel on "Prevention of Cardiovascular Disease in Diabetes Mellitus: Clinical Center Network Proposals": June 1999.

Expert "panelist" for the Department of Defense in the Army After Next AMEDD Technical Workshop to advise strategies for troop health protection in the year 2025. MacLean, Virginia: June 13 1999 – June 18 1999.

Expert panelist for the Center for Health Policy Research/Health Care Financing Association "Normative Standards Project", pertaining to normative standards for home health care (requested; participation aborted due to date conflict with Department of Defense panel above): June 1999.

Panelist and speaker, Violence Prevention Coalition of Greater Los Angeles meeting entitled "How might interdisciplinary models of research guide us to a better understanding of violence?" Los Angeles, CA: Nov 1998.

BRIEFINGS TO NATIONAL ACADEMIES GROUPS

"Gulf War illness," Briefing to IOM Committee on Gulf War & Health, National Academy of Science Building, Washington, D.C, Jan 27, 2014 (invited briefing #2, given remotely; pending)

"Gulf War illness," Briefing to IOM Committee on Gulf War & Health, National Academy of Science Building, Washington, D.C, Dec 3, 2014 (invited talk, given remotely)

Briefing to the Committee on Developing a Consensus Case Definition for Gulf War Illness, NAS Board Room, National Academy of Sciences Building, Washington, D.C. June 26, 2013 (phoned in to give the briefing)

"Coenzyme Q10 in Gulf War Illness: A Randomized Controlled Trial" invited talk for Institute of Medicine Committee on Gulf War and Health: Treatment of Chronic Multisymptom Illness, National Academies Beckman Center, Irvine, CA April 12, 2012.

"Pitfalls in the Application of Evidence." The National Academies seminar *What Can Be Learned from Public Health on the Role of Research for Policy Purposes?,* Invited lecture to Division of Behavioral and Social Sciences and Education Standing Committee on Social Science Evidence for Use, The National Academies, Irvine, CA: Oct 30, 2008.

BRIEFINGS TO GOVERNMENT AGENCIES

"Recruitment of Gulf War veterans for research studies," Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC, Sept 23, 2014

"Gulf War illness and mitochondrial dysfunction "Department of Veterans Affairs: Mitochondrial Disease meeting, June 12, 2014, Washington, D.C.

"Treatment for Gulf War illness: Coenzyme Q10 Study Results", briefing to House of Representative members and Staffers, Cannon House Office Building, Washington, D.C., 3:30 PM (invitation by Rep Kucinich), Feb 1, 2012.

"Treatment for Gulf War illness: Coenzyme Q10 Study Results", briefing to Senate staffers, 418 Russell Senate Office Building (invitation by Senator Bernie Sanders), 2:200 PM, Feb 1, 2012.

"Treatment for Gulf War illness: Coenzyme Q10 Study Results", briefing to Senate members, 332 Dirksen Senate Office Building, Washington, D.C., 5PM, Jan 31, 2012 (invitation by Senator Bernie Sanders).

"Coenzyme Q10 for Gulf War Veterans," Invited talk to Department of Veteran Affairs Research Advisory Committee on Gulf War Veterans' Illnesses, Washington, D.C., June 27, 2011.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: Sept 16, 2008.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: April 08, 2008.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: July 15, 2007.

"Oxidative stress, mitochondria, and illness in Gulf War veterans: A hypothesis." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: April 24, 2007.

"Statin Side Effects." Invited discussion with Senate Finance Committee representatives. Dickson Building, Capitol Hill, Washington DC: June 9, 2006.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: May 16, 2006.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: April 8, 2005.

"Gulf War Illnesses, Anthrax Vaccine." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: April 7, 2005.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses. Washington DC: June 29, 2004.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: Feb 23, 2004.

"Gulf War Illnesses, Research Update." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: June 2003.

"Birth Defects in Gulf War Veterans, Gulf War Veterans Research Update." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: June 2003.

"Candidate Research Recommendations," "Vaccines and illness in Gulf War Veterans", Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: Feb 2003.

"Gulf War Veterans Illnesses, Research Update focusing on Acetylcholinesterase inhibitors." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: Feb 2003.

"Treatments for Gulf War Veterans: What has been tried, and what are candidate treatments?" "Vaccines and illness in Gulf War Veterans." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: Oct 2002.

"Vaccines and illness in Gulf War Veterans." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: Oct 2002.

"Acetylcholinesterase inhibitors and illness in Gulf War veterans." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: June 26, 2002.

"Treatments for ill Gulf War veterans." Research Advisory Committee on Gulf War Veterans Illnesses (Committee meeting open to the public). Washington DC: Feb 2002.

"Pyridostigmine Bromide: A Review of the Scientific Literature as it Pertain to Gulf War Illnesses." Testimony to Congress: House Veterans Affairs Committee, Health Subcommittee and Benefits Subcommittee. Washington DC: Nov 19, 1999. *http://www.rand.org/content/dam/rand/pubs/testimonies/2005/CT164.pdf*

Briefings to members of Senate subcommittees (Foreign Affairs and Veterans Affairs). Washington DC: Oct 19, 1999.

"Pyridostigmine Bromide: A Review of the Scientific Literature as it Pertain to Gulf War Illnesses." Briefing to representatives of multiple U.S. Veterans advocacy groups. Washington DC: Oct 19, 1999.

"Pyridostigmine Bromide: A Review of the Scientific Literature as it Pertain to Gulf War Illnesses." Press Briefing from the Pentagon. Washington DC: Oct 19, 1999.

"Pyridostigmine bromide and illness in Persian Gulf War veterans." Briefing to group consisting of: the Undersecretary of Health, the Undersecretary of the Army, the Surgeon General of the Army, the Principal Deputy for Health Affairs, representatives from the Surgeons General of the Navy and Air Force, several other generals, and the Directors of the Health and Defense Programs at RAND (The group convened for the exclusive purpose of hearing my briefing). Washington DC: Feb 3, 1998.

"RAND on PB and Immunizations." Presidential Special Oversight Board for Department of Defense Investigations of Gulf War Chemical and Biological Incidents. Arlington, VA: Oct 28, 1998.

"RAND Center for Military Health Policy Research: Gulf War Illness." (with Dr. Ross Anthony) Briefing to Major General James B. Peake, Commanding General/Commandant/ Installation Commander, US Army Medical Department Center and School. RAND Arroyo Center, Army Research Division. Santa Monica, CA: Oct 22, 1998.

"Health Effects of Service in the Gulf War." (with Dr. Ross Anthony) Briefing to DARPA and DSO (Defense Science Office. Arlington, VA: Sept 8, 1998.

"Health Effects of Service in the Gulf War." (with Dr. Ross Anthony) Briefing to Advisory Board of the National Defense Research Institute. RAND. Santa Monica, CA: May 5, 1998.

"Health Effects of Service in the Gulf War." (with Dr. Ross Anthony) Briefing to RAND Board of Trustees RAND's 50th birthday. Washington DC: April 9, 1998.

"Pyridostigmine bromide and illness in Persian Gulf War veterans." Briefing to representatives from DoD, VA, FDA, PAC, and Congress. RAND Washington, Washington DC: Nov 4, 1997.

"Pyridostigmine bromide." Briefing to Israeli Defense and Health personnel, as part of a mission to the Middle East with Dr. Bernard Rostker (Assistant Secretary of the Navy; now Undersecretary of the Army) and others from the DoD. Tel Aviv, Israel: Nov 1 1997 (Participated in other briefings in the Middle East - Kuwait, Saudi Arabia, and Egypt - during a ~2 week trip).

Other Research Advisory Committee on Gulf War Veterans Illnesses Meetings Attended: Numerous.

ON-LINE TALKS/INTERVIEWS

Conflict of Interest, Salk Institute talk, 2008: http://www.youtube.com/watch?v=nFtt-W3LROY
Conflict of Interest, 2011 http://vaccinesafetyconference.com/videos.html
Interview Conflict of Interest (I did not name this talk):
http://articles.mercola.com/sites/articles/archive/2010/06/12/beatrice-golomb-interview.aspx
Interview Chocolate: http://www.foodconsumer.org/newsite/Nutrition/Food/chocolate_082620120847.html
Vaccine Safety Meeting: http://www.youtube.com/watch?v=SZHyLODgUvs&feature=plcp
Jon Stewart Daily Show (lampooned on):
http://www.thedailyshow.com/watch/thu-october-21-1999/headlines---pills-bury-doughboys
http://thedailyshow.cc.com/videos/zgu22c/headlines---pills-bury-doughboys
ABC (Australia Broadcasting Company) TV: http://youtu.be/wAKaM330xzg
EHS, radio interview with *Boil the Frog Slowly* with Sebastian Sanzotta

LECTURES, PRESENTATIONS (Includes invited presentations to National Academies groups)

(See also Briefings to Government Agencies; and Abstracts, many of which had accompanying presentations)

"Meta-analysis: Considerations and Limitations," Graduate Biology Seminar, UC San Diego, course director Dr. Pamela Reinagel, La Jolla, CA May 28, 2019

"Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation," American Society of Safety Professionals, Jacobs Center for Innovation, San Diego, CA Mar 12, 2019

"Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation," UCSD Preventive Medicine fellows seminar, La Jolla, CA Mar 1, 2019

"Evidence-based Diet," lecture for Med 410 *From Principles to Practice*, UC San Diego, course director Ian Jenkins, La Jolla, CA, Feb 12, 2019

"Study Designs," General Internal Medicine faculty seminar, UC San Diego, lecture series director Gerry Boss, La Jolla, CA (Jan 9, 2019).

