Potential Impacts on Human Health of Advanced Metering Infrastructure

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Professor, Department of Epidemiology

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About me

30+ years in Non-Ionizing Research

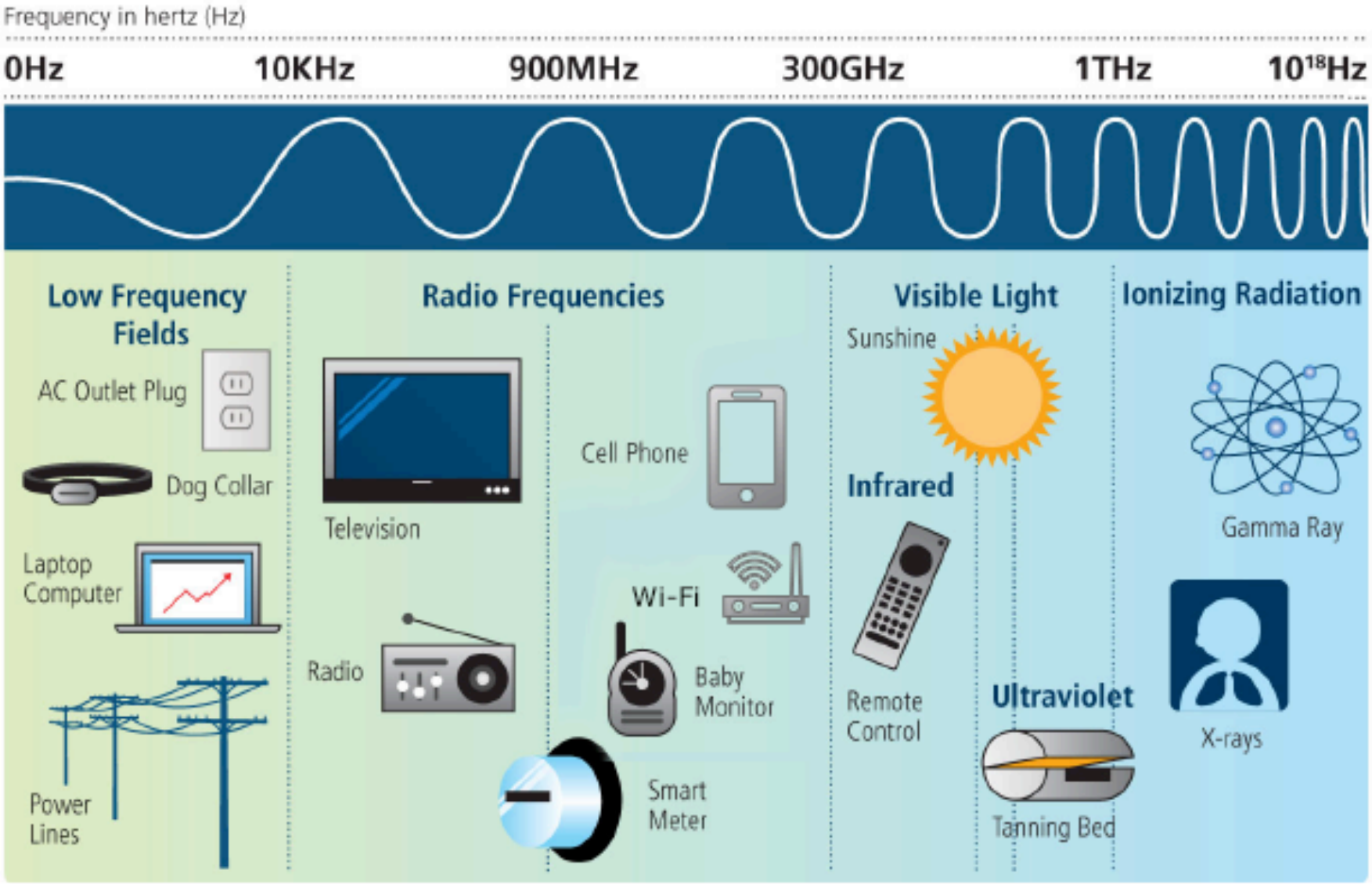
- EPRI, Stanford
- World Health Organization (WHO)
- Now University of California Los Angeles

Numerous Review and Advisory Committees:

- National Academy of Sciences
- EMF-Net European Union
- World Health Organization
- International Labor Organization
- International Agency for Research on Cancer (IARC)
- National Institute of Environmental Health Sciences
- Independent Scientific Advisory Group to Swedish Radiation Protection Authority
- International Commission on Non-Ionizing Radiation Protection

135+ peer-reviewed publications
18+ Book Chapters
Numerous other publications

Electromagnetic Spectrum



Confusion

History of Radio Frequency (RF) Research

1970

Investigation of possible changes in biological parameters in laboratory

1980

Animal studies on embryo and fetal development due to heating

1990

Animal studies on possible effects on brain

Investigation of cancer incidence in proximity to radio and TV transmitters

2000 - present

Start of active research on mobile telephony

Epidemiologic Studies

- **Mobile Phones** – focus on brain cancer incidence
- **Base Stations** – focus on subjective symptoms
- **TV and Radio** – focus on incidence of childhood leukemia
- **Video Display Operators and Physiotherapists** - Reproduction & Development
- **Occupational** – mostly electronic/ military

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Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case–control study

The INTERPHONE Study Group*

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*List of members of this study group is available in the Appendix.

Accepted 8 March 2010

Background The rapid increase in mobile telephone use has generated concern about possible health risks related to radiofrequency electromagnetic fields from this technology.

Methods An interview-based case–control study with 2708 glioma and 2409

Evaluation of RF Evidence by IARC

Human Studies

Sufficient	▪ Casual relationship established ▪ Chance, bias, confounding ruled out
Limited ✓	▪ Positive associations observed ▪ Credible casuality, but ▪ Chance, bias, confounding not ruled out
Inadequate	▪ Studies found insufficient quality, consistency or statistical power ▪ Absence of data
ESLC	▪ Evidence Suggesting Lack of Carcinogenicity

Experimental Animals

Sufficient	▪ Casual relationship established, positive in: • Two or more species • Two or more studies in one species • Both sexes of single species
Limited ✓	▪ Suggestive data, but • Only seen in one experiment (replication) • Issues regarding adequacy of the design, conduct or interpretation • Stronger with co-exposure to chemicals
Inadequate	▪ Studies cannot be interpreted that the exposure is carcinogenic ▪ Absence of data
ESLC	▪ Evidence Suggesting Lack of Carcinogenicity

IARC Group 2B: RF "Possibly Carcinogenic"

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/Internation
classified radiofrequency electromagnetic fields as p
based on an increased risk for glioma, a malign
wireless phone use.

News

Carcinogenicity of radiofrequency electromagnetic fields

Published Online
June 22, 2011
DOI:10.1016/S1470-2045(11)70147-4

For more on the **IARC Monographs** see http://monographs.iarc.fr/

In May, 2011, 30 scientists from 14 countries met at the International Agency for Research on Cancer (IARC) in Lyon, France, to assess the carcinogenicity of radiofrequency electromagnetic fields (RF-EMF). These assessments will be published as Volume 102 of the IARC Monographs.[1]

Human exposures to RF-EMF (frequency range 30 kHz–300 GHz) can occur from use of personal devices (eg, mobile telephones, cordless phones, Bluetooth, and amateur radios), from occupational sources (eg, high-induced electric and magnetic fields and associated currents inside tissues. The most important factors that determine the induced fields are the distance of the source from the body and the output power level. Additionally, the efficiency of coupling and resulting field distribution inside the body strongly depend on the frequency, polarisation, and direction of wave incidence on the body, and anatomical features of the exposed person, including height, body-mass index, posture, and dielectric

regarding associations between use of wireless phones and glioma.

The cohort study[4] included 257 cases of glioma among 420 095 subscribers to two Danish mobile phone companies between 1982 and 1995. Glioma incidence was near the national average for the subscribers. In this study, reliance on subscription to a mobile phone provider, as a surrogate for mobile phone use, could have resulted in considerable misclassification in exposure assessment. Three early case-control studies[5–7] encompassed

The Lancet Oncology 2011, 12: 624-626

IARC Carcinogenicity Classification

IARC Classification	Examples of Agents
Carcinogenic to humans (107) (Usually based on strong evidence of carcinogenicity in humans)	Asbestos Alcoholic beverages Benzene Radon gas Solar radiation Tobacco (smoke and smokeless) X-rays and gamma
Probably carcinogenic to humans (58) (Usually based on strong evidence of carcinogenicity in animals)	Biomass smoke Diesel engine exhaust Formaldehyde Polychlorinated biphenyls (PCBs)
Possibly carcinogenic to humans (250) (Usually based on evidence in humans which is considered credible but for which other explanations could not be ruled out)	Coffee ELF magnetic fields Gasoline engine exhaust Glass wool Pickled vegetables Radiofrequency fields
Not classifiable (512)	Vinyl toluene Tea Hair coloring products (personal use of) Electric fields, Static fields
Probably not carcinogenic to humans (1)	Caprolactam

Base Stations and Wireless Technologies

> Considering the very low exposure levels and research results collected to date, there is no convincing scientific evidence that the weak RF signals from base stations and wireless networks cause adverse health effects.

WHO Fact Sheet N°304 - May 2006
https://www.who.int/peh-emf/publications/facts/fs304/en/

Electromagnetic Hypersensitivity (EHS) Symptoms:

- Sleep disturbances, including insomnia
- Headache
- Depression and depressive symptoms
- Tiredness and fatigue
- Dysesthesia (a painful, often itchy sensation)
- Lack of concentration
- Changes in memory
- Dizziness
- Irritability
- Loss of appetite and weight loss
- Restlessness and anxiety
- Nausea
- Skin burning and tingling

Electromagnetic Hypersensitivity (EHS) Research Difficult to do

- Surveys:
  - Large number of Non-specific Symptoms
  - Relies on self report for most symptoms
  - Unreliable when based on self selection/participation
  - No registries, thus lack of reliable comparison rates
  - Exposure not assessed
- Double blind studies:
  - Possible only for short-term exposure and small number of subjects
  - Exposure not tailored to participants
  - Selection of participants and effectiveness of blinding often problematic
  - Carry over/learning effect
  - Can lead to both false positive and false negative results

Electromagnetic Hypersensitivity (EHS)

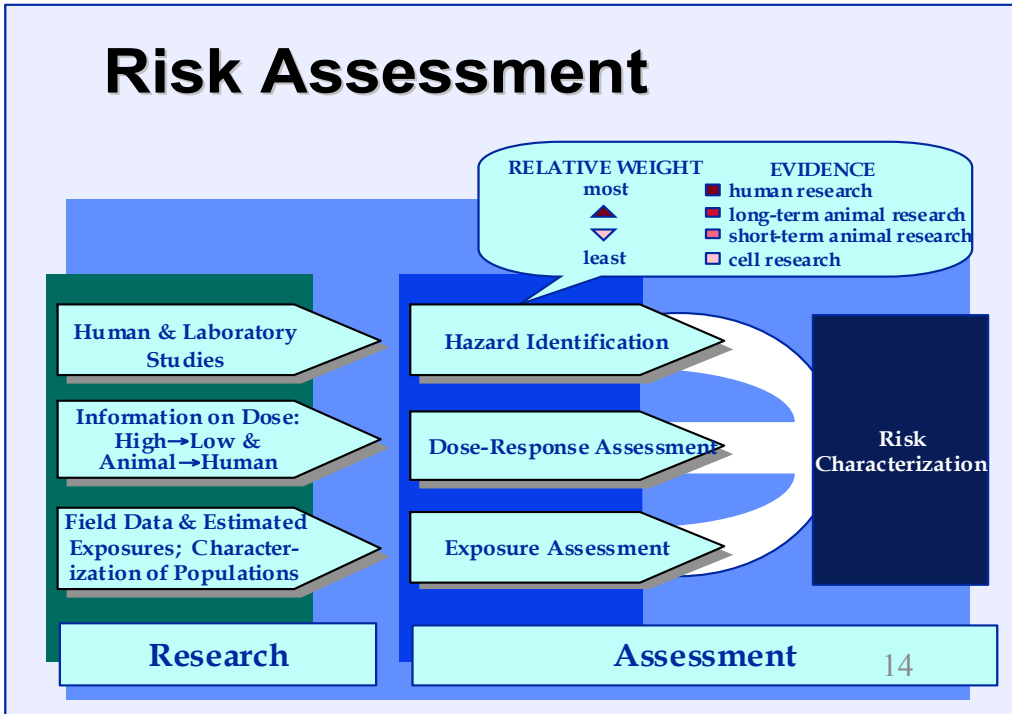
- EHS is characterized by a variety of non-specific symptoms that differ from individual to individual
- The symptoms are certainly real and can vary widely in their severity
- No scientific connection between EHS and exposure to RF

WHO Fact Sheet N°296 - December 2005
https://www.who.int/peh-emf/publications/facts/fs304/en/

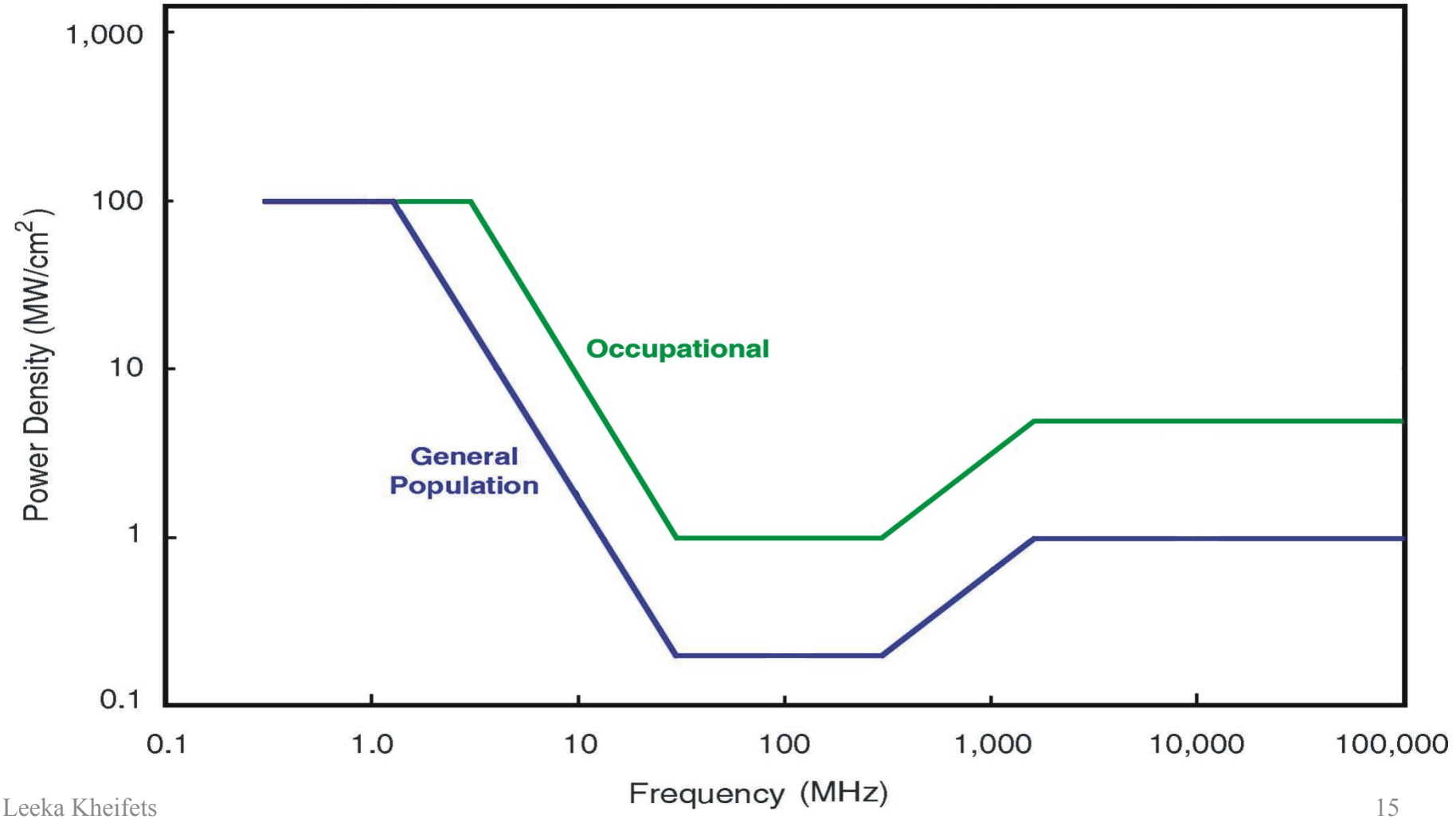
Evaluating Evidence

- A mistake often made by non-scientists is to give inordinate weight to positive studies and to overemphasize selected results within a study that supports their position