"Evaluation of Evidence and Inference," UC San Diego General Internal Medicine faculty seminar, lecture series director Gerry Boss, La Jolla, CA Dec 8, 2018.

"Diplomats' Mystery Illness and Pulsed Radiofrequency/Microwave Radiation," UC San Diego Marshall College Honors Seminar, Couse Director Leslie Carver, La Jolla, CA Nov 26, 2018

"Gulf War illness – why it matters for the rest of us." UCSD CTRI lecture series, Hillcrest, CA May 3, 2017,

"Electrohypersensitivity: A 'current' and future problem". at meeting *Cell Phones and Wireless Technologies—Should Safety Guidelines Be Strengthened to Protect Adults, Children and Vulnerable Populations?* Commonwealth Club, San Francisco (R), June 22, 2015. (invited talk)

"Taking down the enemy: The industry (et al) playbook." at *Royal Society* sponsored meeting *Science at the Crossroads: Scepticism vs Denial and Elitism vs Public Engagement.* Chicheley Hall, Milton Keynes, UK (R). June 15, 2015 (invited talk)

"Gulf War illness," Briefing to IOM Committee on Gulf War & Health, National Academy of Science Building, Washington, D.C (R), Jan 27, 2015 (invited briefing #2)

"Stacking the Deck: Treatment Benefits and Risks" La Jolla Country Club Men's Luncheon Club (retired executives and professionals), La Jolla, CA Jan 7, 2015. (invited talk)

"Gulf War illness," Briefing to IOM Committee on Gulf War & Health, National Academy of Science Building, Washington, D.C (R), Dec 3, 2014 (invited talk)

"Gulf War illness and mitochondrial dysfunction "Department of Veterans Affairs: *Mitochondrial Disease* meeting, Washington, D.C. (R), June 12, 2014

"Chocolate: My Favorite Vegetable." Revelle College Honors Seminar, UC San Diego, La Jolla, CA, Feb 11. 2014.

"Evidence Based Diet," lecture for Med 410 *From Principles to Practice*, UC San Diego, La Jolla, CA, Feb 3, 2014

"When Good People Go Bad: Biological Risk Factors for Aggression". Naval Medical Center, Department of Psychiatry Grand Rounds, San Diego, CA Jan 31, 2014

"The Angina Monologues: Statins in Women" (debate). American College of Cardiology - California, Beverly Hills, Nov 21, 2013.

"Statin Effects and Risk Benefit." Invited presentation, American College of Nutrition, San Diego, Nov 14, 2013

"Distortions in Medical Information: Let me Count the Ways." Science Studies, UCSD, La Jolla, Oct 14, 2013

"The Older the Better?" International Association of Gerontology & Geriatrics 20th World Congress of Gerontology & Geriatrics in Seoul, South Korea. June 26, 2013 (with Marcella Evans)**.**

"Stop Medicating Beyond the Evidence. Guidelines for Guidelines on Preventive Treatments." International Association of Gerontology & Geriatrics 20th World Congress of Gerontology & Geriatrics in Seoul, South Korea. June 24, 2013 (with Marcella Evans).

"Stacking the deck: How conflict of interest advantages identification of benefit over harm." Invited public lecture hosted by the Center for Values in Medicine, Science and Technology, fUT Dallas, Dallas, TX Apr 17, 2013.

"Chocolate: My Favorite Vegetable." Revelle College Honors Seminar, UCSD, San Diego, Feb 14, 2013.

"Evidence Based Diet" lecture for Med 410 *From Principles to Practice*, UC San Diego, La Jolla, CA, Feb 12, 2013.

Statin Roundtable, with Dr. Stephen Sinatra and Dr. David Perlmutter Dec 17, 2012

"Statins in the Elderly," Geriatric Pharmacology Seminar, UC San Diego, La Jolla, CA, Dec 05, 2012

"Chocolate and Memory." American Heart Association, Los Angeles, Nov 6, 2012.

("Statins." Keynote talk, Bringing Evidence to Frontline Clinicians, Vancouver Nov 2, 2012 (I had to cancel))

"Stacking the Deck: Conflict of Interest in Medicine." Osher Lifelong Learning talk, UCSD, La Jolla, CA Oct 23, 2012.

"Statins: The Good, the Bad, the Recommendations, the Evidence." Osher Lifelong Learning talk, UCSD, La Jolla, CA Oct 9, 2012.

"Chocolate: My favorite vegetable." Biomedical library series, UCSD, La Jolla, Oct 4, 2012.

General Internal Medicine Grand Rounds, UC San Diego, La Jolla, CA Sept 26, 2012

"Gulf War illness." briefing to regional Gulf War veterans, La Jolla, CA Sept 5, 2012.

"Placebos." Skyped talk to Placebo meeting, University of British Columbia, Canada, May 23, 2012.

"Vaccines, Oxidative Stress, Autoimmunity, And Chronic Multisystem Health Outcomes " 8th International Congress on Autoimmunity. www.kenes.com/Autoimmunity, Granada, Spain. May11, 2012. 8th International Congress on Autoimmunity. www.kenes.com/Autoimmunity, Granada, Spain. May11, 2012.

"Coenzyme Q10 in Gulf War Illness: A Randomized Controlled Trial" invited talk for Institute of Medicine Committee on Gulf War and Health: Treatment of Chronic Multisymptom Illness, National Academies Beckman Center, Irvine, CA April 12, 2012.

"Statins raise glucose preferentially among men who are older and at greater metabolic risk." AHA Joint Conference - Nutrition, Physical Activity and Metabolism and Cardiovascular Disease Epidemiology and Prevention Scientific Sessions (oral presentation) San Diego. *Co-listed in Abstracts.* Mar 16, 2012.

"Evidence based diet." lecture for Med 410 *From Principles to Practice*, UC San Diego, La Jolla, CA, Feb 14, 2012.

"Sound decisions about drugs. A call for improved drug safety science." 11-20-2011, Washington, D.C.

"Q10 for Gulf War Veterans," Invited talk to Department of Veteran Affairs Research Advisory Committee on Gulf War Veterans' Illnesses, Washington, D.C., June 27, 2011. (Colisted under Briefings above).

"Conflict of interest: Stacking the deck in drug risks vs benefits." Invited lecture, Dept of Medicine "B", Sheba Medical Center affiliated with Tel Aviv University, Tel-Hashomer, Israel. June 16, 2011.

"Janus-faced predictors: And why randomized, double-blind, placebo-controlled trials are none of the above." Conference in Honor of Halbert L. White, Jr. - Causality, Prediction, and Specification Analysis: Recent Advances and Future Directions. San Diego, CA May 6-7, 2011.

"Evidence Based Diet." lecture for Med 410 *From Principles to Practice*, UCSD, La Jolla CA, Mar 15, 2011.

"Stacking the Deck: Drug Risks and Benefits." Phil 26 Science, Society and Values: Good Bad and Junk Science. Course Director Professor Craig Callendar. UCSD, La Jolla, CA Feb 24, 2011.

"Research on drugs and vaccines, evidence vs truth: a call for formal study of drug harms." Vaccine Safety conference, Montego Bay, Jamaica, Jan 5, 2011.

"Representation of drug benefits vs harms: the impact of conflict of interest." Vaccine Safety conference, Montego Bay, Jamaica, Jan 4, 2011.

"Patient Reporting of Drug Adverse Effects." International Society of Pharmacovigilance, Accra, Ghana, Nov 3-6, 2010 (Golomb = invited presenter and talk author; delivered by Marcella Evans whom I funded to attend).

"Conflict of Interest." CREST (Clinical Research Enhancement Through Supplemental Training, http://crest.ucsd.edu), La Jolla, CA, October 27 and 28, 2010.

"Statins and Exercise." Invited lecture, American College of Sports Medicine, Southwest Chapter 2010 Annual Meeting, Mission Valley Marriott, San Diego, CA Oct 22, 2010.

"Statins, Q10 and Mitochondrial Function." invited lecture, International Coenzyme Q10 Association Meeting, Brussels, Belgium May 29, 2010 (Golomb = invited presenter and talk author; delivered by Dr. Peter Langsjoen).

"Statin Effects and Adverse Effects." Rockefeller University, New York, Mar 17, 2010.

"Evidence Based Diet." UCSD School of Medicine SOM410, From Principles to Practice, La Jolla, CA, Feb 23, 2010.

"Rectal (and Swallowed) Foreign Bodies." Invited talk, *Ig Nobel Winners in San Diego*, San Diego Marriott, Feb 19, 2010, http://improbable.com/airchives/miniair/2010/mini2010-02.htm.

"Stacking the Deck." Invited Talk, PRIME-LC group (medical students), UC Irvine, Feb 9, 2010.

"Stacking the Deck: Drug Benefits and Harms." York University, Toronto, Canada, Jan 22, 2010.

"Stacking the Deck." ICES/CEU Conjoint Evaluative Sciences Rounds, University of Toronto, Jan 22, 2010.

"Q10 for Gulf War Veterans." Department of Defense research meeting, Hallmark Crowne Center, Kansas City, MO, Sep 2, 2009.

"Stacking the Deck." Phil 12: Logic and Decision Making, Philosophy of Science, UC San Diego, Warren Lecture Hall, San Diego, CA, Aug 27, 2009.

"Evidence Based Diet." Noon Conference, Veterans Affairs Medical Center, San Diego, CA, June 12, 2009.

"Evidence Based Diet." Hebrew University School of Medicine, Jerusalem, Israel, June 3, 2009.

"Stacking the Deck: Drug Benefits and Harms." The Technion School of Medicine, Haifa, Israel, June 2, 2009.

"Statin Effects." The Technion School of Medicine, Haifa, Israel, June 1, 2009.

"Cholesterol and Behavior: From Case Reports to Population Data." Invited presentation, seminar entitled *Modeling anti-social behavior: lessons from cholesterol biosynthesis*. Society for Biological Psychiatry 64th Annual Meeting, Vancouver: May 14-16, 2009.

"Drug Risks and Benefits: Stacking the Deck." Invited/guest lecture in Soc 40, Sociology of Healthcare Issues, UCSD, Course Director Tom J. Waidzunas, PhD, La Jolla, CA May 18, 2009.

"Statin Effects and Side Effects." Cardiology Grand Rounds, San Diego Cardiac Center, Sharp Memorial Hospital, La Jolla, CA: April 17, 2009.

"Gulf War Syndrome." in Topics and Advances in Internal Medicine, University of California, San Diego School of Medicine, Hilton San Diego Resort, San Diego CA: March 9, 2009.

"Evidence Based Diet." UCSD School of Medicine SOM410, From Principles to Practice, La Jolla, CA: Feb.17, 2009.

"Statin Side Effects." Preventive Medicine seminar, UC San Diego, La Jolla, CA: Feb 10, 2009.

"Aging." San Diego Forum, La Jolla: CA: Jan 27, 2009.

"Pitfalls in the Application of Evidence." The National Academies seminar *What Can Be Learned from Public Health on the Role of Research for Policy Purposes?,* Invited lecture to Division of Behavioral and Social Sciences and Education Standing Committee on Social Science Evidence for Use, The National Academies, Irvine, CA: Oct 30, 2008.

"Issues in the Identification and Communication of Drug Adverse Effects." American Public Health Association, Invited lecture, San Diego, CA: Oct 27, 2008.

"Conflict of Interest in Medicine." *Beyond Belief: Candles in the Dark*, sponsored by *The Science Network* (tsntv.org), session entitled "This is Your Brain on Politics" Salk Institute, La Jolla, CA: Oct 5, 2008; http://thesciencenetwork.org/programs/beyond-belief-candles-in-the-dark/beatrice-golomb.

"Gulf War Syndrome." General Internal Medicine Rounds, UC San Diego, La Jolla, CA: Aug 13, 2008.

"Dissent in Medicine: Stacking the Deck." *London School of Economics/UCSD Science Studies Program Dissent in Science: Origins and Outcomes* Workshop, La Jolla, CA: Mar 3 2008. (Sponsored by AHRC (UK) as part of the Contingency and Dissent in Science project at the CPNSS, London School of Economics).

"Stacking the Deck: Drug Risks and Benefits." Health Services Research & Development Scholarly Conference, Veterans Affairs San Diego Healthcare System, La Jolla CA: Feb 22, 2008.

"Evidence Based Diet." UCSD School of Medicine SOM 410, From Principles to Practice, La Jolla, CA: Feb.19, 2008.

"Stacking the Deck: Treatment Risks and Benefits." General Internal Medicine Grand Rounds, UCSD School of Medicine, La Jolla, CA: Jan. 30, 2008.

"Simvastatin But Not Pravastatin Affects Sleep: Findings from the UCSD Statin Study." American Heart Association annual meeting, oral presentation, Orlando, FL: Nov. 7, 2007.

"Statins: Risks and Benefits." Grand Rounds, Scripps Green Hospital. La Jolla, CA: June 27, 2007.

"Statin side effects. A mitochondrial connection?" Invited talk, UC Irvine MitoMed group (mitochondrial medicine), Irvine, CA: June 18, 2007.

"Cholesterol, Heart Disease, and You." UCSD Health and Wellness Series, Price Center, UCSD. La Jolla, CA: May 22, 2007.

"Statin Side Effects." Invited Lecture, American College for Advancement in Medicine. Chicago, IL: May 13, 2007.

"Mitochondrial Dysfunction and Illness in Gulf War Veterans." Research Advisory Committee on Gulf War Illness. Department of Veterans Affairs, Washington D.C.: April 24, 2007.

"Enhancing Post-marketing Drug Surveillance: A Response to Expressed Needs of Patients." Robert Wood Johnson Foundation Generalist Physician Faculty Scholars Program Annual Meeting oral presentation, San Antonio, TX: Dec 1, 2006.

"Do Low Dose Statins Affect Cognition? Results of the UCSD Statin Study." American Heart Association oral presentation, Chicago, IL: Nov. 15, 2006.

"Ethical Reasoning in Medicine – or the Contrary?" UCSD School of Medicine Biomedical Ethics Seminar: Sept 20, 2006.

"Stacking the Deck." Health Services Research & Development, VA San Diego Healthcare Center. La Jolla, CA: July 20, 2006.

"Treatment risks vs benefits: Stacking the Deck." International Relations course IRGN490, UCSD, April 19, 2006.

"Gulf War Illness." VA San Diego Healthcare Center. La Jolla, CA: April 14, 2006.

"Do statins cause long term adverse effects?" Invited talk followed by invited panelist discussion, Panel: Controversies in Lipid Lowering Therapy, American College of Cardiology meeting. Atlanta, Georgia: March 12, 2006.

"Cholesterol and Violence." Invited talk, San Diego Superior Court. San Diego, CA: Feb 7, 2006.

"Peer Review." Invited talk, VA San Diego Healthcare center. La Jolla, CA: Dec 9 2005.

"Patient Targeted Adverse Event Surveillance: Use for Hypothesis Generation." Robert Wood Johnson Generalist Physician Faculty Scholar meeting. Ft. Lauderdale, FL: Nov 10, 2005.

"Should statins be put in the water supply?" Distinguished Visitor Programme speaker, Biomedical Research Council, Agency for Science, Technology and Research (ASTAR). Singapore: Oct 25, 2005.

"Bridging the basic science/clinical science gap". MSTP (Medical Scientist Training program – MD/PhD program) retreat roundtable presentation. Aug 27, 2005.

"Conflict of interest"; CREST (Clinical Research Enhancement Through Supplemental Training, http://crest.ucsd.edu), Patient Oriented Research II: Ethics and regulation of human research. San Diego, CA: Aug 17, 2005; La Jolla, CA: Aug 18, 2005.

"A Scientific Career." McNair Summer Research Program, UCSD. La Jolla, CA: July 2005.

"Clinical follow-up after stopping statin treatment." Fourth Conference of the International Coenzyme Q10 Association. Los Angeles, CA: April 2005.

"Lack of Physician Response Toward Perceived Statin Adverse Events." 45th Annual Conference on Cardiovascular Disease Epidemiology and Prevention in association with the Council on Nutrition, Physical Activity and Metabolism. April 2005.

"Drug benefits and harms: Stacking the deck." Science Policy Analysis Roundtable series (http://acs.ucsd.edu/~spar/), UCSD. La Jolla, CA: March 10, 2005.

"Adverse Drug Effects: The Case of Statins." UCSD Biomedical Ethics Seminar Series, UCSD. La Jolla: CA. Feb 16, 2005.

"Coenzyme Q10, Mitochondrial Function, Statins, and Aging." Stein Institute for Research on Aging Grand Rounds, UCSD. La Jolla, CA: Jan 10, 2005.

"Should Statins be Put in the Water Supply?" Dept of Medicine, Yale. Newhaven, CT: July 21, 2004.

"CNS effects of low cholesterol." UCSD Dept of Biology colloquium. La Jolla, CA: April 2004.

"Cholesterol and the brain". UCSD Dept of Psychology colloquium. La Jolla, CA: March 16, 2004.

"Should statins be put in the water supply?" CTF C 301, UCSD. La Jolla, CA: March 10, 2004.

"Cholesterol and the brain: Mood, violence, and cognition." Dept of Psychology, University of Southern California. Los Angeles, CA: Feb 11, 2004.

"Cardiovascular Prevention: Putting the Risk in Risk Benefit." Department of Preventive Medicine, SUNY. Stonybrook, NY: Jan 27, 2004.

"The Great Debate. Do benefits of statins as currently used exceed the risks?" (with debaters John H. Lehman, John Robin Crouse and Michael J. Davidson) American College of Toxicology Annual Meeting. Washington DC: Nov 4, 2003.

"Anthrax Vaccine: Is it safe? Is it effective?" VA Faculty Development Seminar Series. La Jolla, CA: June 15, 2003.

"The Anthrax Vaccine: Is it safe and effective?" Epidemiology conference, Family and Preventive Medicine. La Jolla, CA: April 7, 2003.

"Research Recommendations: Focus on Acetylcholinesterase Mechanisms." Presentation to the Dept of Veterans Affairs Research Advisory Committee on Gulf War Illnesses. Washington DC: Feb 2003.

"Recent Gulf War Illnesses Research." Presentation to the Dept of Veterans Affairs Research Advisory Committee on Gulf War Illnesses/ Washington DC: Feb 2003.