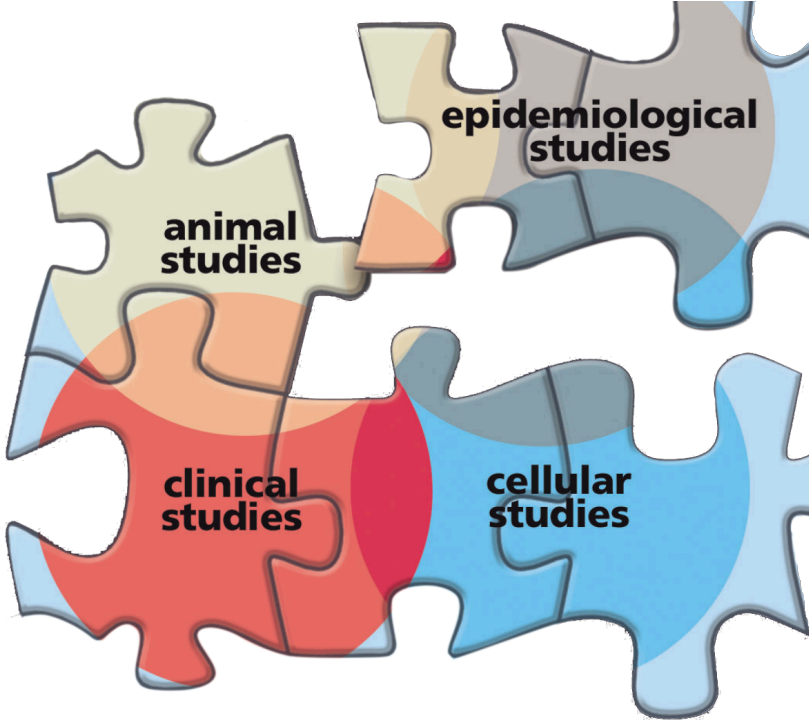
- Need a balanced weight of evidence approach
  - Weight depends on the type of evidence, relevance, quality etc.



FCC FR Maximum Permissible Exposure(MPE) Limits (Reference Levels)



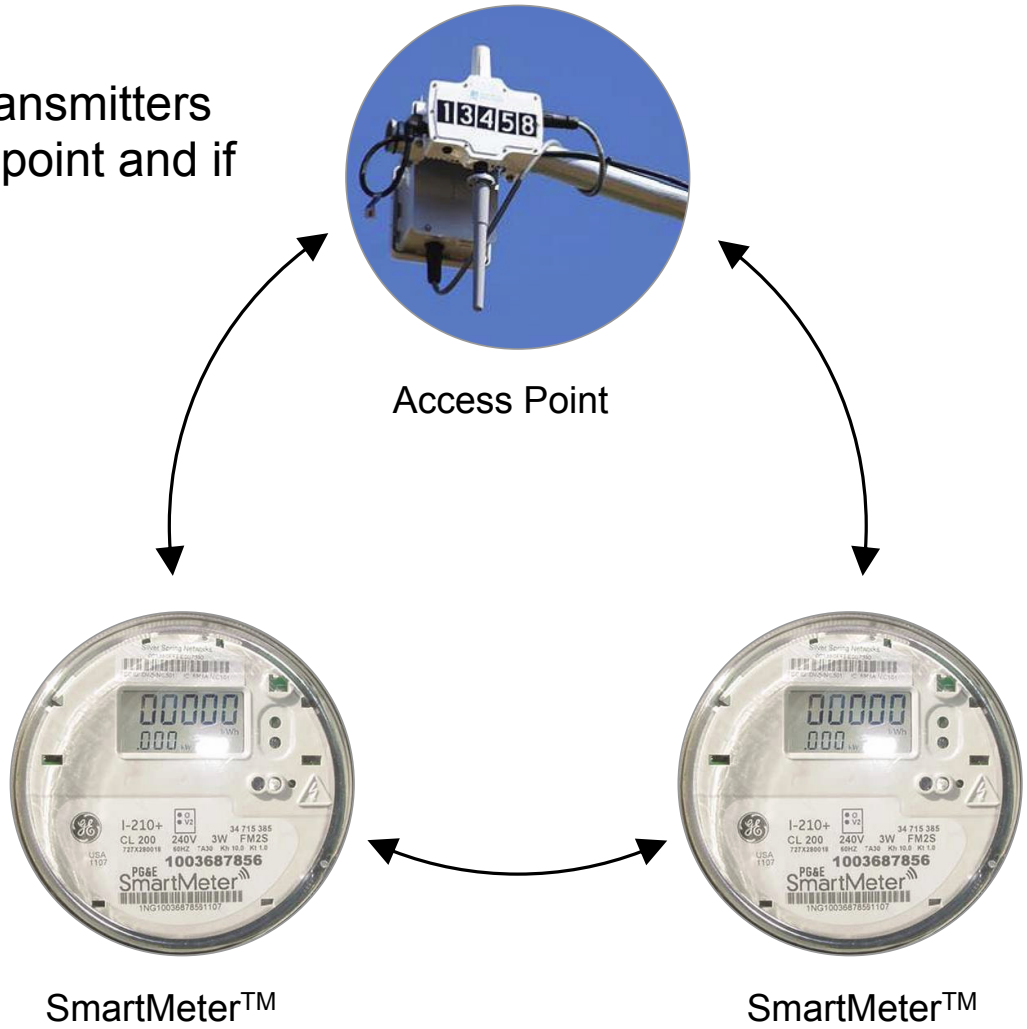
Evidence to Date



- Thermal effects form the basis for guidelines – 0.6 mW/cm2 –includes safety factors
- Some indication of risk
  - IARC 2B classification
- Overall no consistent indication of risk, but important uncertainties

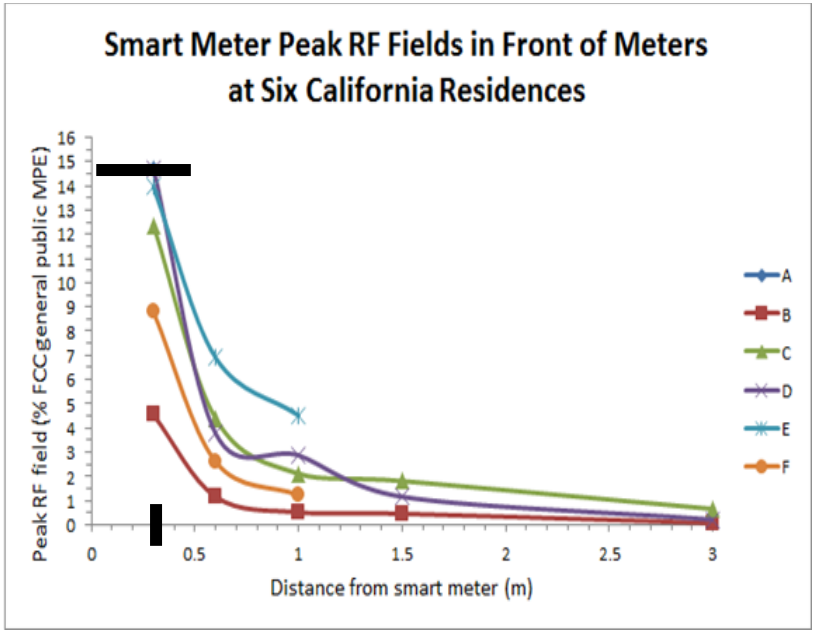
SmartMeters™ Use RF Signals for Data Communications with the Utility

SmartMeters™ use low power transmitters to communicate with an access point and if necessary, other meters



Exposure Depends on:

- Power
- Distance
- Length of use/transmission*



14.7% of Maximum Permissible Exposure

*antenna usually transmits only a few seconds per day

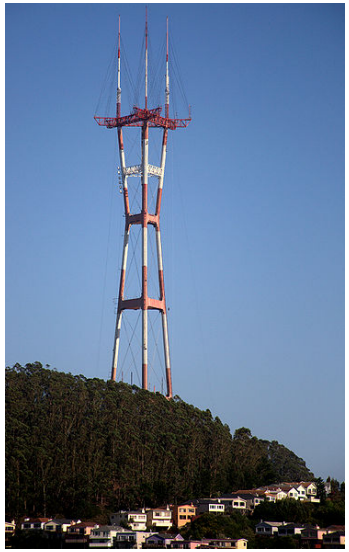
Some Perspective on RF Source Transmitter Powers

1,000,000 W

Doppler weather radar

50,000 W

AM radio broadcast



40,000 W

TV broadcast

30,000 W

FM radio broadcast

1,500 W

Amateur radio

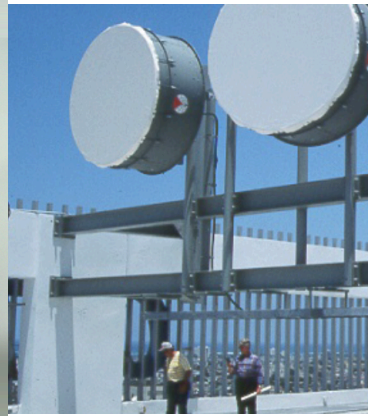
40 W

Cellular telephone base station

Some Perspective on RF Source Transmitter Powers

0.5- 5 W

Walkie Talkie

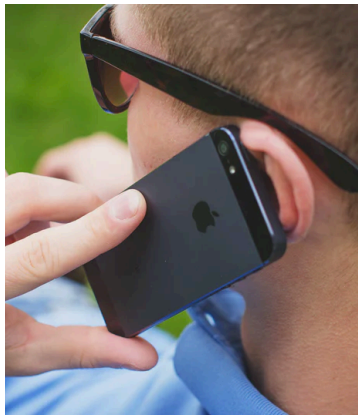


0.3-3 W

Microwave relay

1-2 W

SmartMeter™



0.6-2 W

Cellular telephone

0.5 W

Baby monitor

Laboratory and Field Measurements

Smart Meters

- The maximum power is 1-2 watt
- Transmits for very short periods
- Not immediately next to human body
- Thus exposure generally far below cell phones, Wi-Fi, microwave ovens
- Well below the safety standards set by the Federal Communications Commission

Reliable Sources

World Health Organization (WHO)

http://www.who.int/peh-emf/project/en/

Environmental Defense Fund (EDF)

http://www.edf.org/SmartMeterResponse

California Council on Science and Technology (CCST):

http://www.ccst.us/news/2011/20110111smart.php

National Cancer Institute (NCI)

https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/electromagnetic-fields-fact-sheet

WSSCWATER
DELIVERING THE ESSENTIAL

Interoffice Memorandum

TO: WSSC WATER BOARD OF COMMISSIONERS

THRU: JAY PRICE, DEPUTY GENERAL MANAGER – OPERATIONS 1/31/2020

FROM: DAMION R. LAMPLEY, P.E., DIRECTOR – UTILITY SERVICES

DATE: JANUARY 31, 2020

SUBJECT: STAKEHOLDER CONCERNS ABOUT THE IMPACT OF RADIO FREQUENCY (RF) ON HUMAN HEALTH

In response to various stakeholder concerns about the impact of radio frequency (RF) on human health, WSSC Water engaged Dr. Leeka Kheifets, Professor of Epidemiology at the UCLA School of Public Health to conduct a research study on the potential impacts.

For your review and in preparation for the Commission Meeting on Wednesday, February 19th, please see the attached copy of the final report.

A few report highlights:

- AMI technology is not used in close proximity to the body (unlike cell phones, tablets, WIFI) and because it transmits relatively infrequently, it has very low RF exposure levels
- Exposures to RF from AMI technology is neither long enough, nor strong enough to approach limits set by the Federal Communications Commission
- Concerns about AMI arise from misinformation about AMI-compatible meters and perceived lack of direct individual benefit

Dr. Kheifets is on the agenda for the Commission Meeting on February 19th to present the findings of the study and to allow an opportunity to ask any questions you may have on this topic.

Cc: Sheila R. Finlayson, Esq – Corporate Secretary
Carla A. Reid – General Manager/CEO
Monica J. Johnson – Deputy General Manager
James A. Price – Deputy General Manager
Joseph F. Beach – Deputy General Manager

Report prepared for

Washington Suburban Sanitary Commission
(WSSC) Water

On potential impacts on human health of
advanced metering infrastructure

By

Leeka Kheifets, Ph.D.
Professor in Residence
UCLA

Date: January 2020

Table of Contents

EXECUTIVE SUMMARY

This comprehensive review of potential radiofrequency impacts on human health from exposure to radiofrequency (RF), particularly from exposure to water advanced metering infrastructure (AMI), is based on peer-reviewed literature, as well as studies that provide levels of exposure from smart meters used in advanced metering infrastructure.

Smart meters measure attributes of electricity, natural gas, or water as delivered to consumers and transmit that information using RF to utility companies. The RF transmitters in wireless-equipped Smart Meters operate at similar power levels and in similar frequency ranges as many other digital communications devices in common use.

Since RF radiation induces heating in body tissues and imposes a heat load on the whole body, prevention of excessive heating serves as a basis for most international guidelines for human exposure. Many different non-thermal mechanisms for RF have been proposed. Generally, it is thought that non-thermal interactions are unlikely to be biologically significant at the RF levels below guidance values, but much of the on-going research is directed towards non-thermal mechanisms.

The International Agency for Research on Cancer (IARC) classified RF as possibly carcinogenic to humans based on limited evidence in humans (from studies of glioma and acoustic neuroma in relation to mobile phones) and limited evidence in animals (based on co-carcinogenicity studies).

Because Smart meters are not used in close proximity to human body (unlike cell phones, tablets, computers and even WIFI) and because they transmit relatively infrequently their exposure levels are very low and far below U.S. and international exposure limits.

Policy Relevant Highlights

- As society takes advantage of the many new technologies that use RF, to improve lifestyle and work efficiency, RF exposure has been increasing rapidly. Balancing benefits of technologies to the society overall with potential risks to individuals remains a challenge.