"Acetylcholinesterase Inhibitors and Gulf War Illnesses." Presentation to the Dept of Veterans Affairs Research Advisory Committee on Gulf War Illnesses. Washington DC: Nov 2002.

"Gulf War Veterans Illnesses: Treatment issues." Presentation to the Dept of Veterans Affairs Research Advisory Committee on Gulf War Illnesses. Washington DC: Nov 2002.

"Mitochondrial function and Gulf War Illnesses." Presentation to the Dept of Veterans Affairs Research Advisory Committee on Gulf War Illnesses. Washington DC: Nov 2002.

"A new perspective on cholesterol, statins, and heart disease." Stein Institute for Aging public lecture (televised for UCSD TV), La Jolla, CA: Aug 21, 2002.

"Putting the risk in risk benefit analysis." Dept of Medicine, Stonybrook School of Medicine. Stonybrook, NY: July 16, 2002.

AHA Debate: "Controversies in Preventive Cardiology Debate: NCEP ATP III Guidelines have not gone far enough." Pro: Dr. John Robin Crouse. Con: Dr. Beatrice A. Golomb. American Heart Association Council on Epidemiology and Prevention, and American Society for Preventive Cardiology, 42nd Annual Conference on Cardiovascular Disease Epidemiology and Prevention. Honolulu, Hawaii: April 26, 2001.

"Cholesterol and Mood." UCSD Family & Preventive Medicine monthly conference, La Jolla, CA: Jan 15, 2002.

"The Angina Monologues." American Association of University Women: Oct 20, 2001.

"Restoring the risk to risk benefit analysis." Faculty Development series, VA San Diego Healthcare Center, La Jolla, CA: Oct 12, 2001.

"Syndromes without objective findings." 3rd Annual Federal Workers' Compensation Conference, Chicago, IL: April 23, 2001.

"Cholesterol and Violence." UCSD Medical Scientist Training Program conference series, La Jolla, CA: Aug 6, 2001.

"Cholesterol." *Rancho Carlsbad Health Fair*, Carlsbad, CA: July 16, 2001.

"Cholesterol." VA San Diego Healthcare Center morning conference series, La Jolla, CA: June 15, 2001.

"Cholesterol and you." *Plan for Wellness II*, UCSD sponsored community lecture series, Mission Valley, La Jolla, CA: May 20, 2001.

"Stroke." *Aging in the New Millenium*, Academic Geriatric Resource Center, UCSD School of Medicine, La Jolla, CA: May 19, 2001.

"Cardiovascular Disease." *Aging in the New Millenium*, Academic Geriatric Resource Center, UCSD School of Medicine, La Jolla, CA: May 19, 2001.

"Hyperlipidemia." VASDHS morning conference series, La Jolla, CA: April 18, 2001.

"Statins and cognitive function." VASDHS morning conference, La Jolla, CA: March 16, 2001.

"Cholesterol and lipids." lecture to first year UCSD medical students, La Jolla, CA: Dec. 4, 2000.

"Putting the risk in risk-benefit analysis for cardiovascular disease." invited talk, American Heart Association, Annual Investigators Meeting, Research in Tobacco Related Illness, San Diego: Nov. 30, 2000.

"Restoring the risk to risk benefit analysis for cardiovascular disease." UC Irvine, Irvine, CA: Oct. 5, 2000.

"Gulf War Syndrome." UCSD Department of Medicine Grand Rounds, La Jolla, CA: Aug. 9, 2000.

"Cardiovascular Prevention: Putting the Risk in Risk-Benefit." UCSD course (to international group of physicians), *Topics and Advances in Internal Medicine*, La Jolla, CA: Feb. 11, 2000.

"Medical Care: Restoring the Risk to Risk-Benefit Analysis." University of Chicago Health Sciences group; Chicago, IL: Feb. 8, 2000.

"Gulf War Illness." VASDHS Medicine Faculty Development series, La Jolla, CA: June 11, 1999.

"Aspirin for Primary Prevention of Coronary Artery Disease." Debate vs Dr. Leda Felicio. Dept of Medicine quarterly conference series, "Why Do We Do It?." VA San Diego Healthcare System, La Jolla, CA: March 26, 1999.

"Cholesterol and Violence: Where do we go from here?" Health Services Research and Development Seminar Series, San Diego VAMC/UC San Diego, La Jolla, CA: Feb. 11, 1999.

"Cholesterol and Violence." Colloquium, Social Science Research Institute, USC, Los Angeles, CA: Nov. 19, 1998.

"Cholesterol and Violence." Grand Rounds, Dept of Psychiatry, UC San Diego, La Jolla, CA: Nov 12, 1998.

Invited speaker and panelist: "How might interdisciplinary models of research guide us to a better understanding of violence?" USC Interdisciplinary Perspectives for Understanding and Preventing Violence, co-sponsored by the Violence Prevention Coalition of Greater Los Angeles, Long Beach, CA: April 17, 1998.

"Cholesterol and Violence." Dept of Psychology Colloquium, UCSD, La Jolla, CA: April 16, 1998.

"Measurement and Management of Hyperlipidemia for the Primary Prevention of Coronary Heart Disease." with Dr. Michael H. Criqui. Primary Care Grand Rounds, UCSD Dept of Family and Preventive Medicine, La Jolla, CA: April 15, 1998.

"The Cholesterol Controversy." VA San Diego Healthcare System quarterly "Why Do We Do It?" seminar, La Jolla, CA: March 29, 1997.

"Cholesterol and Violence: The Serotonin Connection." Mc Donnell Pew Research Center, Warner Springs Ranch, CA: March 15, 1997.

"Cholesterol and Violence." USC Dept. of Preventive Medicine, Los Angeles, CA: Feb 21, 1997.

"The Cholesterol Controversy." San Diego VAMC, La Jolla, CA: Jan 10, 1997.

"Hyperlipidemia Panel Discussion" Discussants: Alistair Fyfe, MD, PhD; B. Golomb, MD, PhD; David Heber, MD. UCLA Department of Medicine Grand Rounds, Los Angeles, CA: Aug 14, 1996.

"Cholesterol and Violence: Is There a Connection?" RAND/UCLA Child and Adolescent Health Policy Seminar, RAND, Santa Monica, CA: July 9, 1996.

"Cholesterol and Violence: The Serotonin Connection." Telluride Summer Research Center Public Lecture, Telluride CO: July 5, 1996.

"Cholesterol and Violence: New Evidence." UCLA Health Services Research Seminar Series, Los Angeles, CA: June 21, 1996.

"Cholesterol Reduction: When is it Indicated?" Cardiology Grand Rounds, Cedars Sinai Medical Center: June 18, 1996.

"Cholesterol, Serotonin, and Violence: Is there a Connection?." The Helmholtz Society, UC Irvine, Irvine, CA: June 11, 1996.

"Cholesterol Reduction in Primary Prevention: When is it Indicated?" Cedars Sinai Medical Center, Health Services Research Group: March 6, 1996.

"Cholesterol Reduction: When and Who?" St. Johns Medical Center, Santa Monica, CA: Nov 2, 1995.

"The Cholesterol Controversy." The Alzheimer Disease Research Consortium of Southern California, USC, Los Angeles, CA: April 21, 1995.

"Cholesterol Reduction in Primary Prevention." Debate vs Dr. David Leaf. WLA VA Medical Center, Dept. of Medicine Grand Rounds, Los Angeles, CA: March 8, 1995.

"The Cholesterol Controversy." UCLA Dept. of Medicine Grand Rounds, Los Angeles, CA: Jan 11, 1995.

"Neural Networks Distinguish Demented Subjects from Elderly Controls based on EEGs." Neural Information Processing Systems conference, Neural Networks in Medicine workshop, Vail, CO: Dec. 3, 1994.

"Cholesterol Reduction in Primary Prevention: Rethinking the Evidence." UCLA Dept. of Endocrinology Grand Rounds, Los Angeles, CA: Sept. 21, 1994.

"Advance Directives." West Los Angeles VA Medical Center, Dept. of Medicine Conference, Los Angeles, CA: Sept. 16, 1994.

"The Cholesterol Myth." Grand Rounds, West Los Angeles V. A. Medical Center, Dept. of Medicine, Los Angeles, CA: June 8, 1994.

"Death by Hiccup." Reno V.A. Medical Center, Dept. of Medicine Conference, Reno NV: Feb. 1994.

"Hiccups." V. A. West Los Angeles Medical Center, Dept. of Medicine Conference, Los Angeles, CA: Jan. 1994.

"Neural Networks that Recognize Sex and Expressions from Faces." in international conference, *Facial Expression: Brain, Perception, and Development*, The Salk Institute, La Jolla, CA: April 6, 1991.

"SexNet: A neural network that distinguishes sex from face." *Neural Information Processing Systems*, Spotlight presentation, Colorado: 1990.

PUBLICATIONS

RESEARCH PAPERS

Naviaux RK, Naviaux JC, Li K, Wang L, Monk JM, Bright AT, Koslik HJ, Ritchie JB, **Golomb BA** 2019. Metabolic features of Gulf War illness. PLoS ONE. 14(7): e0219531. https://doi.org/10.1371/journal.pone.0219531

Golomb BA, Koslik H, Christians U, Ritchie J, Wilson P, Elkins N, Klawitter J, Klawitter J, Smith D, Repine J 2019. Depressed prostaglandins and leukotrienes in veterans with Gulf War illness. *J Environ Sci Health,* Part B. https://www.tandfonline.com/doi/full/10.1080/03601234.2019.1596001

Golomb BA 2018. Diplomats' mystery illness and pulsed radiofrequency/ microwave radiation. Neural Computation 30(11): 1-104. https://www.mitpressjournals.org/doi/abs/10.1162/neco_a_01133

Golomb BA, Verden A, Messner AK, Koslik HJ, Hoffman, KB **2018**. Amyotrophic lateral sclerosis associated with statin use: A disproportionality analysis of the FDA's Adverse Event Reporting System. *Drug Safety* 41(4): 403-13. http://doi.org/10.1007/s40264-017-0620-4

Mangin D, Bahat G, **Golomb BA**, Mallery L, Moorhouse P, Onder G, Petrovic M, Garfinkel D **2018**. International Group for Reducing Inappropriate Medication Use & Polypharmacy (IGRIMUP). Position Statement and Ten Recommendations for Action. *Drugs and Aging* 35 (7): 575-87. https://www.ncbi.nlm.nih.gov/pubmed/30006810

Koslik HJ, Meskimen AH, **Golomb BA 2017**. Physicians' Experiences as Patients with Statin Side Effects: A Case Series. *Drug Safety - Case Reports.* 4 (1):3. https://link.springer.com/article/10.1007/s40800-017-0045-0

White RF, Steele L, O'Callaghan JP, Sullivan K, Binns JH, **Golomb BA** et al **2016**. Recent research on Gulf War illness and other health problems in veterans of the 1991 Gulf War: Effects of toxicant exposures during deployment. *Cortex.* 74: 449-75. http://www.sciencedirect.com/science/article/pii/S0010945215003329

Golomb BA, Dimsdale JE, Koslik HJ, Evans MA, Lu X, Rossi S, Mills PJ, White HL, Criqui MH **2015**. Statin effects on aggression: Results from the UCSD Statin Study, a randomized controlled trial. *PLoS ONE.* 10 (7): e0124451 *http://www.ncbi.nlm.nih.gov/pubmed/26132393*
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0124451
http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0124451&representation=PDF

Golomb BA, Bui AK **2015** A fat to forget: Trans fat consumption and memory. *PLoS ONE.* 10 (6): e0128129. *http://www.ncbi.nlm.nih.gov/pubmed/26083739*
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0128129
http://www.plosone.org/article/fetchObject.action?uri=info:doi/10.1371/journal.pone.0128129&representation=PDF

Golomb BA, Koslik HJ, Redd AJ **2015**. Fluoroquinolone-induced serious, persistent, multi-symptom adverse effects. BMJ Case Rep. 1 Sept 2015. doi:10.1136/bcr-2015- 209821 http://www.saferpills.org/wp-content/uploads/2014/10/FQ-induced-serious-persistent-multisx-adverse-effects-BMJ-Case-Reports.pdf

Cham S, Koslik HJ, **Golomb BA 2015**. "Mood, Personality and Behavior Changes During Treatment with Statins: A Case Series". Drug Safety – Case Reports. 3(1): 1-13. doi: 10.1007/s40800-015-0024-2 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5005588/

Golomb BA, Allison M, Koperski S, Koslik HJ, Devaraj S, Ritchie JB **2014**. Coenzyme Q10 benefits symptoms in Gulf War veterans: Results of a randomized double-blind study. *Neural Computation* 26(11):2594-4651. *http://www.ncbi.nlm.nih.gov/pubmed/?term=Coenzyme+Q10+Benefits+Symptoms+in+Gulf+War+Veterans%3A+Results+of+a+Randomized+Double-Blind+Study*

Koslik HJ, Hamilton G, **Golomb BA 2014**. Mitochondrial dysfunction in Gulf War illness revealed by 31Phosphorus magnetic resonance spectroscopy: A case-control study. *PLoS ONE* 9(3) e92887. doi:10.1371/journal.pone.0092887 *http://www.plosone.org/article/fetchObject.action?uri=info%3Adoi%2F10.1371%2Fjournal.pone.0092887&representation=PDF*

Golomb BA, Chan VT, Denenberg JO, Koperski S, Criqui MH **2014**. Risk marker associations with venous thromboembolism. A cross-sectional analysis. *BMJ Open* 4(3): e003208. doi:10.1136/bmjopen-2013-003208 *http://www.ncbi.nlm.nih.gov/pubmed/24657882*

Golomb BA, Erickson LC, Scott-Van Zeeland AA, Koperski SM, Haas RH, Wallace DC, Naviaux RK, Lincoln AL, Reiner GE, Hamilton G **2014**. Assessing Bioenergetic Compromise in Autism Spectrum Disorder with ^{31}P-MRS: Preliminary Report. *J Child Neurology* 20(2): 187-93. doi:10.1177/0883073813498466 *http://jcn.sagepub.com/content/29/2/187*

Erickson LC, Ritchie JB, Javors JM, **Golomb BA 2013**. Recruiting a special sample with sparse resources: Lessons from a study of Gulf War veterans. *Clinical Trials* 10:481-90; doi: 10.1177/1740774512470040. ***Email us for full text on an individual basis***

Golomb BA, Evans MA, Dimsdale JE, White HL **2012**. "Effects of statins on energy and fatigue with exertion: Results from a randomized controlled trial." *Arch Intern Med* 172 (15): 1180-2. doi:10.1001/archinternmed.2012.2171 *http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinternmed.2012.2171*

Golomb BA, Koperski S, White HL **2012**. "Association between more frequent chocolate consumption and lower body mass index." *Arch Intern Med* 172: 519-21. doi: 10.1001/archinternmed.2011.2100 *http://archinte.jamanetwork.com/article.aspx?articleid=1108800*

Golomb BA, Evans MA, White HL, Dimsdale JE **2012**. "Trans fat consumption and aggression." *PLoS ONE* 7(3): e32175; doi: 10.1371/journal.pone.0032175 *http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0032175*

Golomb BA, Chan VT, Evans MA, Koperski S, White HL, Criqui MH **2012**. The older the better: Are elderly study participants more nonrepresentative? Analysis of observational and clinical trial samples. *BMJ Open* 2: e000833. doi:10.1136/bmjopen-2012-000833*; http://bmjopen.bmj.com/cgi/content/full/bmjopen-2012-000833.*

Hoffman KB, Kraus C, Dimbil M, **Golomb BA 2012**. A survey of the FDA's AERS database regarding muscle and tendon adverse events linked to the statin drug class. *PLoS ONE* 7(8): e42866. doi:10.1371/journal.pone.0042866 *http://www.plosone.org/article/fetchObject.action?uri=info%3Adoi%2F10.1371%2Fjournal.pone.0042866&representation=PDF*

Erickson LC, Scott-Van Zeeland AA, Hamilton G, Lincoln A, **Golomb BA 2012**. "Approaches to (31)P-MRS in Awake, Non-Sedated Children with and without Autism Spectrum Disorder." *J Autism Dev Disord* 42:1120-6. doi: 10.1007/s10803-011-1359-x *http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3668346/*

Reilly D, Cham S, **Golomb BA 2011**. "First degree relatives with behavioural adverse effects on statins." *BMJ Case Reports.* doi:10.1136/bcr.09.2011.4758. ***Email us for full text on an individual basis***

Golomb BA, Erickson LC, Koperski S, Sack D, Enkin M, Howick J **2010**. "What's in placebos: Who knows?" Analysis of randomized controlled trials." *Ann Intern Med* 153: 532-35. doi: 10.1059/0003-4819-153-8-201010190-00010 ***Email us for full text on an individual basis***

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Golomb BA, Yaghmai R, Renvall MJ, Ramsdell JW 2010. "Electronic medical records and upper extremity symptoms: pain with the gain?" *Arch Intern Med* 170(7):655-657. doi: 10.1001/archinternmed.2010.55 *http://archinte.jamanetwork.com/article.aspx?articleid=486868*

Cham S, Evans MA, Denenberg JO, **Golomb BA** 2010. "Statin-associated muscle-related adverse effects: a case series of 354 patients." *Pharmacotherapy* 30(6): 541-553. doi:10.1592/phco.30.6.541 *http://www.medscape.com/viewarticle/724842*

MacGregor AJ, Shaffer RA, Dougherty AL, Galarneau MR, Raman R, Baker DG, Lindsay SP, **Golomb BA**, Corson KS 2010. "Prevalence and psychological correlates of traumatic brain injury in Operation Iraqi Freedom." *J Head Trauma Rehabil* 25(1):1-8. doi: 10.1097/HTR.0b013e3181c2993d *http://www.dtic.mil/dtic/tr/fulltext/u2/a541876.pdf*

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MacGregor AJ, Corson KS, Larson GE, Shaffer RA, Dougherty AL, Galarneau MR, Raman R, Baker DG, Lindsay SP, **Golomb BA** 2009. "Injury-specific predictors of posttraumatic stress disorder." *Injury* 40(9):1004-10; doi: 10.1016/j.injury.2009.04.006 *http://www.researchgate.net/publication/26290686_Injury-specific_predictors_of_posttraumatic_stress_disorder/file/9fcfd511d493aded5f.pdf.*