- Radiofrequency fields have been classified as a 'possible human carcinogen', or a Group 2B, by the International Agency for Research on Cancer (IARC). However, the weight of evidence has not risen to a level that would change the basis for RF exposure limits, a which are currently based on preventing heating of the tissue.

- Because Smart meters are not used in close proximity to human body (unlike cell phones, tablets, computers and even WIFI) and because they transmit relatively infrequently their exposure levels are very low.

- Some of the reasons leading to concern about smart meters, include whole body exposure, that their use is not under the control of the public, their presence is not perceived to be of direct individual benefit and misinformation about smart meters.

- The exposures to RF from smart meter are neither long enough nor strong enough to approach the safety standards set by the Federal Communications Commission (FCC) and other bodies.

Introduction

At the request of WSSC Water I have conducted a comprehensive review of potential radiofrequency impacts on human health from exposure to radiofrequency (RF), particularly from exposure to water advanced metering infrastructure (AMI). As part of this review I conducted a review of peer-reviewed literature to identify most relevant studies which examine potential health effects of RF, as well as studies that provide levels of exposure from smart meters used in advanced metering infrastructure.

The electromagnetic spectrum encompasses frequencies that range from above approximately 10^{20} hertz (Hz) for ionizing radiation at the high end of the spectrum, to static fields at the low end. In order of decreasing frequency, the spectrum comprises gamma-rays, X-rays, ultraviolet radiation, visible light, infrared radiation, radiofrequency (RF) and extremely low frequency electric and magnetic fields. Over the past two decades a lot of the research has focused on radiofrequency fields (RF), in particular, on mobile phone use and tumors of the head and neck, with less attention to other sources and outcomes.

Technological developments involving exposure to electromagnetic fields bring social and economic benefits to large sections of society, but the health consequences can be difficult to predict and manage. As countries take advantage of the many new technologies that use RF, to improve lifestyle and work efficiency, RF exposure has been increasing rapidly.

Traditional water meters are read quarterly by a meter reader, and a water bill is generated from this manual reading of the meter. Advanced meters (or "Smart" meters) can be read remotely and more frequently, providing instant access to water consumption information for both customers and water utilities (Ref.: 1). Smart meters have many benefits for customers and water agencies. For customers, the systems allow them to make informed conservation decisions and enable leak detection (Ref.: 2). For agencies, the meters reduce costs associated with manual meter reading. In general, Environmental Defense Fund has been supportive of use of wireless smart meters (Ref.: 3). However, concerns have been raised about the safety of smart meters, mainly because they use radiofrequency (RF) waves.

In this report, I summarize potential health effects of radiofrequency exposure using both original publications and comprehensive evaluations by international review bodies (focusing on publications over past two decades), describe applicable federal and state standards and guidelines for RF radiation, evaluate what is known about RF exposure from advanced metering infrastructure on residences, including single family homes and apartment complexes and compare these exposures to standards and guidelines.

Summary of Potential RF Health Effects

(adopted from Ref.:4)

Sources and environmental levels

With rapid advances in electromagnetic field technologies and communications, people are increasingly exposed to frequencies in the radiofrequency (RF) range. RF fields are produced by radio and TV broadcasts, mobile phone base stations, and other communication infrastructure. The most relevant exposure is to mobile phones. This technology typically uses frequencies from 450 to 2,500 megahertz or million hertz (MHz), although new technology has broadened this band to Gigahertz or billion hertz range (GHz).

In a cellular radio network, the base station is used for the transmission and reception of the radio signals between the mobile phones and the network. The transmission from a base station to a mobile phone is called downlink. The transmission path from a mobile phone to a base station is called uplink.

Other sources of exposure to the general population are radio and television transmitters which operate at between 200 kilo hertz or thousand hertz (kHz) and 900 MHz. Radio and TV signals are broadcast to a large area from comparatively few sites (Ref.:5). Compared to radio and TV transmitters, mobile phone base stations cover a smaller area, and produce much lower emissions, but are vastly more common in many countries. Residential exposures also come from wireless monitors used in children's cribs, cordless phones, and Wi-Fi (wireless Internet connections) commonly used at home and in schools. Occupational exposures include RF PVC welding machines, plasma etchers, and military and civil radar systems. All operate at different frequencies.

Handheld mobile phones available since the late 1980s became widely used by the general population only in the late 1990s. Most used mobile phone technology worldwide Most used mobile phone standard for calling, data transmission and short message service (SMS) is Global System for Mobile Communications (GSM), which transmits at frequencies are 900 MHz, 1800 MHz and 1900 MHz.

Currently there are more than 5 billion mobile phone users worldwide, with a penetration in some countries reaching 120 percent (i.e. many people have more than one). Use of mobile phones has changed markedly over recent years, concomitant with the development of new technologies (e.g. 2G to 3G, power control, handover management, and novel uses of smartphones). Phones operating under 2G and 3G can have significantly different output power; 3G is thought to be around 1% of the power emitted by a phone operating under 2G. 5G technologies and networks use the largely untapped bandwidth of the millimeter wavelength, between 30 and 300 GHz on the radio spectrum, which uses smaller base stations than current wireless technology. As a result, wireless antennae may be placed densely throughout neighborhoods on infrastructure such as lamp posts, utility poles, and buildings. The Internet of Things (IoT) refers to the ever-growing network of physical objects that feature an IP address for internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. Machine-to-machine, or M2M, is a broad label that is used to describe any technology that enables networked devices to exchange information and perform actions without the manual assistance of humans. Both IoT and M2M devices are becoming a reality, which will likely lead to changes in RF exposure.

In addition, modes of mobile phone use are constantly changing as texting, web-surfing, playing games, and listening to music and video streaming on mobile phones are now common. Exposure from mobile phones is concentrated closest to the handset and the antenna. Absorption of RF from mobiles is localized and depends on the position of the phone during use. This represents a very important determinant of exposure: only calls made with the mobile phone close to the head result in absorption of RF energy inside the head.

For whole body exposure, mobile phone base stations, can be the largest individual source of RF, but other sources such as radio or TV transmitters can result in comparable exposures depending on where the measurements are taken (most people do not live close to radio or TV transmitters). For RF sources other than mobile phones, typical power densities outdoors would be 0.01–1 milliWatt per square meter (mW/m2), but could be orders of magnitude higher (i.e. 100 mW/m2 and above). Indoor levels are often lower than

outdoor exposures by orders of magnitude; for example, in Europe, a median indoor power density of 0.005 mW/m2 has been reported. Recent study of European children reports median total personal RF-EMF exposure of 75.5 microWatts per square meter (μW/m2) (6). Downlink was the largest contributor to total exposure (median: 27.2 μW/m2) followed by broadcast (9.9 μW/m2). Exposure from uplink (4.7 μW/m2) was lower. Wi-Fi and cordless phones contributed very little to exposure levels in children. While exposures from mobile phone base stations are several orders of magnitude lower than from phones, it differs from that of mobile phones in other ways: base stations expose the whole body, and the exposure duration is considerably longer. Perhaps more importantly, base station exposure has been a subject of much concern to the public because it is not under the control of the public and its presence is not perceived to be of direct individual benefit.

Population exposures to RF fields are less completely characterized than exposures to extremely low frequency (ELF) fields. This is due to: (1) technical challenges; (2) the rapid evolution of RF-related technology (frequency, coding schemes); and (3) changing patterns of use (duration of calls, text messaging, web surfing, etc.).

Health effects

Since RF radiation induces heating in body tissues and imposes a heat load on the whole body, prevention of excessive heating serves as a basis for most international guidelines for human exposure. Studies of the interaction of RF with tissue in the range used for mobile phones have led to the proposal of many different non-thermal mechanisms for RF interaction. Generally, it is thought that non-thermal interactions are unlikely to be biologically significant at the RF levels below guidance values, but much of the on-going research is directed towards non-thermal mechanisms.

Cancer

Epidemiological studies of health effects related to RF exposure from mobile phones are numerous and have primarily focused on cancer, especially brain tumors, although studies with long-term exposure with sufficient latency are still limited. Currently it is only possible to evaluate short- to medium-term effects of mobile phone exposure; while some

studies report effects for heavy or long-term users (Ref.: 7), the majority of studies have found no effects on either brain or parotid gland tumor risk (Ref.: 8). Exposure assessment remains problematic: substantial random error has been shown for even short-term recall of mobile phone use; and information bias appears to affect at least the reporting of the side of the head where the phone is commonly used. Also, some studies may be compromised by a non-representative control group, caused by an increased participation of mobile phone users. Results for acoustic neuroma are more suggestive albeit inconsistent (Ref.: 8). Recently, a few studies have examined other cancers, such as leukemia, non-Hodgkin's lymphoma, and uveal and testicular cancers. Results are unremarkable, but subject to the same limitations as brain tumor studies. So far only one study has examined the possible association between brain tumors and use of mobile phones in children (Ref.: 9). Small and imprecise risks were reported in the high exposure categories, which became more pronounced in a subgroup of about 1/3 of the subjects for whom objective operator data were available. However, due to methodologic limitations, some internal inconsistencies, and most importantly, lack of increases in the brain tumor rates for children in the registry, the authors considered their data to argue against causality. Clearly, more studies of children are needed.

A few studies have assessed cancer risk in relation to radio and TV transmitters (Ref.: 10). Often driven by a previously identified cancer cluster, these analyses are based simply on distance from the source and often include an extremely small number of cases. It is therefore not surprising that such studies have been uninformative. Four recent case-control studies of cancer risk related to mobile phone base stations (Refs.: 11-14) have employed improved methods both in terms of design and exposure assessment. While reporting some positive associations for disease and exposure subgroups, overall these studies provide no consistent evidence of association between exposure from base stations and other transmitters and risk of childhood cancer. However, numerous methodologic limitations remain, including the inability to detect small increases in risk.

Although occupational studies have been performed over a longer time period (since 1988), we are only beginning to measure and learn about RF exposures in various occupations, and the exposure may not always be relevant for

an assessment of effects of mobile phone frequencies. Although some increased risks have been found in certain studies, there is no consistent evidence of risk increases for any cancer sites (i.e. many studies are imprecise, some showing an increase and others a decrease of risk). The studies have several methodological weaknesses: (1) studies are not based on measurements of the actual RF exposure for the subjects included; (2) exposure classification has often been based on job title alone; and (3) control of other factors, if any, has been limited (Ref.: 10).

All of the studies have reported null results for carcinogenicity in normal animals at exposure levels compatible with mobile phones, however, co-carcinogenicity studies (studies in which animals are exposed to both RF and another exposure, e.g. chemical) have been suggestive (Ref.: 15). Of note is the most comprehensive animal study conducted by National Toxicology program (NTP) of the National Institute of Environmental Health Sciences (NIEHS) investigating whether mobile phone radiation increases cancer risk in rats and mice. Rats were exposed at 0, 1.5, 3, or 6 W/kg for 7 days per week, throughout gestation and lactation and after birth. Exposure was up to 18 hours and 20 minutes per day with continuous cycling of 10 minutes on and 10 minutes off during the exposure periods. The NTP studies found that exposure to RF (900 MHz) was associated with clear evidence of tumors in the hearts of male rats (malignant schwannomas), some evidence of tumors in the brains of male rats (malignant gliomas), some evidence of tumors in the adrenal glands of male rats (benign, malignant, or complex combined pheochromocytoma). It was unclear if tumors observed in the studies were associated with exposure to RF in female rats (900 MHz) and male and female mice (1900 MHz) (Ref.: 16). Most recent publication from the same study suggest that exposure to RFR is associated with an increase in DNA damage in mice and rats (Ref.: 17).

Other outcomes

It is well established in animal studies that hyperthermia during pregnancy can cause embryonic death, abortion, growth retardation, and developmental defects; development of the central nervous system is especially susceptible. Numerous studies have evaluated developmental effects of RF fields on mammals, birds, and other non-mammalian

species (Refs.: 18,19). These studies have shown that RF fields can cause birth defects at exposure levels that are high enough to cause significant increases in temperature. There is no consistent evidence of effects at non-thermal exposure levels, although a few studies have evaluated possible effects on postnatal development using sensitive endpoints, such as behavioral effects. Serious health effects of hyperthermia in humans however, are associated only with greatly elevated body temperatures (>40°C), and such temperature rises are well above those generated by the maximum allowable level for public RF exposure.

Several studies of occupational RF exposure, primarily of physiotherapists (note some devices used by physiotherapists, such as diathermy devices, can produce high fields), have reported an increased risk of congenital malformations, but no specific type of malformation has been consistently reported, and there is a potential for recall bias in these studies (Ref.: 20). Exposure to RF during sensitive periods of development in early life may lead to lasting effects on health (Ref.: 21). No association was found between mobile phone use during pregnancy and early neurodevelopment in very young children in two studies (Refs.: 22,23). A Danish study has raised the hypothesis that pregnancy and childhood exposure to mobile phones may result in common childhood behavioral problems (Ref.: 24). Prospective evaluations of this association was confirmed in the same cohort (25). Behavioral problems related to mobile phone use in children stands out as the only association independently confirmed in several studies (Refs.: 26,27,28): pooling of five international cohorts found that maternal mobile phone use during pregnancy may be associated with an increased risk for behavioral problems, particularly hyperactivity/inattention problems, in the offspring (Ref.: 29). The interpretation of these results is unclear as other factors may influence both maternal cell phone use and child behavioral problems.

Possible health effects based in part on anecdotal reports of numerous symptoms such as headaches and sleep disturbance from continuous whole-body RF exposure from base stations is an area of major public concern. Because of numerous methodologic shortcomings, data regarding effects of such RF exposure on symptoms are inadequate for assessment at present.

Reviews

The International Agency for Research on Cancer (IARC) classified RF as possibly carcinogenic to humans (Ref.: 15) based on limited evidence in humans (from studies of glioma and acoustic neuroma in relation to mobile phones) and limited evidence in animals (based on co-carcinogenicity studies).

The Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) of the European Commission concluded (Ref.: 30):
"Overall, the epidemiological studies on mobile phone RF EMF exposure do not show an increased risk of brain tumours. Some studies raised questions regarding an increased risk of glioma and acoustic neuroma in heavy users of mobile phones. The results of cohort and incidence time trend studies do not support an increased risk for glioma while the possibility of an association with acoustic neuroma remains open. Epidemiological studies do not indicate increased risk for other malignant diseases, including childhood cancer. ... mobile phone RF EMF exposure may affect brain activities as reflected by EEG) studies during wake and sleep.... However, the relevance of the small physiological changes remains unclear and mechanistic explanation is still lacking. ...Overall, there is a lack of evidence that mobile phone RF EMF affects cognitive functions in humans. .... Symptoms that are attributed by some people to various RF EMF exposure can sometimes cause serious impairments to a person's quality of life. However, ... RF EMF exposure is not causally linked to these symptoms. This applies to the general public, children and adolescents, and to people with idiopathic environmental intolerance attributed to electromagnetic fields (IEI-EMF). ...no adverse effects on reproduction and development from RF fields at non-thermal exposure levels. Human studies on child development and behavioural problems have conflicting results and methodological limitations. Therefore, the evidence of an effect is weak. Studies on male fertility are of poor quality and provide little evidence. "

There are many national government agencies that have published reviews and released statements regarding potential health effects from RF. Additionally, there are self-

appointed groups who have reviewed the RF science. For review of opinions from more than 30 government agencies and international organizations see ref 31.