Linares L, **Golomb BA**, Jaojoco J, Sikand H, Phillips PS 2009. "The Modern Spectrum of Rhabdomyolysis: Drug Toxicity Revealed by Creatine Kinase Screening." *Current Drug Saf*ety Sept 1. PMID: 19534642 E-pub ahead of print; doi: 10.2174/157488609789007010. ***Email us for full text on an individual basis***

Golomb BA, Kwon E, Koperski SM, Evans MA 2009. "Amyotrophic lateral sclerosis-like conditions arising in possible association with cholesterol-lowering drugs:" *Drug Safety* 32(8):649-651. doi: 10.2165/00002018-200932080-00004 ***Email us for full text on an individual basis***

Evans MA, **Golomb BA** 2009. "Statin associated cognitive problems reported by 171 subjects." *Pharmacotherapy* 29(7): 800-11. doi:10.1592/phco.29.7.800 ***Email us for full text on an individual basis***

MacGregor AJ, Shaffer R, Wade A, Galarneau M, Raman R. Baker D, Lindsay S, **Golomb BA**, Corson K 2009. "Psychological correlates of battle and nonbattle injury among Operation Iraqi Freedom veterans: Results from the Navy-Marine Corps Combat Trauma Registry." *Military Medicine* 174(3): 224-231. doi: 10.7205/MILMED-D-03-9107 *http://publications.amsus.org/doi/pdf/10.7205/MILMED-D-03-9107*

Golomb BA, Evans MA 2008. "Statin adverse effects: a review of the literature and evidence for a mitochondrial mechanism." *Am J Cardiovasc Drugs* 8:373-418. doi: 10.2165/0129784-200808060-00004 *http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2849981/*

Golomb BA 2008. "Acetylcholinesterase Inhibitors and Gulf War Illnesses." *Proceedings of the National Academy of Science* 105(11): 4295-4300. doi: 10.1073/pnas.0711986105 *http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2393741/*

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http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.5.4537&rep=rep1&type=pdf

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http://archinte.jamanetwork.com/article.aspx?articleid=216553

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Golomb BA, Koperski S 2013. "Who Becomes Weak on Statins? Effect Modification Exposed in a RCT by Risk Factor Compounding." Epidemiology and Prevention | Nutrition, Physical Activity and Metabolism 2013 Scientific Sessions. March 19-22, 2013, New Orleans, LA. *Circulation* 127: AP072. *http://circ.ahajournals.org/cgi/content/meeting_abstract/127/12_MeetingAbstracts/AP072*

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Golomb BA, Evans MA 2013. "The Older the Better?" *Journal of Nutrition, Health & Aging* 17 (Supplement 1): S257. ***Email us for abstract on an individual basis***

Golomb BA, Evans MA 2013. "Stop Medicating Beyond the Evidence: Guidelines for Guidelines on Preventive Treatments." *Journal of Nutrition, Health & Aging* 17 (Supplement 1): S96. ***Email us for abstract on an individual basis***

Lai, Thai Hoang, **Golomb BA.** "Dispensing information on medicines prescribed: patients' preferences and perceived rights" (abstract submitted with both authors names, listed with student's name only) International Summit on GMP and GCP: USA, Europe, Japan, Asia Pacific. Dec 4, 2012, Philadelphia. http://www.omicsonline.org/gmp-gcp2012/scientific-programme.php?day=2&sid=200. ***Email us for abstract on an individual basis***

Golomb BA, Vomberg Z, Huynh K, Meskimen AH 2012. More frequent chocolate consumption is linked to better word memory. AHA Scientific Sessions 2012, November 6, 2012, Los Angeles (oral presentation) *Circulation* 126: A16156. *http://circ.ahajournals.org/cgi/content/meeting_abstract/126/21_MeetingAbstracts/A16156*

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Golomb BA, Koperski S, White HL 2012. Statins raise glucose preferentially among men who are older and at greater metabolic risk. AHA Joint Conference - Nutrition, Physical Activity and Metabolism and Cardiovascular Disease Epidemiology and Prevention 2012 Scientific Sessions Mar 16, 2012, San Diego (oral presentation). *http://circ.ahajournals.org/cgi/content/meeting_abstract/125/10_MeetingAbstracts/A055*

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Golomb BA, Koperski S, White HL 2011. Chocolate Consumption is Linked to Aggression. AHA Joint Conference - Nutrition, Physical Activity and Metabolism and Cardiovascular Disease Epidemiology and Prevention 2011 Scientific Sessions. Mar 22, 2011, Atlanta. Page173, abstract #P53. *http://my.americanheart.org/idc/group s/ahamah-public/ @wcm/@sop/@scon/documents/downloadable/ucm_323597.pdf*

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Golomb BA 2010 "Patient reporting of drug adverse effects" *Drug Safety* 33(10): 952-3 From: ISOP meeting, Accra, Ghana. ***Email us for abstract on an individual basis***

Golomb BA, Criqui MH, Dimsdale JE, Evans MA, Broadwin JA, White HL 2009 "Statin effects on energy: Results from the UCSD Statin Study, a randomized trial." *Circulation* 119: e308. (Joint Conference – 49th Cardiovascular Disease Epidemiology and Prevention Annual Conference, and Nutrition, Physical Activity and Metabolism Conference. Abstract ID 837, March 11, Palm Harbor, Florida, presented 3-11-09). ***Email us for abstract on an individual basis***

Golomb BA, Broadwin JA, White HL, Criqui MH, Dimsdale JE 2009. "Statins reduce orgasm. Results from the UCSD Statin Study, a randomized trial." American Psychosomatic Society, March 6, Chicago (presented 3-6-09). ***Email us for abstract on an individual basis***

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Golomb BA, Dimsdale JE, Evans MA, Denenberg JO, White HL, Criqui MH 2008. "Effects of Statins on Aggression Differ by Gender: Results of a Double Blind Placebo Controlled Trial." *Circulation* supplement; 117(11):e268-269. Presented at the American Heart Association 48th Cardiovascular Disease Epidemiology

and Prevention Annual Conference, and Nutrition, Physical Activity and Metabolism Conference, Colorado Springs. ***Email us for abstract on an individual basis***

Golomb BA, Kwon EK, Criqui MH, Dimsdale JE 2007. "Simvastatin But Not Pravastatin Affects Sleep: Findings from the UCSD Statin Study." *Circulation suppl*; 116:II-847. *http://circ.ahajournals.org/cgi/content/meeting_abstract/116/16_MeetingAbstracts/II_847?maxtoshow=&HITS=10&hits=10&RESULTFORMAT=&fulltext=3725&searchid=1&FIRSTINDEX=0&resourcetype=HWCIT*

Yaghmai R; Renvall MJ; **Golomb BA**; Lenert LA; Ramsdell JW 2007. "An Epidemic Of Musculoskeletal Symptoms Among Physicians In Two Institutions Using EMR-Based Systems For Routine Care." Poster presentation/abstract, Society of General Internal Medicine meeting, Toronto, Canada: April 25-28, 2007. ***Email us for abstract on an individual basis***

Golomb BA, Dimsdale JE, White HL, Criqui MH 2006. "Do Low Dose Statins Affect Cognition? Results of the UCSD Statin Study." *Circulation suppl*; 114(18): II-289. *http://circ.ahajournals.org/cgi/content/meeting_abstract/114/18_MeetingAbstracts/II_289-d*

Golomb BA, McGraw J 2005. "Lack of Physician Response Toward Perceived Statin Adverse Events." *Circulation* supplement; 111(14):255. ***Email us for abstract on an individual basis***

Golomb BA, Ritchie JB, Criqui MH, Dimsdale JE. 2004. Statins Lower Blood Pressure: Results from the UCSD Statin Study. *Circulation* (suppl 3) 110(17): 402. ***Email us for abstract on an individual basis***

Kordas K, Phillips P, **Golomb BA** 2004. Clinical Characteristics of 1053 Patients with Statin-Associated Muscle Complaints. *Arterioscler Thromb Vasc Biol*; 24:e51-136. ***Email us for abstract on an individual basis***

Golomb BA, Yang E, Denenberg J, Criqui MH 2003. "Statin Associated Muscle Adverse Effects." Poster presentation/abstract, AHA Council on Epidemiology and Prevention meeting, Miami FL: March 7, 2002. *Circulation suppl*. ***Email us for abstract on an individual basis***

Yang E, Jaworski B, Denenberg J, Criqui MH, **Golomb BA** 2002. Muscle symptoms in patients on statins. American Heart Association Young Investigators Forum, San Diego, CA: Sept. 2002.

Golomb, BA 1999. "Could dysregulation of acetylcholine (from pyridostigmine bromide or other acetylcholinesterase inhibitors) contribute to illness in Persian Gulf War veterans?" Conference on Federally Sponsored Gulf War Veterans' Illnesses Research, June 23-25, 1999 (Abstract accepted; withdrawn for security reasons at request of DoD).

Golomb BA and Criqui MH 1998. "Put the risk back in risk-benefit," 1998 San Diego Biostatistics & Epidemiology Research Exchange Conference. La Jolla, CA (Platform presentation May 5, 1998).

Bagley S and **Golomb BA** 1998. "Patient interest and response to genetic testing for cancer susceptibility: A systematic review of the literature," American Federation for Medical Research, Western Regional Meeting, Feb 4-7, 1998, Carmel, CA. *J Investigative Medicine* 46(1).

Pyne J, **Golomb BA**, Schten E, Jaworski B, Bozzette S 1998. "Appropriate roles for psychiatrists delivering primary medical care," VA HSR&D meeting, Feb 1998

Golomb BA 1996. "Low cholesterol and Violent Crime," Proceedings of the Robert Wood Johnson Clinical Scholars Program 24th National Meeting, Ft. Lauderdale, FL. (Platform presentation: Nov 1996).

Golomb BA 1995. "Cholesterol, serotonin, and violence: Is there a connection?" Proceedings of the Robert Wood Johnson Clinical Scholars Program 23rd National Meeting, Ft. Lauderdale, FL. (Platform presentation: Nov 9, 1995).

Golomb BA and Leuchter AF 1993. "Neural Networks Distinguish Demented Patients from Elderly Controls Based on EEG Recordings," Solomon Scholar Research Award, UCLA. (Platform presentation: June 1993).

Golomb BA, Lawrence D, Sejnowski T, and Ekman P 1992. "Neural Networks Evaluate Facial Muscle Actions," Solomon Scholar Research Award, UCLA, 1992. (Platform presentation, June 1992).

Golomb BA 1990. "Cross adaptation to flow field motion," *Investigative Ophthalmology and Visual Science* 31 (4):522. Poster presentation, Association for Research in Vision and Ophthalmology, Sarasota, FL, April 1989.

Golomb BA 1988. "Motion Escape," *Investigative Ophthalmology and Visual Science* 29. Poster presentation, Association for Research in Vision and Ophthalmology, Sarasota, FL, April 1988.

Golomb BA 1986. "The Crankshaft Effect," *Investigative Ophthalmology and Visual Science* 27(3): 345. Poster presentation, Association for Research in Vision and Ophthalmology, Sarasota, FL, April 1986.

Golomb BA, Andersen, RA, Nakayama, K, MacLeod, DIA, Wong, A. 1984. "Thresholds for shearing motion detection in monkey and man," *Investigative Ophthalmology and Visual Science* 25(3):69. Poster presentation, Association for Research in Vision and Ophthalmology, Sarasota, FL, April 1984.

MEDIA INTEREST (Partial list). "x2" (or x3) generally means stories were run on 2 (or 3) different of our studies.

2019: NCIS LA

2018: *NY Times* (Diplomat mystery illness), *Newsweek, Nature, Men's Health, Daily Mail (UK), Vice.com*

2017: *Al Jazeera*

2016: *Scientific American Mind, Psychology Today, San Diego Union Tribune*, *MIT Press, Healthline, The Reno Dispatch, Star Tribune, Truthout.org, Daily Mail (UK)*

2015: *New York Times, Time magazine, Washington Post, BBC radio, CBS radio, CBS radio Detroit (diff topic), KPBS radio, WUFT public radio, Daily Mail (UK), Nature.com, Reuters Health, Medscape, The Daily Beast, Shape, The Heart.org, RadioMD, Consultant360, Motherboard Press, Chemistry and Biology, Pharmaceutical Journal, Pittsburg Triune Review, HowStuffWorks, Aging News, Revista Salude Brazilian Health mag, La Maison du 21 Siecle magazine, LiveScience.com, Neurology Today,*

2014: *Atlantic Monthly, CNN, CNN Money, Newsweek*, *Forbes, Fox News, San Diego Union Tribune, Time, USA Today, US News and World Report,*

(Note: 2014 includes more obscure loci because we were sent a tracked list for one of our pieces in the news. For most other years we had no formal attempt to see where items were covered.)

A Breaking News, A Closer Look, (The) Age, ABP News, Aetna InteliHealth, Air Force Times, Alexandria Daily Town Talk, American Heart Association, AniNews.in, Argentinastar, Argus Leader, Army Times, Article.wn.com, Asbury Park Press, Asian News International (ANI), AZCenteral.com, Bazaar, *Battle Creek Enquirer, Baxter Bulletin, Bazaar Magazine, Best Life, BioPortfolio, BioSpace, Boston Globe, Brisbane Times,Business Standard, Canberra Times, Capital Bay, CentralOhio.com, Channel4000, Chennaionline, Chillicothe Gazette,China Topix, Cincinnati Enquirer,* Clarion Ledger, *Clarksville, ClickOrlando, Clinical Advisor, ClinicaSpace, Counsel & Heal, Courier-Pos, tDaily Advertiser, Daily Journal, (The) Daily Meal, Daily Record, Daily News Journal, Daily Times, DailyRx, Des Moines Register, Deccan Chronicle, delhidailynews.com, Desert Sun, Detroit Free Press,Diabetes Care, DNA India, Doctors Lounge, EHE & me, eHealthy News You Can Use, EIN News,E! Science News, EurekAlert!, eWallstreeter, Examiner, Express.co.uk, FoodNavigaor-USA.com, FoodWorldNews.com, Fort Collins Coloradoan, Fremont News Messenger, Gary Null Show, Good Housekeeping, Good Medicine, Green Bay Press Gazette, Guam Pacific Daily News, (The) Gulf Today,Hattiesburg American, HCP Live, Headlines and Global News, Health.com, Health Finder,Health On the Net Foundation, Healthy Eats, HealingWell, Herald Times Reporter, Hindustan Times, Houston Style Magazine, Indianapolis Star, IOL, IOL (ZA), Iowa City Press-Citizen, Irish Health, Jackson Sun, Journal & Courier, Katie Couric Show, KAGS-TV, KARE-TV, KCCI-TV, KCRA-TV, KDVR-TV, KENS-TV, KEYT-TV, KESQ-TV, KETV-TV, KGNS-TV, KGW-TV, Khaleej Times, KHBS-TV, KHOG-TV, KHOU-TV, KIFI-TV, KING-TV, KION-TV, KITV-TV, KMIZ-TV, KMOV-TV, KOAT-TV, KOCO-TV, KOTA-TV, KPRC-TV, KRCR-TV, KRDO-FM, KREM-TV, KSBW-TV, KSDK-TV, KSPR-TV, KTHV-TV, KTUU-TV, KTVB-TV, KTVM-TV, KTXS-TV, KUSA-TV, KVIA-TV, KVUE-TV, KWCH-TV, KWGN-TV, KXLY-TV, KXTV-TV, KYTV-TV, KYTX-TV,La Voz, Lancaster Eagle Gazette, Lansing State Journal, Legion Media Group, Le Quotidien de Medicin (France), Leaf Chronicle, Livingston County Daily Press and Argus, Louisville Courier Journal, KSL-TV online, LiveScience.com, Mail Online, Marine Corps Times, Mangalorean, Marion Star, Marshfield News Herald, medbroadcast.com, Medical Daily, Medical Express, Medical News Today, MedicineNet.com, MEDINDIA, MedlinePlus, Mens Health, Montgomery Advertiser, Monthly Prescribing Reference, MotherNature Network, MSN.com, my.news.yahoo.com, Navy Times, NDTV-India, NetIndia123.com, Newark Advocate, News 7 (Australia TV),Newkerala.com, News-Herald, News Journal, News Leader, News Press, News Star, Newsday, NewsMax, NorthWest Cable News (NWCN), Nutrition Horizon,Observer & Eccentric Newspapers, Oncology Nurse Advisor, Palladium-Item, Panorama.am, Pensacola News, Pharmacy Times, philly.com, Physicians Briefing, Port Huron Times Herald, Post-Crescent, Poughkeepsie ournal, Press & Sun Bulletin, Press-news.org,Redbook, RedOrbit, (The) Reporter, (The) Salinas Californian, Science Daily, Sciencecodex.com, Sheboygan Press, Sify.com, (The) Spectrum, Springfield News - Leader, State House News Service, Statesman Journal, stuff.co.nz, Summit Medical Group, Sydney Morning Herald, Tallahassee Democrat, Targeted News Service, Tennesseean, (The) Times, Times of India, Times of Oman, (The) Verge,Virtual Strategy Magazine, Visalia Times-Delta,VOCM-AM, Walta Info, WAtoday.com.au, Wausau Daily Herald, WAPT-TV, WBAL-TV, WBIR-TV, WCNC-TV, WCSH-TV, WCTI-TV, WCVB-TV,WCYB-TV, WDIV-TV, WDJT-TV, WDSU-TV, webindia12.com3, (The) Week, WESH-TV, WFAA-TV, WFMZ-TV, WGAL-TV, WHAS-TV, What's On Ningbo, WICU/WSEE-TV, Winnipeg Free Press, Wisconsin Rapids Daily Tribune, WISN-TV, WJXT-TV, WJXX-TV, WKBT-TV, WKYC-TV,WLBZ-TV, WLTX-TV, WLKY-TV, WLWT-TV, WMAZ-TV, WMBC-TV, WMTV-TV,*

WMUR-TV, WPBF-TV, WPTZ-TV, WREG-TV, WSBT-TV, WTAE-TV, WTSP-TV,WWLP-TV, WXIA-TV, WXII-TV, WZZM-TV, Yahoo! India, Yahoo! News UK and Ireland, Yuma News Now, Zanesville Times Recorder, ZeeNews.com

2013: *Philadelphia Inquirer, Washington Post, Australian Broadcasting Company (ABC) TV, Chatelaine (Canada), Columbia Chronicle, Estadao (Brazil), Le Nouvel Observateur (France), Menta Magazine (Israel), Rodale.*