Guidelines and Limits

Although safety limits on exposures to high power RF sources (which can cause serious injury) have always been necessary, and there were reports of health effects at lower levels in the 1960s and 1970s (Ref.: 32), serious scientific inquiry about possible health effects to the public is relatively recent.

Among the most influential guidelines are those set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (Refs.: 32,33) and the Institute of Electrical and Electronics Engineers (IEEE) (Refs.: 34-36). As there are no compulsory international safety standards for the exposure to nonionizing radiation various international limit guidelines are adopted in each country into its national recommendations or legally binding regulations. World Health Organization (WHO) compiled a database describing worldwide Standards (Ref.: 37). In the US, the main agency responsible for RF health and safety standards is Federal Communications Commission (FCC) (Ref.: 38).

Since the Commission is not a health and safety agency, they defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe. FCC adopted present exposure limits in 1996, based on guidance from federal safety, health, and environmental agencies and the recommendations of other organizations. In 2013 FCC has opened an Inquiry, to determine whether current exposure limits remain appropriate. The Inquiry is intended to open discussion on both the currency of our RF exposure limits and possible policy approaches regarding RF exposure, and is still ongoing.

Guidelines often allow for higher exposure for the occupationally exposed population (ie. those trained to be aware of potential risk and to take appropriate precautions, such as, for example, turning transmitter off prior to servicing it). Additionally, occupationally exposed population consists

of adults who are generally exposed under known conditions. By contrast, the general public comprises individuals of all ages and of varying health status and may include particularly susceptible groups or individuals, thus for them, a further reduction of 5 times is introduced.

Limits are based on effects associated with heating of tissue, as these are considered to be established effects (Ref.: 39). Although the International Agency for Research on Cancer has classified RF as a 'possible human carcinogen' (Group 2B) based on 'limited evidence' from both human and animal studies (Ref.: 15) the weight of evidence has not risen to a level that would change the basis for RF exposure limits. Most of the ongoing research is focused on possible non-thermal effects.

FCC sets limits as Specific Absorption Rate (SAR) expressed in W/kg and maximum permissible exposure (MPE) expressed in W/m2. These limits are frequency dependent. FCC limits on exposure for mobile phones the general public is intended to restrict local tissue temperature rises to acceptable levels and currently is set to 0.08 Wkg–1, for the whole body, and 1.6 Wkg–1, for the head. As the increase in temperature of the body's tissues as a result of RF exposure is gradual, FCC allows a 6-min averaging time for occupational exposures and a 30-min average for the public. MPE is often used for exposure to stationary devices measured where human exposure is likely to occur at a distance of more than 20 cm. For example, for 902–928 MHz, the frequency band in which many smart meters transmit, the FCC's maximum permissible exposure (MPE) for the general public is 6.1 W/m2 (0.61 mW/cm2) averaged over a 30-min period (for 400 MHz limits will be lower around 2 W/m2).

Smart Meters

Description

Smart meters measure attributes of electricity, natural gas, or water as delivered to consumers and transmit that information (e.g., usage) digitally to utility companies. The RF transmission originates from the Meter Interface Unit (MIU)

that is hard-wired to the register of the smart meter. Some Smart meters are also designed to transmit real-time information to the consumer. These smart meters replace traditional, analog meters and meter readers with an automated process that is expected to reduce operating costs for utilities, and potentially, costs for customers (Ref.: 40).

There are many kinds of smart meters manufactured by a variety of companies. They provide for the automatic meter infrastructure (AMI) through different set-ups such as point to point or mesh network. In point to point set-up the meter sends data (using RF fields) to an access point, where it is collected along with data from many other customers and transmitted to a utility company. In Mesh set-up a meter is part of a broader network ("mesh") and may act as a relay among other smart meters and an access point. The Table below provides some information on frequencies used, and type of transmission of some of the water meters (provided by WSSC Water)

Vendor	Technologies	Licensed	Frequency	Open Standards	Technology Age	Collector Style	Integrations
Sensus	Point to Multipoint RF	Yes	901 and 941	No	>5 Years	Base Station	MultiSpeak, CMEP
Aclara	Point to Multipoint RF	Yes	450 and 470	No	>5 Years	Pole Mount, Tower Mount (lattice or water tower), roof top	MultiSpeak, Flat File Transfer (CMEP or custom)
Neptune	Point to Multipoint RF	No	902 – 928 ISM	Yes (L900 System is LoRaWAN)	>5 Years (R900) <5 Years (L900)	Pole Mount (R900 System); Network as a Service (L900 System)	Published Web-services API
Mueller	Point to Multipoint RF	No	902 – 928 ISM	Yes (LoRaWAN System)	>5 Years LoRa <5 Years LoRaWAN	Pole Mount (LoRa System); Base Station (LoRaWAN System)	Flat File Transfer
Itron	Mesh (Single Hop)	No	902-928 ISM	Yes (Wi-SUN)	<5 Years	Pole Mount	XML
Master Meter	Point to Multipoint RF	Yes	450 and 470	No	<5 Years	Base Station	Flat File Transfer
Badger	Cellular	Yes	GSM and CDMA	Yes (Narrowband IoT)	>5 Years	N/A	Flat File Transfer

The main determinants of exposure to the general public from smart meters are distance, power of the transmittal and rate of transmission (or duty cycle). Some manufacturers make

both electric and other meters (e.g. ITRON), including water, and state that the technology is same or similar (Ref.: 41).

About 60% of WSSC water meters are located inside the basement of homes. Whereas, 40% are located outside the home at the property line. As of today, WSSC does not have a bank of meters in apartment buildings. Generally, in the water industry, these types of dwelling units have one master meter outside in a vault at the property line. The distance from the front door to the property line can vary with minimum distances of about 5-10 feet (personal communication WSSC). Therefore, in general, meters are located away from area where people spend time.

Most systems transmit at 1W (with a range from 0.25 to 2W). with a low duty cycle. Transmission is typically below 1% (4-6 times a day and typically less than 1s each), with higher transmission for mesh networks, where meters communicate with each other. Duty cycle is likely to be lower for water meters.

Measurements

Measurements around smart meters

No exposure assessment studies focused on water smart meters have been identified, however several studies have looked at electric smart meters. Given that exposure from electric meters is likely to be higher than that of water meters they are reviewed below as representative of an upper bound.

The study of the Itron meters arranged as a mesh network, with end point meters operating at 902–928MHz rated at 250mW, and some meters acting as access point (AP) rated at 1.5W (836.6MHz GSM) and 0.75W (1880MHz GSM) (Ref.: 42). The study made measurements around meters both in laboratory and real life environments. The highest instantaneous power density at 0.3m was from 6.8% to 14.5% of the FCC's MPE. Duty cycles whose value is crucial to assessing time-averaged exposure levels were typically <1 %.

The second was a study of the GE/LG end point meters, rated at 1W, operate within a mesh network in the 902–928MHz band (Ref.: 43). Unlike the Itron system, this network reports to an AP mounted on a pole top away from the residences,

transmitting the data at a power of 1W. the spatial average power density was 21% of the peak value (for the GE) and 18% for LG. For duty cycle the 90th-, 99th-, and 99.9th-percentile values were 0.13%, 0.40%, and 1.13%, respectively, with a maximum of 13.9%.

A study in Japan assessed human exposure to radiofrequency fields in the vicinity of a smart meter using the finite-difference time-domain method to calculate spatially averaged specific absorption rate (SAR) values over 10g of tissues (Ref.: 44). The operating frequencies were 920 MHz and 2.45 GHz, which are used for wireless communication between smart meters and AP. The position of the antenna in front of a human eye gives a higher SAR than other position at both 920 MHz and 2.45 GHz. In the case of a distance of 10 mm between a vertically oriented antenna and the right eye of a human, the maximum of SAR values were 0.11 W/kg and 0.37 W/kg at 920 MHz and 2.45 GHz with an input power of 20 mW.

A small study reported on measurements from one manufacturer (Trilliant) (Ref.: 45). Simple calculations based on a free space propagation model indicate that peak RF field intensities are in the range of 10 mW m or less at a distance of more than 1-2 m from the meters. The duty cycle of transmission from the meters is very low (< 1%).

The distribution of the electric fields from a sample of 39 smart meter devices was measured in a controlled laboratory environment, in a UK study (46). The maximum equivalent power density measured during transmission around smart meter devices at 0.5 m and beyond was 15 mW/m2, with an estimation of maximum duty factor of only 1%. One outlier electricity meter had a maximum power density of 91 mW/m2.

In a numerical assessment, by the same group, the smart meter antenna with 1 W power which is an overestimation of what real devices typically emit (15 mW). The highest observed whole body specific energy absorption rate value was 1.87 mW/kg within the child model at a distance of 15 cm from a 2,450 MHz device (Ref.: 47).

Environmental Measurements

Generally, emissions directly behind a smart meter, which would be those that cross a wall into a residence, are considerably lower than those directed outward to communicate with the network (in front of the meter). Following studies have attempted to measure exposures from smart meters and to compare them to other devices that contribute to overall RF exposure.

A total of 77 measurements were made in six residences, in the ITRON study described before (Ref.: 43). The peak fields for 90th, 95th, 97.5th, and 99th percentile were, respectively, 0.048%, 0.13%, 0.30%, and 0.80% of the FCC MPE for the general public. With the duty cycle factored in, these values are conservatively 100 times or more lower.

Limited measurements conducted in two houses with the meters, from a study previously described (Ref.: 45) were unable to clearly distinguish emissions from the meters from the considerable electromagnetic clutter in the same frequency range from other sources, including Wi-Fi routers and, when it was activated, a microwave oven.

A final paper of the UK project provides quantitative information on exposure levels in real scenarios within a convenience sample of 20 homes which includes in home area network using Zigbee (Ref.: 48). They report that background exposure from the 2 GHz band (which includes Wireless Local Area Network (WLAN) and Zigbee (is a special type of WLAN) is similar or lower to common sources (e.g., mobile phone communications). In addition, smart meter devices generally have smaller duty factors compared with WLAN devices.

Radio frequency emissions from 55 residential devices were measured in 10 residences (Belgium and France) and compared to environmental levels and mobile phones (Ref.: 49). Wireless access points (due to frequent use) and especially mobile phones and other personal communication devices (due to their use close to the body) continue to represent the bulk of the radiofrequency electromagnetic field exposure in the smart home. However, some residential devices can significantly increase the exposure if their duty cycles are high enough (>10%), especially when held or used close to the body. Individual smart meters, on the other hand, will generally contribute little exposure, despite emissions of

up to 20 V m at 50 cm, due to their low duty cycles (maximum 1%) and locations.

An indirect confirmation of very low exposures from smart meters comes from an extensive study of personal environmental exposure to radiofrequency electromagnetic fields in children of five European countries (Ref.: 50). Highest contributor to exposure was exposure from mobile phones during downlink. WiFi and cordless phones contributed very little to exposure levels. While exposure from smart meters was not included as it was judged to be very low.

Health effects

People claim that smart meters can cause cancer, anxiety, insomnia, and other complications. Additionally, there are protests against adoption of smart meters, and protesters cite health as their main concern. However, I have been able to identify only one study that looked at potential health effects of smart meters (Ref.: 51). Unfortunately, this study was not designed to evaluate hypothesis, but was just a report of case series based on self-reporting with no information on actual exposure. The most frequently reported symptoms from exposure to smart meters were (1) insomnia, (2) headaches, (3) tinnitus, (4) fatigue, (5) cognitive disturbances, (6) dysesthesias (abnormal sensation), and (7) dizziness. Aside from a problem of numerous biases introduced by self-reporting, there is no information as to whether this group experienced higher or lower risk for any of these symptoms compared to general population or any unexposed group.

Comparison to Guidelines

In all studies of smart meters (Refs.: 42-49) both measurements and modeling of exposures were well below guidelines of both ICNIRP and FCC limits for the exposure to general public. Furthermore, in a detailed review of smart meter technology and subsequent RF exposures (Ref.: 52), authors calculate maximum exposure levels that under "no imaginable realistic circumstances could be exceeded in the opinion of the authors". With all factors considered a Geometric Mean of the time-weighted-average (TWA) whole-

body-average (WBA) % of FCC MPE for general public is 0.31% with a 99th interval from 0.11% to 0.88%.

Opposition

Some argue that averaging emitted power over six(ICNIRP) or thirty minutes (FCC), during most of which time the meter is not emitting, is not appropriate, as it is based on tissue heating (Ref.: 53). As described above, only thermal effects are considered to be sufficient to serve as a basis for the guidelines and limits, while research on non-thermal effects continues. A group of scientists published an appeal in which they question adequacy of existing guidelines for RF from variety of devices, including smart meters (Ref.: 54).

As will be clear from the quotes below, most official organizations do not share this concern.

Statements on smart meters from Official Organizations

American Cancer Society (Ref.: 55):

> "Because, the amount of RF radiation you could be exposed to from a smart meter is much less than what you could be exposed to from a cell phone, it is very unlikely that living in a house with a smart meter increases risk of cancer. ""

IEEE Committee on Man and Radiation (Ref.: 56):

> "The low peak power of Smart Meters and the very low duty cycles lead to the fact that accessible RF fields near Smart Meters are far below both U.S. and international RF safety limits whether judged on the basis of instantaneous peak power densities or time-averaged exposures. This conclusion holds for Smart Meters alone or installed in large banks of meters."

The Environmental Protection Agency (Ref.: 57);

> "Advanced ("smart") meters transmit data using radio-frequency waves, which are a form of electromagnetic radiation. However, the radiation given off by a smart meter is similar in type and strength to the radiation from other common consumer devices."

Public Health England (Ref.: 58):

> "The evidence to date suggests exposures to the radio waves produced by smart meters do not pose a risk to health."

French Agency for Food, Environmental and Occupational Health & Safety (ANSES) (Ref.: 59):

> " .. the Agency concludes that it is unlikely that exposure to electromagnetic fields emitted by either radio-frequency smart meters (gas and water) or other meters (electricity), as they are currently being deployed, would generate health effects in either the short or the long term."

Australian Radiation protection and Nuclear Safety Agency (ARPANSA) (Ref.: 60):

> "The measured and calculated exposures are all well below the public exposure limits. The radiofrequency used is similar to the frequency used by GSM mobile phones and the peak transmission power is somewhat less. ...The radiofrequency electromagnetic energy transmitted in a single pulse from the smart meter is similar to that measured from a car remote unlocking fob and much less than measured from a single GSM SMS transmission. The measurements do not provide any indication of why smart meter transmissions would provoke symptoms in people otherwise unaffected by other wireless technologies such as GSM mobile phone handsets."

Environmental Defense Fund (EDF) (Ref.: 3):

> "Even though we have very strong evidence that the use of smart meters and the smart grid can make a substantial contribution to protecting and enhancing human health, EDF would certainly change its position if strong enough evidence surfaced concluding that RFs emitted by smart meters — the wireless ones, at least were doing substantial health damage."

California Council on Science and Technology (Ref.: 61):

"The current FCC standard provides an adequate factor of safety against known thermally induced health impacts of existing common household electronic devices and smart meters.
To date, scientific studies have not identified or confirmed negative health effects from potential non-thermal impacts of RF emissions such as those produced by existing common household electronic devices and smart meters.
Not enough is currently known about potential non-thermal Impacts of radiofrequency emissions to identify or recommend additional standards for such impacts".