2012: *New York Times (x4, including most emailed story), Wall St Journal, CNN, NPR (x2, including most emailed story), Boston Globe (x2), Bloomberg News, ABC, CBC, BBC x 3, KPBS (radio, television), NBC, NBC Latino, CBS Radio, Radio New Zealand, Radio Scotland, Brazil Band News, CBC (Canadian Broadcasting System), News TV live, Daily Telegraph (UK), ABC Sydney, Al Jazeera (TV), Discovery News, CCTV (China), Globe and Mail (Canada),Huffington Post (x2), San Diego Union Tribune (x3), LA Times, Science News, NPR radio (x 2), NY Times Magazine, Time, Thomson Reuters (x2), UK Press association, Time, USA Today.*

AARP Bulletin, About.com (NY Times), American Baby, American Medical News, Arthritis Today, Better Homes and Gardens, Bottom Line (x2), California Watch, Consumer Reports (x2), Dagbladet (Norway), Destination Sante (France), Doctor Oz You Beauty, EatDrinkBetter, El Mundo, Experience Life, First for Women, First Watch, Fitness (x2), Fitbe (Rodale), Fitness (x2), Food Network Magazine, Health, Healthday (x2), Healthy Woman, Hospitalist, The Internist (ACP), Istoe Magazine (Brazil), Journal Watch, Korea Radio "1013 Main Street", Korea news, La Vanguardia (Spain), Marie Claire (x 2), MedPage Today, Medscape (most emailed story), Mens Health, Mens Journal, Mercola (Skype interview), MyHealthNewsDaily, NewsMax, Now magazine, Pacific Standard OnLine, Parade, People's Pharmacy (radio interview), Postmedia News Canada, Prevention (x2), Revista Ciencia Hoje ("Science Today," from Brazilian Assn for Advancement of Science), Science News, Science & Vie (France), Scientific American Mind, Self (x2), Shape, Simply Nutrition, Sound Medicine, South China Morning, Spry, Tufts Health Letter, Post, La Vanguardia (Spain), Voice of Russia radio, WebMD (x2), Women's Health, WTIP Community Radio Roundtable, Yale Daily News, Yoga Journal.

Our article on chocolate and body mass index was the topic of the most emailed *NY Times* story that day, as well as the most emailed Medscape story. It was the leading news story from the University for that month (March), though it came out near the end of the month (Mar 26), besting the next biggest news story for the University that month by a factor of two; that story was also from our lab (on trans fats and aggression).

2011: ABC, NBC, *Washington Post, Philadelphia enquirer, Slate*, Boing Boing, Ivanhoe Broadcast

2010: *Time* magazine, *Scientific American*, *CNN*, BBC News, *Wall Street Journal*, *LA Times*, *Business Week (both News and Lifestyle sections), AOL, ABC News, CBS News,* CANWorld, KNBC TV, *Mens Health*, *Women's Health*, *FDA Reporter*, *The Globe and Mail* (Canada), Radio New Zealand, UK Press Association, *NPR,* Reuters, *Bloomberg News*, CNN Health.com, *CAN West news* (Canada), *LA Times (x 2), the Australian, Fox, Fox Business.com, Boston Global, Chicago Tribune, Denver Post, Discovery Health*, *Montreal Gazette*, *MSN*, *MSNBC*, *The Australia*n, *The Daily Mail* (UK), *Time* magazine (again),*Times (India), Medscape, United Press International, WebMD, Xinhua News, Yahoo News, many others.*

Our April 2010 article on chocolate and depression in *Archives of Internal Medicine* (Google: chocolate depression Archives April 2010) led to hundreds of news stories extending to at least 50 foreign nations per Google News – the runaway big story for our University that month, and had only descended to the number 2 health story on CNN a month later (with stories still being run in major media).

2009: NBC TV (San Diego News Now!), *USA Today* (section A story), *CNN radio, 60 minutes, Forbes, The Globe and Mail (Canada), WebMD, San Diego Union Tribune* (front page story).

2008: *BBC, Bloomberg News, Business Week, CNN, Daily Mail (UK), Daily Telegraph (UK), Discovery, Economist, Good Morning America (ABC TV), LA Times, New Scientist, New York Times, Reuters, The Australian (Australia), The Doctors (TV show), US News and World Report, Wall St Journal, Washington Post.*

Previous (selected).

Statin Adverse Effect website:

Wall Street Journal. "Researchers Ask Patients to Help Fill Gap in Data on Side Effects of Statins." Tara Parker-Pope 10/3/2006

United Press International. "Statin Users Report Side Effects Online." Leah Carliner. 9/22/2006; Channel 10 television news, San Diego, Carol LeBeau
ABC7 News.com. "Risks & Benefits of Statin Drugs."

Washington Post Online, Reuters Online, MSNBC Online, KPBS,
American Heart Association, WebMD, Fox News, LA Times. "Cholesterol-lowering drug linked to sleep disruptions."

The New York Times. Dec 21, 2007.
The New York Times. Tara Parker-Pope. 2/13/2008.

Cholesterol; and Statin risk-benefit:

11-97 *KNBC TV;* 3-98 *New York Times* 5 column article, *CNN, NBC, ABC, CBS, LA Times, Reuters/AP*, *Science magazine*. Also, British newspapers.

NBC Nightly News, 8-24-01. *NBC Nightly News*, 11-13-01. *Wall Street Journal*, 4-25-02. *MSNBC* (print) 8-24-01.*Wall Street Journal*, 12-02. *San Diego Union Tribune* 5-03. *Los Angeles Times* 7-03. *Wall Street Journal* 1-04. *New York Times* 7-04. *CBS News with Dan Rather* 5-04. *Newsday* 7-04. *The San Diego Union Tribune* 7-04. *The Times (London)* 8-04.

Other: Multiple newspapers throughout US 7-00, 9-00; *LA Times*, 2000 & 2001. *San Diego Union Tribune*, 5-16-01 & 5-28-01 (front page article); *Philadelphia Enquirer* 8-27-01. *Sciences et Avenir* (France), 10-01. *WebMD* (peripheral neuropathy) 5-02. *Discover magazine*. *KPBS radio* 5-29-02 10-11 "These Days"; with Tom Fudge and Dr. Michael Criqui; *UCSD TV*, lecture 8-02. *Men's Health*, *San Francisco Chronicle* 1-05. *The Sunday Times-Britain* 3-05. *San Diego Union Tribute* 7-05. *Lifetime Fitness* 12-05. *Daily News* (UK) 6-06. *Daily Mail* (UK) 6-06. *BusinessWeek* 8-06. *Daily Mail* (UK) 1-07. *ABC7News.com* 2-07. *Smart Money*

The New York Times. "Great Drug, but Does It Prolong Life?" Tara Parker-Pope. 1/29/2008

Ladies' Home Journal. "Does Cholesterol Really Count?" Linda Marsa. Feb-08

Business Week

The Wall Street Journal. Melinda Beck. 2/12/2008.

Good Morning America 2-08

Israeli press (Hebrew symbols)

Gulf War illness:

Following Pentagon press briefing 10-99 (and interviews)

NY Times and *LA Times* (front page of each); *Washington Post*, *San Diego Union Tribune*, multiple other newspapers; *NPR*, other radio stations, national TV news on *ABC* and *CBS* (lead story), *NBC*; *CNN*, *CSPAN*; *policy.com, Yahoo* (lead news story), ***The Daily Show with Jon Stewart*** (lead "Headline News" story); science journals including *New Scientist*. *BBC radio* interview, *BBC television*, television news throughout Western Europe (e.g. Britain, Germany, other), Eastern Europe, Australia; newspapers and news magazines throughout same distribution (10-99) – e.g. *Le Monde* (France), Hungarian newspapers and news magazines, Danish periodicals, German, BBC news

Following Congressional testimony in 11-99: *CNN*.

Subsequent: *Science magazine* 4-01. *Science magazine* 4-02. *NPR Science Friday* (radio guest) 3-03.

On release of Committee report 2004: Front page article *NY Times* 10-15-04; Front *page San Diego Union Tribune* 10-15-04; *BBC radio* 10-15-04 (or 10-16); *London Times*; Others internationally.;*Science Magazine; BMJ* (news section); *BBC News* (and *BBC radio*) 10-04. *BMJ News Extra* 10-04.

"Study: Sarin at Root of Gulf War Syndrome." Kelly Kennedy. *Army Times*. 5/25/2007

Following PNAS article on acetylcholinesterase inhibitors and illness in Gulf War veterans: *BBC radio* 3-08; *CNN radio* 3-08, *Economist* 3-08; other UK media/ press, *The Australian* (leading Australian daily), German radio interview, *LA Times, Reuters, Washington Post, San Diego Union Tribune, Bloomberg News,* many other venues

Following Gulf War RAC Committee Report: Nov 2008: most major news venues

Pyridostigmine FDA approval for Nerve Agent Protection 3-03: *Science magazine*, multiple regional papers (e.g. *Rocky Mountain Times, Orange County Register*)

Cholesterol and violent crime: *Web MD* 2000; *Clinical Pearls* 2001; *Crime Times* 2001

Alcohol and diabetes: re: *JAMA* article: 7-99: *Fox News, Science News,* other

Neural networks: pertaining to SexNet and ExpressionNet: 1990 *CNN*; 1990 Jim Jubek, *In the Image of the Brain* (featured in chapter one of lay book on neural network revolution); 1992, *The Machine that Changed the World, Episode 4: The Thinking Machine* (A PBS NOVA Documentary).