Conclusions

The RF transmitters in wireless-equipped Smart Meters operate at similar power levels and in similar frequency ranges as many other digital communications devices in common use, and their exposure levels are very far below U.S. and international exposure limits.

In comparison to mobile phones, base stations expose the whole body, and the exposure duration is considerably longer. Perhaps more importantly, base station exposure has been a subject of much concern to the public because it is not under the control of the public and its presence is not perceived to be of direct individual benefit. These considerations apply to the smart meters as well, and perhaps, that is why there has been an opposition to their implementation, despite the fact that exposure from them so low.

In conclusion, the exposures to RF from smart meter are neither long enough nor strong enough to approach the safety standards set by the FCC and other bodies.

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CURRICULUM VITAE

LEEKA I. KHEIFETS

EDUCATION:

Ph.D.	Epidemiology	University of California, Berkeley	1984 - 1986
M.A.	Statistics	University of California, Berkeley	1976 - 1977
B.S.E	Mathematics	University of Yerevan, USSR	1971 - 1975

EXPERIENCE:

2013 **Jacob and Lena Joels Visiting Professor in the Life and Medical Science**
Hebrew University, Faculty of Medicine, School of Public Heath

2003-present **Professor of Epidemiology in Residence**
UCLA, School of Public Health
Department of Epidemiology
Member, JCCC Healthy and At-Risk Populations Program Area

2001-2003 **Head of Radiation Program**
World Health Organization
Responsible for scientific oversight and program development, staff supervision, international collaboration and training for the WHO International EMF Project and Ionizing Radiation program. Responsible for programmatic scientific evaluation of human health effects, protection standards, epidemiological studies of workers and other exposed populations, and guidelines for medical use; diagnosis of overexposure and treatment of injuries, medical handling of emergencies and humanitarian assistance to victims of radiation accidents. Core Diplomatic Status.

1988 – 2001 Positions reflecting a steady progression of increasing responsibility
Electric Power Research Institute

1997 - 2001 **Technical Executive** (Director level position),
Position given in recognition of technical excellence and scientific leadership.
Only six awarded in the 25 years of Institutes existence.

1995 - 2001 **Area Manager**, EMF Effects Assessment & Management,
Responsible for all aspects of health, risk and field management research, including the planning evaluation and implementation of $10-12 million/year multidisciplinary program. Managed department of 10 staff, most Ph.D. or MD managers of programs in epidemiology, toxicology, engineering and other sciences.
Product Line Leader, Occupational Health**:**
Among first offered pivotal position to develop and implement new business model. Responsible for planning and implementation of EMF and Occupational Health Research

1988 – 1995 **Manager, Epidemiology**:
Managed epidemiological research on the effects of ionizing and non-ionizing radiation.

1986 – 1988 **Manager, Occupational Health Programs**, Syntex Inc.:
Managed Health Surveillance and Optimal Health Programs; designed, evaluated, and conducted epidemiological studies of both employees and communities near company sites; advised senior management on employee health, health risk management, and health-related corporate liabilities and community relations.

1981 - 1984 **Biostatistician**, Environmental Health Associates:
Supervised programming staff and the screening of occupational health records; helped to design case-control and cohort studies; analyzed study results; wrote major sections of proposals and reports to clients.

1980 - 1981 **Senior Statistician**, UCLA School of Public Health:
Responsible for all activities of the Risk Factor Update Project, which updated both the methodology and resulting estimates of U.S. risk factors for cardiovascular disease and traumatic injury. Managed staff, budget, meetings, scientific methodology, and coordination of multi-disciplinary team effort.

1978 – 1980 **Statistician**, UCLA Neuropsychiatric Institute:
Statistical consulting for sociologists, anthropologists, psychiatrists, and neurobiologists, including database management, record keeping, and the statistical design, analysis, and interpretation of studies.

SELECTED PROFESSIONAL ACTIVITIES:

2015-present National Materials and Manufacturing Board
The National Academies of Sciences, Engineering, and Medicine
Committee on Airport Passenger Screening

2012-present National Center of Security and Protection (NATSP) Board of directors

2012-2014 Ministry of Environmental Protection and Ministry of Energy and Water Resources, Israel

2013-2016 International Commission on Non-Ionizing Radiation Protection (ICNIRP), Scientific Expert Group

2008-2016 McLaughlin Centre for Population Health Risk Assessment, University of Ottawa. Science Panel for risk communication program on RF

2008 Latin American Science Review International Board

2008-present NIOSH NORA TWU Sector Council, Corresponding Member

2007	National Academy of Sciences, Committee to Identify Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices.
2005-2010	Scientific Coordinator, PROJECT EMF-SP, Brazil
2005-2007	Extremely Low Frequency Environmental Health Criteria Task Group (WHO), member of the editorial group
2005	Adviser, Childhood Lead Poisoning Prevention Branch, California Department of Health Services
2004-2009	EMF-NET - Task Working Group on ELF epidemiology, EMF-Net, EU
2004	Static Fields Environmental Health Criteria Task Group (WHO), Chair of Epidemiology Committee
2003-2007	Adviser, Radiation Programme, World Health Organization (WHO)
2002-2009	Independent Scientific Advisory Group to Swedish Radiation Protection Authority (SSI)
2001-2013	International Commission on Non-Ionizing Radiation Protection (ICNIRP), Member of the Standing Committee on Epidemiology
2001-2003	Radiation Standards Safety Committee (RASSC), International Atomic Energy Agency (IAEA)
2001-2004	Board of Directors Bioelectromagnetics Society (BEMS)
2001-2002	Programme Committee Member for International Conference on Occupational Protection: Protecting Workers Against Exposure to Ionizing Radiation (ILO)
2001	International Agency for Research on Cancer (IARC) Monograph on the Evaluation of Carcinogenic Risk to Humans, working group member Vol. 80
2000-2001	International Commission on Non-Ionizing Radiation Protection (ICNIRP), consulting member
1998-2001	Conférence Internationale des Grands Réseaux Electriques à Haute Tension (CIGRE), committee member
1996-2001	World Health Organization (WHO), Research Coordinating Committee
1998	National Institute of Environmental Health Sciences (NIEHS), Working Group
1992-1998	National Academy of Sciences/National Research Council (NAS/NRC) Commission on Life Sciences Board on Radiation Effects Research: Committee on Assessment of Center for Disease Control (CDC) Radiation Studies
1996-1998	Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF-RAPID), invited symposia participant, plenary speaker, rapporteur

1991-1996	Institute of Electrical and Electronic Engineers (IEEE) Committee on Man and Radiation
1994	Organizing Committee Conference on Statistics and Computing in Disease Clustering
1993-1994	National Council on Radiation Protection (NCRP) Annual Meeting Organizing Committee
1993	Co-organizer Workshop on Dose Reconstruction for Epidemiologic Uses, National Academy of Sciences
1991	Invited Participant The First International Sakharov Conference on Chernobyl
1991	Member International Collaborative Study Group on Cancer Risk Among Radiation Workers in the Nuclear Industry International Agency for Research on Cancer (IARC)

MAJOR RESEARCH INTEREST:
Cancer Epidemiology (particularly breast, leukemia and brain), Epidemiologic methodology, Environmental and Occupational Epidemiology, Methodologic issues in capturing environmental exposure, Public Health Policy Development, Non-Ionizing (static, extremely low frequency and radiofrequency electromagnetic field exposures) and Ionizing Radiation, Epidemiology of chronic diseases including cancer, cardiovascular and neurodegenerative disease

CURRENT RESEARCH INTEREST:
Gene-environment interaction, use of epidemiology for evidence-based health policy, applications of precautionary principle, experimental and non-experimental inference, International Health, 60 Hz EMF exposure and childhood leukemia, mobile cell phone and base station health effects, Smart Meters. Mitigation of, preparedness for, and response to the natural occurrence, accidental release, or the deliberate use of radiation.

PEER-REVIEW PUBLICATIONS:

1. Amoon, A.T., Arah, O. A., **Kheifets, L.,** The sensitivity of reported effects of EMF on childhood leukemia to uncontrolled confounding by residential mobility: a hybrid simulation study and an empirical analysis using CAPS data. (2019) Cancer Causes & Control, 1-8, DOI 10.1007/s10552-019-01189-9

2. Tsarna E., Reedijk M., Birks L., Guxens M., Ballester F., Ha M., Jiménez-Zabala A., **Kheifets L**., Lertxundi A., Lim H., Olsen J., Safont L., Sudan M., Cardis E., Vrijheid M., Vrijkotte T., Huss A., Vermeulen R., Maternal cell phone use during pregnancy,

pregnancy duration and fetal growth in four birth cohorts", *American Journal of Epidemiology*, 2019 https://doi.org/10.1093/aje/kwz092

3. Swanson J., **Kheifets L**, Vergara X., Changes over time in the reported risk for childhood leukaemia and magnetic fields, *J Radiol Prot. 2019 Feb 8;[Epub ahead of print]. https://doi.org/10.1088/1361-6498/ab0586*

4. Crespi CM, Swanson J, Vergara XP, Kheifets L. Childhood leukemia risk in the California Power Line Study: Magnetic fields versus distance from power lines. Environmental Research. 2019 Jan 11;[Epub ahead of print]. https://doi.org/10.1016/j.envres.2019.01.022

5. Sudan M, Birks LE, Aurrekoetxea JJ, Ferrero A, Gallastegi M, Guxens M, Ha M, Lim H, Olsen J, González-Safont L, Vrijheid M, **Kheifets L,** Maternal cell phone use during pregnancy and child cognition at age 5 years in 3 birth cohorts. Environ Int. 2018 Nov;120:155-162, DOI: 10.1016/j.envint.2018.07.043

6. Amoon, A.T., Oksuzyan, S., Crespi, C.M., Arah, O. A., Cockburn, M., Vergara, X., **Kheifets, L.,** Residential Mobility and Childhood Leukemia, Environmental Research, 164 (2018) 459–466

7. Amoon A.T., Crespi C.M., Ahlbom A., Bhatnagar M., Bray I, Bunch K.J., Clavel J., Feychting M., Hemon D., Johansen C., Kreis C., Malagoli C., Marquant F., Pedersen C., Raaschou-Nielsen O., Röösli M., Spycher B.D., Sudan M., Swanson J., Tittarelli A., Tuck D.M., Tynes T., Vergara X., Vinceti M., Wünsch-Filho V., **Kheifets L.** Proximity to Overhead Power Lines and Childhood Leukemia: An International Pooled Analysis, BJC 2018, https://doi.org/10.1038/s41416-018-0097-7

8. Eeftens M, Struchen B, Birks LE, Cardis E, Estarlich M, Fernandez MF, Gajšek P, Gallastegi M, Huss A, **Kheifets L**, Meder IK, Olsen J, Torrent M, Trček T, Valič B, Vermeulen R, Vrijheid M, van Wel L, Guxens M, Röösli M. Personal exposure to radio-frequency electromagnetic fields in Europe: Is there a generation gap? Environ Int 2018, 121 Pt 1: 216-226

9. Birks L., Struchen B., Eeftens M., Huss A., Gajšek P., **Kheifets L.,** Gallastegi M., van Wel L., Dalmau-Bueno A., Estarlich, M. Fernandez M., Meder,I Ferrero A,, Jiménez-Zabala A., Torrent M., Vrijkotte T., Cardis E., Olsen J., Valic B., Vermeulen R., Vrijheid M. Röösli M., Guxens M.. "Spatial and temporal variability of personal environmental exposure to radio frequency electromagnetic fields in children in Europe" Environment International, 2018

10. Birks L., Guxens M., Papadopoulou E., Alexander J., Ballester F., Estarlich M., Gallastegi M., Ha M., Haugen M., Huss A., **Kheifets L**., Lim H., Olsen J., Santa-Marina L., Sudan M., Vermeulen R., Vrijkotte T., Cardis E., Vrijheid M. "Maternal cell phone use during pregnancy and child behavioral problems in five birth cohorts." Environment International. 2017; 104:122-131.

11. **Kheifets L**, Crespi CM, Hooper C, Cockburn M, , Amoon A, Vergara X, [1] "Residential magnetic fields exposure and childhood leukemia: a population-based case-control study in California". (2017), CACO, DOI 10.1007/s10552-017-0951-6

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14. Sudan M., Arah O.A., Becker T, Levy Y,., Sigsgaard, Olsen J, Vergara X, **Kheifets L**, "Re-examining the Association between Residential Exposure to Magnetic Fields from Power Lines and Childhood Asthma in the Danish National Birth Cohort", (2017); PLoS ONE 12(5): e0177651. https://doi.org/10.1371/journal.pone.0177651

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17. Sudan M., Arah O.A., Olsen J., Obel C., **Kheifets L**. "A Prospective Analysis of the Association between Cell Phone Exposures and Behavioral Problems in Children." 2016; JECH Online First, published on May 23, 2016 as 10.1136/jech-2016-207419

18. Sudan M., Arah O.A., Olsen J., Sigsgaard T., **Kheifets L**. "Trends in Cell Phone Use Among Children in the Danish National Birth Cohort at Ages 7 and 11 Years", Journal of Exposure Science and Environmental Epidemiology 03/2016; DOI:10.1038/jes.2016.17

19. Sudan M., Arah O.A., Olsen J., **Kheifets L**. "Reported Associations Between Asthma and Acute Lymphoblastic Leukemia: Insights From a Hybrid Simulation Study." European Journal of Epidemiology, (2016), DOI 10.1007/s10654-016-0126

20. Kandel, S., Swanson, J. and **Kheifets, L**. Health-Economics Analyses Applied to ELF Electric and Magnetic Fields. Risk Analysis, (2016), doi:10.1111/risa.12551

21. Oksuzyan S, Crespi CM, Cockburn M, Mezei G, Vergara X, **Kheifets L**. Socio-economic status and childhood leukemia in California. Cancer Prev Curr Res 2015, 3(4)

22. Hareuveny R, Sudan M, Halgamuge MN, Yaffe Y, Tzabari Y, Namir D, **Kheifets L.** Characterization of extremely low frequency magnetic fields from diesel, gasoline and hybrid cars under controlled conditions. Int J Environ Res Public Health. 2015 Jan 30;12(2):1651-66. (Free): http://dx.doi.org/10.3390/ijerph120201651

23. Hareuveny R, Kavet R, Shachar A, Margaliot M, **Kheifets L**, Occupational exposures to radiofrequency fields: Results of an Israeli national survey. J Radiol Prot. 2015 Jun;35(2):429-45. doi: 10.1088/0952-4746/35/2/429. Epub 2015 May 15.

24. Vergara X, Kavet R, Crespi C, Hooper C, and **Kheifets L,**
Estimating Magnetic Fields of Homes Near Transmission Lines in the California Power Line Study, Environmental Research, 2015 *DOI: 10.1016/j.envres.2015.04.020*

25. Oksuzyan S, Crespi CM, Cockburn M, Mezei G, Vergara X, **Kheifets L**. Race/ethnicity and the risk of childhood leukemia: a case-control study in California. J Epidemiol Commun H. 2015 Mar 19. pii: jech-2014-204975. doi: 10.1136/jech-2014-204975. [Epub ahead of print]

26. Fischer H, **Kheifets L**, Huss A, Peters T.L., Vermeulen R, Ye W, Fang F, Wiebert P, Vergara X.P., Feychting MA. Nested Case-Control Study of Occupational Exposure to Electric Shocks and Magnetic Fields and Amyotrophic Lateral Sclerosis in Sweden from 1991 to 2010, Epidemiology, 2015 Nov;26(6):824-30.
doi: 10.1097/EDE.0000000000000365

27. Greenland S, Fischer H, and **Kheifets L.**, Methods to account for bias introduced by job exposure matrices. Journal of Risk Analysis, 2015; Risk Analysis 07/2015; DOI:10.1111/risa.12438

28. Vergara X, Fischer H, Yost M, Silva M, Lombardi D and **Kheifets L**, Advanced Electric Shock Job Exposure Matrix Quantifies Uncertainty, Int. J. Environ. Res. Public Health 2015, 12, 3889-3902; doi:10.3390/ijerph120403889

29. Fischer H, Vergara X, Yost M, Silva M, Lombardi D and **Kheifets L**, Developing a job-exposure matrix with exposure uncertainty from expert elicitation and data modeling, *Journal of Exposure Science and Environmental Epidemiology advance online publication 13 May 2015; doi: 10.1038/jes.2015.37*

30. Shapiro BB, Streja E, Rhee CM, Molnar MZ, **Kheifets L**, Kovesdy CP, Kopple JD, Kalantar-Zadeh K Revisiting the association between altitude and mortality in dialysis patients. Hemodial Int. 2014 Jan 15. doi: 10.1111/hdi.12129. [Epub ahead of print]

31. Vergara X., Mezei G, Kheifets L., Case-Control Study of Occupational Exposure to Electric Shocks and Magnetic Fields and Mortality from Amyotrophic Lateral Sclerosis in the U.S., 1991-1999", *Journal of Exposure Science and Environmental Epidemiology* 06/2014; DOI:10.1038/jes.2014.39

32. Mezei G, Sudan M, Izraeli S, **Kheifets LI**. Epidemiology of childhood leukemia in the presence and absence of Down syndrome. Cancer *Epidemiology. 2014 Aug 8;[Epub ahead*

of print]. *http://dx.doi.org/10.1016/j.canep.2014.07.006*

33. Sudan M, **Kheifets LI**, Arah OA, Divan HA, Olsen J. Complexities of sibling analysis when exposures and outcomes change with time and birth order. Journal of Exposure Science and Environmental Epidemiology. 2013 Sep 25. [Epub ahead of print] PubMed PMID: 24064530.

34. Lipp MEN, Barbieri FE, Santánna L, Justo AP, Cabral AC, dos Santos FU, Gallo S, **Kheifets L**. Perception of risk from electric and magnetic fields: Stress effects and psychological aspects. Estudos de Psicologia (Campinas). 2013;30(4):497-506. Free of charge: http://dx.doi.org/10.1590/S0103-166X2013000400003

35. Lukowsky LR, **Kheifets L**, Arah OA, Nissenson AR, Kalantar-Zadeh K., Nutritional predictors of early mortality in incident hemodialysis patients. *Int Urol Nephrol*. 2013 May 24. DOI 10.1007/s11255-013-0459-2

36. **Kheifets L**, Crespi CM, Hooper C, Oksuzyan S, Cockburn M, Ly T, Mezei G Epidemiologic study of residential proximity to transmission lines and childhood cancer in California: Description of design, epidemiologic methods and study population, *2013, JESSE*

37. Oksuzyan S., Crespi C.M., Cockburn M., Mezei G., **Kheifets L.,** Birth weight and other perinatal factors and childhood CNS tumors: a case-control study in California, *Cancer Epidemiology (2013);*

38. Okokon EO, Roivainen P, **Kheifets L,** Mezei G, Juutilainen J. Indoor transformer stations and elf magnetic field exposure: use of transformer structural characteristics to improve exposure assessment, *J Expo Sci Environ Epidemiol.* 2013 Sep 11. [Epub ahead of print]

39. Lukowsky LR, Mehrotra R, **Kheifets L**, Arah OA, Nissenson AR, Kalantar-Zadeh K. Comparing mortality of peritoneal and hemodialysis patients in the first two years of dialysis therapy: a marginal structural model analysis, 2013, *CJASN*, doi: 10.2215/CJN.04810512

40. Sudan M, **Kheifets L**, Arah O, Olsen J. Cell Phone Exposures and Hearing Loss in Children in the Danish National Birth Cohort, 2013, *Paediatric & Perinatal Epidemiology*, doi: 10.1111/ppe.12036

41. Arah O.A., Sudan M. , Olsen J., **Kheifets L**. "Marginal Structural Models, Doubly Robust Estimation, and Bias Analysis in Perinatal and Paediatric Epidemiology." Paediatric and Perinatal Epidemiology. 2013; 27(3):263-265.

42. Vergara X., **Kheifets L.**, Greenland S, Oksuzyan S, Cho YS, Mezei G,."Occupational Exposure to Extremely Low Frequency Electromagnetic Fields and Neurodegenerative Disease: A Meta-Analysis," *JOEM*, Volume 55, Number 2, February 2013, 135-146.

43. Divan HA, **Kheifets L**, Sun Y, Christensen J, Olsen J. Prenatal cell phone use and associations with epilepsy and febrile seizures in children, 2013 Submitted to *Epilepsy Research*

44. Sudan M, **Kheifets L**, Arah O, Olsen J, Zeltzer L. Prenatal and postnatal cell phone exposures and headaches in children. *The Open Pediatric Medicine Journal*. 2012; 2012(6):46-52.

45. Huss A, Vermeulen R, Bowman JD, **Kheifets L**, Kromhout H. Electric shocks at work in Europe: development of a job exposure matrix. *Occup Environ Med.* 2012 Nov 22;[Epub ahead of print].

46. Lukowsky LR, **Kheifets L,** Arah OA, Nissenson AR, Kalantar-Zadeh K. Predictors of Early Mortality in Incident Hemodialysis Patients: New insights. *Am J Nephrol*. 2012; 35(6):548-58. doi: 10.1159/000338673. Epub 2012 Jun 6

47. S. Oksuzyan, C.M. Crespi, M. Cockburn, G. Mezei, **L. Kheifets**
Birth weight and other perinatal characteristics and childhood leukemia in California, *Cancer Epidemiology (2012); 36e359–e365*

48. J Schüz, K Grell, S Kinsey, M S Linet, M P Link, G Mezei, B H Pollock, E Roman, Y Zhang, M L McBride, C Johansen, C Spix, J Hagihara, A M Saito, J Simpson, L L Robison, J D Dockerty, M Feychting**, L Kheifets** and K Frederiksen, Extremely low-frequency magnetic fields and survival from childhood acute lymphoblastic leukemia: an international follow-up study. *Blood Cancer Journal (2012); doi:10.1038/bcj.2012.43* *Published online 21 December 2012*

49. Swanson J and **Kheifets, L** Could the geomagnetic field be an effect modifier for studies of power-frequency magnetic fields and childhood leukaemia? , *J. Radiol. Prot. 32 (2012) 413–418*

50. Lukowsky LR, **Kheifets L**, Arah OA, Nissenson AR, Kalantar-Zadeh K. Conference Paper: Patterns and predictors of mortality in the months after initiation of dialysis in incident hemodialysis patients Spring Clinical Meeting of the National-Kidney-Foundation; 04/2012

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40. **Kheifets L.** (1986) "An epidemiologic analysis of breast cancer survival," Ph.D. dissertation, University of California, Berkeley.

41. The Risk Factor Update Project (1985) "Final Report" prepared for the Center for Disease Control, U.S. Department of Health and Human Services.

42. The Risk Factor Update Project (1981), "Working Paper" prepared for the Center for Disease Control, U.S. Department of Health and Human Services.

PUBLISHED ABSTRACTS (2001 – 2017 only):

1. Birks L., Guxens M., Papadopoulou E., Alexander J., Ha M., Huss A., **Kheifets L**., Lim H., Olsen J., Sudan M., Vermeulen R., Cardis E., Vrijheid M. Maternal cell phone use during pregnancy and child behavior problems in five birth cohorts. Platform presentation at the annual conference of the International Society for Environmental Epidemiology, Rome, Italy. September 2016.

2. Birks L., Eeftens M., Struchen B., Estarlich M., Fernandez M., Ferrero A., Gajsek P., Gallastegi M., González L., Huss A., Jiménez-Zabala A., **Kheifets L.**, Meder I.K., Olsen J., Santa-Maria L., Torrent M., Valic B., Vermeulen R., Cardis E., Vrijheid M., Roosli M., Guxens M. Personal exposure to radio frequencyelectromagnetic fields in children in Europe. Platform presentation at the annual meeting of the Bioelectromagnetics Society and the European Bioelectromagnetics Association, Hangzhou, China. June 2017.

3. Sudan M., Arah O.A., Olsen J., Obel C., **Kheifets L**. "A Prospective Analysis of the Association between Cell Phone Exposures and Behavioral Problems in Children." Accepted for platform presentation at the Annual Meeting of the Bioelectromagnetics Society and the European Bioelectromagnetics Association, Gent. June 2016.

4. **Kheifets L**, "Mobile Phones: A Love story", COSA's 42nd Annual Scientific Meeting, 2015

5. **Kheifets L,** Sudan M., "Cancer Clusters in Environmental Epidemiology & Resources for Physicians" COSA's 42nd Annual Scientific Meeting, 2015

6. **Kheifets L,** Sudan M., "Meta and Pooled Analysis as tools when numbers are small" COSA's 42nd Annual Scientific Meeting, 2015

7. Sudan M., **Kheifets L**. Arah O.A., Olsen J. Trends in Cell Phone Use Behaviors Among Children in the Danish National Birth Cohort at Ages 7 and 11 Years: A Prospective Analysis. Accepted for platform presentation at the Annual Meeting of the Bioelectromagnetics Society and the European Bioelectromagnetics Association, Monterey Bay. June 2015.

8. Sudan M., Hareuveny R., Halgamuge M.N., Yaffe Y., Tzabari Y., Namir D., **Kheifets L.** Characterization of Extremely Low Frequency Magnetic Fields from Diesel, Gasoline and Hybrid Cars under Controlled Conditions. Accepted for platform presentation at The Annual Meeting of the Bioelectromagnetics Society and the European Bioelectromagnetics Association, Monterey Bay. June 2015.

9. Fischer H, **Kheifets L**, Huss A, Peters T.L., Vermeulen R, Ye W, Fang F, Wiebert P, Vergara X.P., Feychting M. A Nested Case-Control Study of Occupational Exposure to Electric Shocks and Magnetic Fields and Amyotrophic Lateral Sclerosis in Sweden from 1991 to 2010. Poster session presented at: 2014 SCERC Fall Interdisciplinary Workshop; 2014 Sept 23; Los Angeles, CA.

10. Hareuveny R, Eliyahu I, Yaffe Y, Ben David I, Riven M , Kandel S and **Kheifets L**, **A National Survey of Exposure to Power Frequency Magnetic Fields ("ORCHID"),** The 27th Conference of the Nuclear Societies in Israel, Dead Sea, Israel, February 11-13 2014, p. 15-17.

11. Susanna Lagorio, **Leeka Kheifets**, Indoor levels of ELF magnetic fields in buildings with built-in transformers. ICEmB meeting, Napoli 2-4 2014

12. Heidi Fischer, Ximena Vergara, Michael Yost, Michael Silva, David Lombardi, **Leeka Kheifets**, Developing a job-exposure matrix with exposure uncertainty from expert elicitation and data modeling, *BioEM2014, Cape Town, South Africa*, Jun 08 - 13, 2014

13. Ximena Vergara, Heidi Fischer, Michael Yost, Michael Silva, David Lombardi, **Leeka Kheifets**, Advanced Electric Shock Job Exposure Matrix Quantifies Uncertainty, *BioEM2014, Cape Town, South Africa,* Jun 08 - 13, 2014

14. Madhuri Sudan, Gabor Mezei, Shai Izraeli, **Leeka Kheifets** , Childhood leukemia with and without Down syndrome, *BioEM2014, Cape Town, South Africa,* Jun 08 - 13, 2014

15. Ximena Vergara, **Leeka Kheifets**, Gabor Mezei, Occupational Electric Shocks and Extremely Low Frequency Magnetic Fields Exposure and Mortality Due to Amyotrophic Lateral Sclerosis, *BioEM2014, Cape Town, South Africa*, Jun 08 - 13, 2014

16. Ronen Hareuveny, Madhuri Sudan, Malka Halgamuge, Yoav Yaffe, Yuval Tzabari, Daniel Namir, **Leeka Kheifets**, A Preliminary Analysis of Magnetic Fields Emitted from Non-hybrid and Hybrid Cars, *BioEM2014, Cape Town, South Africa*, Jun 08 - 13, 2014

17. **Kheifets L**, Crespi CM, Hooper C, Oksuzyan S, Cockburn M, Ly T, Mezei G, Epidemiologic study of residential proximity to transmission lines and childhood cancer in California: Description of design, epidemiologic methods and study population, BioEM2013, Thessaloniki, Greece, Jun 10 - 14, 2013

18. **Kheifets L**, , Mezei G, Sudan M, Novel Epidemiologic Approaches to Investigate the Magnetic Field—Childhood Leukaemia Association, BioEM2013, Thessaloniki, Greece, Jun 10 - 14, 2013

19. Sudan M., Mezei G., **Kheifets L**. "Novel Epidemiologic Approaches to Investigate the Magnetic Field-Childhood Leukemia Association." Poster presented at the meeting of the Southern California Society for Risk Analysis, Los Angeles. May 2012.

20. Sudan M., Mezei G., **Kheifets L**. "Novel Epidemiologic Approaches to Investigate the Magnetic Field-Childhood Leukemia Association." Poster presented at the Children With Cancer UK Conference. London, UK. June 2012.

21. Sudan M., **Kheifets L**., Arah O.A., Olsen J. "Prenatal and postnatal cell phone exposures and headaches in children." Paper presented at the Congress of the European Bioelectromagnetics Association, Rome, Italy. February 2011.

22. Vergara X., **Kheifets L.**, Greenland S, Oksuzyan S, Cho YS, Mezei G, Occupational Exposure to Extremely Low-Frequency Electromagnetic Fields and Neurodegenerative Disease, BioEM2013, Thessaloniki, Greece, Jun 10 - 14, 2013

23. Halgamuge M, Vijayalaxmi, Kheifets L, Wood A, White J, Skafidas E, Influence of the mRNA Degradation Rate on the Circadian Rhythm in Humans due to Weak Electromagnetic Exposure, BioEM2013, Thessaloniki, Greece, Jun 10 - 14, 2013

24. Lukowsky L., **Kheifets L**, Arah O., Nissenson A., and Kalantar-Zadeh K Associations between Quarterly Changes in Serum Albumin and Mortality in the First 24 Months after Initiation of Hemodialysis, ASN, 2012

25. Lukowsky L., **Kheifets L**, Arah O., Nissenson A., and Kalantar-Zadeh K Associations between Changes in Protein Catabolic Rate and Mortality in Incident Hemodialysis Patients During First two Years after Hemodialysis Initiation, ASN, 2012

26. Lukowsky L., **Kheifets L**, Arah O., Nissenson A., and Kalantar-Zadeh K Marginal Structural Modeling of Dialysis Modality and Survival in Incident Dialysis Patients during the first Two Years, ASN, 2012

27. Lukowsky L., **Kheifets L**, Arah O., Nissenson A., and Kalantar-Zadeh K. Associations of Serum Albumin Level and Dietary Protein Intake Estimate with Patient Mortality in the First 24-Months of Incident Hemodialysis, ASN, 2012

28. Oh SS*, Thompson CA, Jin Y, Chang SC, Greenland S, **Kheifets L,** Yuan-Chin AL, Mao JT, Morgenstern H, Park LP, Rao JY, Tashkin DP, You NC, Zhang ZF. "Correlates of lung cancer

survival: inflammatory single nucleotide polymorphisms and tumor biomarker expression." 35th Annual Meeting of the American Society for Preventive Oncology. Las Vegas, Nevada. March 2011. (*Oral presentation)

29. Vergara X., **Kheifets L.**, Silva M., Bracken D., Yost M. "PB-120 Electric shock job exposure matrix. BEMS 33rd Annual Meeting", 13-17 Jun 2011, Halifax, Canada.

30. Lukowsky L., **Kheifets L.**, Arah O., Nissenson A., and Kalantar-Zadeh K., "Vascular Access Type and Early Death in the First Two Years of Hemodialysis Treatment". (ASN 2011 for the Kidney Week 2011 will be held in Philadelphia, PA November 3rd-8th)

31. Lukowsky L., **Kheifets** L, Arah O., Nissenson A., and Kalantar-Zadeh K. "Mortality Trends in the First 2 Years after Initiation of Dialysis among Incident Hemodialysis Patients". (Submitted 06/08/11 to ASN 2011 for the Kidney Week 2011 will be held in Philadelphia, PA November 3rd-8th)

32. Sudan M., **Kheifets L.**, Olsen J. "Prenatal and Postnatal Cell Phone Exposure and Headaches in Children". Conference Proceedings of the 10th International Congress of the European Bioelectromagnetics Association. Rome, Italy. 2011. Available:http://proceedings.ebea2011.org/modules/requesta02e.html?module=oc_program&action=summary.php&id=5149.

33. Lukowsky L., **Kheifets L.**, Arah O, Kovesdy C., and Kalantar-Zadeh K.. Comparing Demographic Factors as Predictors of the First 90-Day Mortality in Incident Hemodialysis Patients. ASN 2010

34. Lukowsky L., **Kheifets L.**, Arah O., Nissenson A., Kovesdy C. and Kalantar-Zadeh K. "Relative Mortality Trends in the First 2 Years among Incident Hemodialysis Patients." ASN 2010

35. Lukowsky L., **Kheifets L.**, Arah O., Nissenson A., Kovesdy C. and Kalantar-Zadeh K. "Laboratory Measures as Predictors of the First 3-Month Mortality in Incident Hemodialysis Patients." ASN 2010

36. Divan H., **Kheifets L.**, Obel C., Olsen J. "Prenatal cell phone use and associations with developmental milestone delays at age 6 and 18 months". Society for Epidemiologic Research Conference. Am J Epidemiol. 2010 Jun 1;171(11 Suppl):S1-157.-

37. Divan H., **Kheifets L.**, Obel C., Olsen J., Prenatal cell phone use and associations with epilepsy and febrile seizures in children. Society for Epidemiologic Research Conference. Am J Epidemiol. 2010 Jun 1;171(11 Suppl):S1-157.

38. Divan H., **Kheifets L.**, Obel C., Olsen J. "Replication of an association between prenatal and postnatal exposure to cell phone use and behavioral problems in young children". Society for Epidemiologic Research Conference. Am J Epidemiol. 2009 Jun;169(11 Suppl):S1-137.

39. Divan H., **Kheifets L.**, Obel C., Olsen J. "Prenatal and postnatal exposure to cell phone use and behavioral problems in children". International Society for Environmental

Epidemiology/International Society of Exposure Analysis Joint Conference. October 2008. Pasadena, CA Epidemiology. 2008 Nov;19 Suppl 6:S13-379

40. Divan H., **Kheifets L.**, Obel C., Olsen J. "Prenatal and postnatal exposure to cell phone use and behavioral problems in children". Invitee for the Student Poster Composition at the International Society for Environmental Epidemiology/International Society of Exposure Analysis Joint Conference. October 2008. Pasadena, CA [poster] Epidemiology. 2008 Nov;19 Suppl 6:S13-379

41. Sudan M., **Kheifets L.**, Olsen J. "Prenatal and Postnatal Cell-phone Exposure and Migraine and Other Headaches in Children", PIERS Proceedings, 12 - 16, March 20-23, Marrakesh, MOROCCO 2011

42. Mezei G., Cho YS, Vergara X., **Kheifets L.** "Meta-analysis of Occupational and Residential Extremely Low Frequency Magnetic Fields Exposures and Neurodegenerative Disease", PIERS Proceedings, 12 - 16, March 20-23, Marrakesh, MOROCCO 2011

43. Roosli M., Jenni D., **Kheifets L.**, Mezei G. "P-A-83: Extremely low frequency magnetic field (ELF-MF) measurements in buildings with transformer stations in Switzerland". BEMS 32nd Annual Meeting, 14-18 Jun 2010, Seoul, South Korea

44. Silva M., Mezei G., **Kheifets L.**, Hooper C. "Theoretical evaluation of magnetic field Determinants for residences above Electric transformer rooms". 30th Annual Meeting, San Diego, Ca, 2008.

45. Vergara X., **Kheifets L.**, Monroe J., Mezei G., Afifi A. "Occupational EMF and Leukemia and Brain Cancer: An Update to Two Meta-Analyses. International Society for Environmental Epidemiology & International Society of Exposure Analysis". 2008 Joint Annual Conference Exposure and Health in a Global Environment, Epidemiology. 2008 Nov;19 Suppl 6:S13-379

46. **Kheifets** L, Exposure assessment and other challenges in non-ionizing radiation studies, Berlin, ICNIRP/WHO/BfS, 2009

47. **Kheifets L.** Building National Capacity while Contributing to the International Database: Case Study of EMF in Brazil, ISEE, 2007

48. Schuz J., Svendsen A., Linet M., McBride M., Roman E., Feychting M., **Kheifets L.**, Lightfoot T., Mezei G., Simpson J., Ahlbom A. "Night-time exposure to electromagnetic fields and childhood leukemia: An extended pooled analysis". *Bioelectromagnetics Society, 29th Annual Meeting Proceedings, Kanazawa, Japan,* June 2007.

49. Mezei G., Gadallah M., **Kheifets L.** Meta-analysis of childhood brain tumors and magnetic fields. *Bioelectromagnetics Society, 29th Annual Meeting Proceedings, Kanazawa, Japan,* June 2007.

50. **Kheifets L.**, Hooper C., Herz M., Kavet R., Mezei G., Cockburn M., Ye G., Oksuzyan S. "Risk of Childhood Leukemia and Brain Tumors and Distance to Power Lines in California", CalGIS 2007 Conference

51. Foliart D., Pollock B., Mezei G., Iriye R., Silva M., Ebi K., **Kheifets L.** "Link MP., Kavet R. Magnetic field exposure and survival among children with leukemia". *Bioelectromagnetics Society, 28th Annual Meeting Proceedings, Cancun, Mexico,* June 2006.

52. Neubauer G., Röösli M., Feychting M., Hamnerius Y., **Kheifets L.**, Kuster N., Schüz J., Wiart J. "Feasibility of future epidemiological studies on possible health effects of mobile phone base stations", Abstracts of the 27th Annual Meeting of the Bioelectromagnetics Society Meeting, Dublin, Ireland 2005

53. **Kheifets L.** "ELF Epidemiologic Evidence and Risk Assessment", NATO workshop, Erevan, Armenia, 2005

54. Ahlbom A., Feychting M., **Kheifets L.** "Comparing ELF and RF Epidemiology". Proceedings from Biological Effect of EMFs 3rd International Workshop, Kos, Greece, 2004: p.721.

55. Neubauer G., Röösli M., Feychting M., Hamnerius Y., **Kheifets L.**, Kuster N., Schüz J., Wiart J. "Feasibility of future epidemiological studies on possible health effects of mobile phone base stations", ISEE/ISEA conference, 2006

56. **Kheifets L.** "Childhood leukemia and EMF, The Sensitivity of Children". Proceedings of the 2004 EPRI-cosponsored World Health Organization Workshop

57. Neubauer G., Röösli M., Feychting M., Hamnerius Y., Kheifets L., Kuster N., Schüz J., Wiart J. "Study on the Feasibility of Epidemiological Studies on Health Effects of Mobile Telephone Base Stations." Abstracts of the 26th Annual Meeting of the Bioelectromagnetics Society Meeting, Washington DC, 2004

58. **Kheifets L.**, Repacholi M., van Deventer E, "Establishing a Dialogue on Risks from Electromagnetic Fields", Proceedings of the Finnish National Research Programme 1998-2003, Helsinki , Finland, 2003

59. **Kheifets L.**, Shuz I., Feychting M. "Epidemiologic studies of populations around base stations: Can they be done?" Abstracts of the 25t Annual Meeting of the Bioelectromagnetics Society Meeting, Maui, Hawaii, 2003

60. **Kheifets L.** "Risk Assessment". Proceedings of the Symposium on Risks and Governance, Japan Ministry of Environment, Tokyo, Japan, 2003

61. **Kheifets L.** "ELF And Public Health": Reviews, Proceedings of The EMF Biological Research Trust Workshop, Royal Society, London, UK, 2003

62. **Kheifets L.**, Repacholi M. "ELF Fields and cancer: What to do about them?", 2nd International Workshop on Biological Effects of Electromagnetic Fields, Rhodes, Greece 2002

63. **Kheifets L.** "Precautionary Principle", 3rd International Conference: EMF and Human Health, Fundamental and Applied Research, St Petersburg, Russia 2002

64. **Kheifets L.** and Repacholi M. "The World Health Organization's New Program on Radiation and Health" Geneva - ILO, International Conference on Occupational Radiation Protection: Protecting Workers against Ionizing Radiation, 2002

65. **Kheifets L.** "ELF and Public Health: Reviews and Research Priorities", Abstracts of the 24th Annual Meeting of the Bioelectromagnetics Society Meeting, 2002

66. **Kheifets L.** "Royal Swedish International Union of Radio Science Stockholm", Proceedings Sweden 2002

67. **Kheifets L.**, Hester G., and Banerjee G. "The Precautionary Principle and EMF: Implementation and Evaluation", The Israeli Nuclear Societies scientific meeting Haifa, Israel 2002

68. **Kheifets L.** "Harmonization of EMF Standards International Seminar on Electromagnetic Fields, new technologies and health", Ljubljana, Slovenia 2002

69. **Kheifets L.** "WHO'S International EMF Project", Forum Europe-ENVIROCOM 2002 Electrosmog and Communication, Neuchâtel, Switzerland 2002

70. **Kheifets L.** "WHO / ICNIRP Conference on EMF Biological Effects &WHO Standards Harmonization for the African Region and WHO RF Research Coordination meeting, Cape Town, South Africa, December 2001

71. **Kheifets L.** - Francetelecom 2001, Paris, France, 2001

72. **Kheifets L.** "The Precautionary Principle & EMF", Seoul, South Korea - WHO Meeting on EMF Biological Effects and Standards Harmonization in Asia and Oceania 2001

73. **Kheifets L.** "WHO'S INTERNATIONAL EMF PROJECT". The National Electrical Engineering Association, Meeting on Social and Financial impact of EM safety standards., Rome, Italy. 2001

74. **Kheifets L.** "Epidemiological evidence on EMF and Cancer", ISEE 2001 Symposium:, Garmish, Germany , September 2001

75. **Kheifets L.** "EMF Epidemiology: State of the Science Workshop on EMF & Health", Yoyogi, Tokyo Japan, 2001

76. **Kheifets L.** " Review of Epidemiologic Evidence for RF and ELF" Lima Peru, WHO Regional Meeting,. 2001

REVIEWING ACTIVITIES:

Referee for *Epidemiology, American Journal of Epidemiology, WHO Bulletin, Health Physics, Bioelectromagnetics, Journal of Occupational and Environmental Medicine, National Academy of Sciences/National Research Council (NAS/NRC), European Journal of Epidemiology, Annals of of Epidemiology, International Journal of Cancer, Social and Preventive Medicine, Environmental Health Perspectives, Risk Analysis, Radiation Research, Cancer Causes and Control, Naturwissenschaften, Annals of Occupational Hygiene, Journal of Official Statistics, Environmental Health, North American Journal of Medical Science, Journal of Radiological Protection, Environment International, Regulatory Toxicology and Pharmacology, Reproductive Toxicology, The Lancet Global Health, The Lancet, International Journal of Biochemistry & Cell Biolog, Environmental Research, Environment International, , Cancer Medicine, Radiation and Environmental Biophysics, International Journal of Environmental Research and Public Health, PLOS ONE, Annals of Epidemiology, International Journal of Epidemiology, American Journal of Alzheimer's Disease and Other Dementia, BMC Public Health, BMC Cancer, BioMed Research International, Science of the Total Environment, Journal of Oncology, American Journal of Preventive Medicine, International Journal of Nephrology, Division of Radiological Health U.S. Food and Drug Administration*

Grant Reviewer: for UK Mobile Telecommunications and Health Research Programme, European commission, Australian Ministry of Health, Finnish National Research Programme LaVitaII, Saudi Research Programme, Fondation Santé et Radiofréquences, Swiss National Science Foundation, Armenian National Science and Education Fund, Environment and Health Fund (EHF) in Israel, Italian Ministry of Health, U.S. Civilian Research and Development Foundation (CRDF), American Association for the Advancement of Science (AAAS), CDC/NIH, EU Horizon 2020, The Israeli Ministry of Science and Technology, Children with Cancer UK, University of Sharjah UAE.

Scientific Review: the Standards and Policies of Radiofrequency Radiation Protection in Latin America, Environment Directorate of the European Commission's DG Research and Innovation.

EDITORIAL ACTIVITIES:

2016-present The Open Pediatric Medicine Journal Editorial Board

2014-present Frontiers in Public Health Editorial Board

2012-present Journal of Leukemia Editorial Board

2008--present Editorial Advisory Board The Open Pediatric Medicine Journal

2004-2007 Editor WHO. Environmental Health Criteria (EHC)

2004-2005 Guest **co-editor** Bioelectromagnetics

2002-2004 **Chairman**, Editorial Committee, Journal of Bioelectromagnetics

1992-1994 Guest **co-editor** of Statistics in Medicine

TEACHING EXPERIENCE:

2015-2017 Instructor,
Methods in Environmental and Occupational EPIDEM 265

2015 Guest Lecturer Environmental Health Sciences 230B

2006-2014 Instructor,
Methods in Environmental and Occupational EPIDEM 265
Field Studies EPIDEM 400
RSRCH-DISSERTATION EPIDEM 599
DRCTD INDIV STD&RSC 596
Comp and Qualifying EPIDEM 597
RSRCH-MASTER THESIS EPIDEM 598

2013 Instructor,
Methods in Environmental Epidemiology,
Hebrew University, Faculty of Medicine, School of Public Heath

2010 Instructor,
Special topics, Epidemiology 291

2007 Guest Lecturer Epidemiology 200 and Epidemiology 292

2005-2010 PhD Advisor, Hebrew University, Jerusalem, Israel

2005 Instructor, Environmental and Occupational Cancer Epidemiology EPIDEM 262

2004 Instructor, Environmental Epidemiology, UCLA EPIDEM 260

2003-present Honorary Chair, UNESCO Institute for Life Sciences, Armenia,
Developing of curriculum for the Department of Epidemiology

2001 Instructor, Stanford University School of Medicine
Developed and taught graduate course: Environmental and Occupational Epidemiology 229

1994 -2001 Lecturer, Stanford University School of Medicine

Lectured in graduate courses and seminars. Subjects include occupational and environmental epidemiology, meta-analysis, and occupational and environmental health, risk assessment

1993 Lecturer, NATO Workshop, Rome, Italy
"Epidemiology and what it can tell us",

1992 Instructor, DOE Contractors Review, St. Petersburg, Florida
"Basic Epidemiology"

1989 Instructor, Electric Power Research Institute
"Epidemiologic methods"

1985 Instructor, California State University at Hayward:
Developed and taught upper division course: "Epidemiologic methods" within the Department of Biology.

1984 Teaching Assistant, University of California, Berkeley,
School of Public Health, Department of Epidemiology, "Epidemiologic Methods"

1977 Teaching Assistant, University of California, Berkeley,
School of Letters and Science, Department of Statistics, "Analysis of Variance", "Analysis of Categorical Data"

UNIVERSITY COMMITTEE SERVICE

2019 UCI Ad Hoc Promotion Committee

2018-present Admissions Committee

2017-2018 Committee on Academic Actions

2014-2016 FSPH Undergraduate Committee

2015- 2016 Doctoral Committee Epidemiology, UCLA

2013-2014 Doctoral Committee Epidemiology, UCLA

2013-2015 Search Committee Epidemiology, UCLA

2011-2013 Student Affairs Committee

2010-2013 Senate Seven Year Review

2011-present Curriculum Committee

2008 – 2010 Academic Computing Committee for the School of Public Health

2007-2008 Injury Search Committee, UCLA

2006-2009 Doctoral Committee Epidemiology, UCLA

2005-2006 Acting Chair, Doctoral Committee Epidemiology, UCLA

2004 Chair, Core Course Committee, Epidemiology, UCLA

STUDENT SUPERVISION AND MENTORING:

Graduate Students:
Primary advisor:
S. Kandel, Ph.D. in Policy, Dissertation Co-Chair, Hebrew University (graduated 2010)
Liang-Ni Wu, M.A. in Epidemiology, Program Advisor, Stanford University

UCLA:
S. Chaudhary, MPH
D. Arima, MPH
H.A. Divan, PhD
S. Seung-Hoon,
L. Lukowsky, PhD
X. Vergara PhD
A. Sverdlik, PhD
L. McLemore MS
E. Lin, MS
J. Kanton, MPH
J. Monroe, MS
S. Oksyzyan PhD
S. Oh PhD
D. Sanchez MPH
M. Sudan PhD
H. Fisher PhD
A. Turandot Amoon PhD
A. Park PhD
Yingzhe Yuan MPH
Mikala Evans MPH
Fan Zhao MPH
Shichen Zheng MPH
Andrew Nguen PhD

Secondary advisor:
Z. Zhang, Ph.D. Biostatistics, UCLA (collaborative research with A. Afifi)
U. Forseen, Opponent for a PhD epidemiology dissertation, Karolinska Institute, Institute of Environmental Medicine

A. Lahkola, pre-examiner for a PhD in epidemiology dissertation, Faculty of Medicine of the University of Tampere

Dissertation committee Chair UCLA:
H.A. Divan, PhD
L. Lukowsky, PhD
X. Vergara PhD
S. Oksyzyan PhD
S. Oh PhD
M. Sudan PhD
A. Turandot Amoon PhD

Dissertation/Thesis committee:
J. Wang
A. Krishnadasan
Y. Zhao
Y. Li
A. Lipsky, M.D.
M. Krudysz
R. Shimkada
J K. Virk
E. Liu
Chunyuan Fei
A. Wang
Tianyi Huang, MS
S. Narayan
C. Thompson
A. Park
K. Paul
Chenxiao Ling
Kirsty A Clark
Sijia Wang, MS

Postdoctoral Supervision:

M. Halgamuge, Ph.D., UCLA
Y. Cho, Ph.D., UCLA
M Gadallah, Ph.D., UCLA
G. Mezei, MD, Ph.D., EPRI
Z. Carr, MD, Ph.D., WHO
M. Rooslii, Ph.D., University Bern, Switzerland
M. Sudan Ph.D., UCLA
M. Bhatnagar MD, MA., UCLA

Fogarty Fellows:
J. Flores Lujano

ADDITIONAL ACTIVITIES 2001+ (Partial List):

Invited Lectures / Presentations:

November 2015	Invited keynote speaker: COSA's 42nd Annual Scientific Meeting Hobart TASMANIA
November 2015	Invited Presentation : Cancer Clusters in Environmental Epidemiology & Resources for Physicians COSA's 42nd Annual Scientific Meeting Hobart TASMANIA
November 2015	Invited Presentation: Meta and Pooled Analysis as tools when numbers are small COSA's 42nd Annual Scientific Meeting Hobart TASMANIA
November 2011	Invited presentation International Scientific Conference: Electromagnetic Fields and Public Health, EU, Brussels, Belgium
June 2011	Workshop on Electromagnetic Field and Dwelling Environment Security, Beijing, China.
April 2011	Google, Mountain View, USA
November 2010	EEI International EMF/RF Seminar for the Electric Power Industry, Washington DC
September 2010	CPUC, San Francisco, USA
May 2010	International Advisory Committee (IAC) meeting Bordeaux – France
May 2010	Institute for Risk Assessment Sciences, Utrecht, Netherlands
July 2010	FAA, Hughes Technical Center,
December 2009	Ministry Of Health, Ministry Of Environmental And Climate Affairs Muscat, Oman
October 2009	CADHS Environmental and Occupational Disease Control webinar
September 2009	Environment and Health Fund, Wireless Communication: Health, Science and Policy, Tel Aviv, Israel

May 2009	Karolinska, Stockholm, Sweden
May 2009	Regio Emilia and Modena, Italy (2 presentations)
May 2008	Berlin, Germany, ICNIRP/WHO/BfS Workshop on Risk Factors to Childhood Leukemia
May 2008	Erevan, Armenia. American University
May 2008	Sao Paolo, Brazil, Fundamentals of Non-Ionizing Radiation Protection
March 2008	ERICE (Sicily) – Italy March 2008 International School of Bioelectromagnetics, ETTORE MAJORANA -2 lectures
September 2007	Paris, France, EMF Science Review And Research Priorities EMF Science Review And Research Priorities
August 2007	Washington, USA, Potential Differences in risk to children
June 2007	Geneva, Switzerland, 12th International Advisory Committee (IAC)
June 2007	Geneva, Switzerland, WHO workshop on *Developing and implementing protective measures for ELF EMF*
May 2007	Washington, USA, EMF State of Science EEI Conference
September 2006	Edinburgh, Future needs of occupational ELF epidemiology
August 2006	Sao Paulo, Brazil, ABRICEM II workshop
May 2005	Sao Paulo, Brazil, ABRICEM workshop
March 2005	Erevan, Armenia, NATO workshop
December 2004	Paris, France, Interactions of RF with the human being State of knowledge
November 2004	Washington, USA, EMF State of Science EEI Conference
June 2004	Hertzelyia, Israel, Science, Uncertainty and Policy
June 2004	Istanbul, Turkey, WHO Workshop on Childhood Sensitivity to EMFs
March 2004	London, Mobile Telephones and Health
November 2003	San Paolo, Brazil, ABRICEM, Seminario Sobre Exposicao Humana a Campos Electros E Magneticos
November 2003	Brazilia, Brazil, Plenary and Advisory to Brazilian Government

October 2003	Sophia, Bulgaria "Non-Ionizing Radiation in Physiotherapy – Risks for the Medical Personnel".
October 2003	Helsinki , Finland, Mobile Telephony and Health – Final Seminar of the Finnish National Research Programme 1998-2003
September 2003	Tokyo, Japan: Symposium on Risks and Governance, Japan Ministry of Environment
September 2003	Risk Characterization for Leukemia in Children National Institute for Environmental Studies (NIES), Tsukuba, Japan
June 2003	Maui, Hawaii, 25th Annual Meeting of the Bioelectromagnetics Society Meeting, Plenary lecturer
June 2003	Geneva, Switzerland, WHO, 8th International Advisory Committee Meeting on EMF
June 2003	Geneva, Switzerland, WHO - EMF Research Review Meeting
May 2003	Stockholm, Sweden Swedish Radiation Protection Authority (SSI) Independent Scientific Group on EMF
May 2003	Stockholm, Sweden – Karolinska Institute, Institute of Environmental Medicine
March 2003	Monterey, California - BAC– EPRI Environment Sector Advisory Meeting
February 2003	Luxembourg - Precautionary Principle Workshop
January 2003	Royal Society London, UK - The EMF Biological Research Trust Workshop
December 2002	Geneva, Switzerland, WHO - Neurodegenerative Workshop
November 2002	London, UK - Mobile Telecommunications and Health Research Programme Meeting (11-12 Nov); COST 281 meeting (12-13 Nov)
November 2002	The Netherlands - Static Field Workshop The Health Council of the Netherlands
October 2002	Rhodes, Greece - 2nd International Workshop on Biological Effects of Electromagnetic Fields
October 2002	Athens, Greece - 2nd European Radon Forum
September 2002	Moscow, St Petersburg, Russia - 3rd International Conference: EMF and Human Health, Fundamental and Applied Research

August 2002	Geneva, Switzerland - ILO, International Conference on Occupational Radiation Protection: Protecting Workers against Ionizing Radiation
June 2002	Quebec, Canada - 24th Annual Meeting of the Bioelectromagnetics Society Meeting, Plenary lecturer
June 2002	Stockholm, Sweden - Royal Swedish International Union of Radio Science (Keynote Speaker)
May 2002	Jerusalem, Israel - Cancer Society
May 2002	Haifa, Israel - The Israeli Nuclear Societies scientific meeting
May 2002	Ashdod, Israel - SOREQ
May 2002	Ljubljana, Slovenia - International Seminar on Electromagnetic Fields, new technologies and health (organized by National Institute of Public Health, Slovenia).
March 2002	Ispra, Italy - Joint Research Center-European Commission "Human exposure to radiation from GSM and GPRS/UMTS base stations across Europe"
February 2002	Washington - USA, Winter Workshop
February 2002	Neuchâtel, Switzerland - Forum Europe-ENVIROCOM 2002 Electrosmog and Communication
January 2002	Brussels, Belgium - Environment and Society" Working Group, Eurelectric offices
December 2001	Cape Town, South Africa - WHO / ICNIRP Conference on EMF Biological Effects &WHO Standards Harmonization for the African Region and WHO RF Research Coordination meeting
December 2001	Paris, France - Francetelecom
November 2001	London, UK - Mobile Telecommunications and Health Research Programme
October 2001	Seoul, South Korea WHO Meeting on EMF Biological Effects and Standards Harmonization in Asia and Oceania
September 2001	Rome, Italy - The National Electrical Engineering Association Meeting on Social and Financial impact of EM safety standards
September 2001	Garmish, Germany - ISEE 2001 Symposium: Epidemiological evidence on EMF and Cancer

April 2001	Berkeley, California – Childhood Leukemia Study
March 2001	Yoyogi, Tokyo, Japan - Workshop on EMF & Health
February 2001	Lima, Peru – WHO, Regional Meeting

Chairman / Organizing Committee (Partial List):

November 2014	NATO Advanced Research Workshop Preparedness for Nuclear and Radiological Threats
May 2008	Sao Paolo, Brazil I Latin American Symposium on High Frequency Electromagnetic Fields and Health
August 2007	Workshop on Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices, Washington - USA,
June 2007	Chair, WHO workshop on Developing and implementing protective measures for ELF EMF , Geneva, Switzerland
September 2007	International conference on electromagnetic fields, health and environment Wroclaw Poland , EHE'07
October 2006	4th International Workshop on Biological Effects of Electromagnetic Fields, Crete Greece
September 2006	**Chair,** Workshop on future needs of occupational ELF epidemiology. Edinburgh Scotland
April 2006	International Conference on Electromagnetic Fields, Health and Environment, Madeira, Portugal,
April 2005	**Chair**, Scientific Advisory Committee for the International Study of Cohort of Mobile Phone Users
October 2005	Delhi, India, URSI Session K, Convener Epidemiology
February 2005	NIEHS/WHO Policy Workshop
December 2004	**Chair** of Epidemiology Committee, WHO Task Group on Static Fields
June 2004	WHO Workshop on Childhood Sensitivity to EMFs
September 2003	ELF Risk Characterization for Leukemia in Children National Institute for Environmental Studies (NIES), Japan

July 2003	**Chair**, WHO - Working Group on feasibility of base stations epidemiology
June 2003	WHO - EMF Research Review Meeting
June 2003	WHO - 8th International Advisory Committee Meeting on EMF
May 2003	Stockholm, Sweden - Cardiovascular Meeting
February 2003	Luxembourg - Precautionary Principle Workshop
December 2002	WHO Geneva - Neurodegenerative Workshop
October 2002	Rhodes, Greece - 2nd International Workshop on Biological Effects of Electromagnetic Fields
September 2002	Moscow and St Petersburg, Russia - 3rd International Conference: EMF and Human Health, Fundamental and Applied Research
June 2002	WHO HQ – Geneva, International Advisory Committee Meeting
April 2002	ILO, Geneva - Programme Committee Meeting for International Conference on Occupational Radiation Protection: Protecting Workers against Ionizing Radiation
March 2002	WHO HQ – Geneva M-105 - Temperature Workshop
2002 – 2004	**Chair**, BEMS Election Committee
December 2001	Cape Town South Africa WHO / ICNIRP Conference on EMF Biological Effects & WHO Standards Harmonization for the African Region and WHO RF Research Coordination meeting
October 2001	Seoul, South Korea WHO Meeting on EMF Biological Effects and Standards Harmonization in Asia and Oceania
October 2001	Brussels, Belgium, **Chair** EU Commission meeting on mobile phones.
October 2001	WHO, Geneva, IAEA – WHO Expert Advisory Group Meeting on "Follow up of delayed health consequences of acute accidental radiation exposure – lessons to be learned from their medical management", **Chair**
July 2001	Whistler, Canada, Selection Bias Workshop

Committees/ invited workshops:

2008-present	McLaughlin Centre for Population Health Risk Assessment, University of Ottawa. Science Panel for risk communication program on RF

2008-2010	Latin American Experts Committee on High Frequency Electromagnetic Fields and Human Health
2008-present	Scientific Advisory Committee for Occupational Health, EPRI
September 2006	Edinburgh, Future needs of occupational ELF epidemiology
November 2004	Stockholm, Sweden - Swedish Radiation Protection Authority (SSI) Independent Scientific Group on EMF
November 2004	Paris, France – Estimating exposure for populations around Environmental RF sources
June 2004	Stockholm, Sweden - Swedish Radiation Protection Authority (SSI) Independent Scientific Group on EMF
March 2004	Geneva, Switzerland, WHO, Development of Protective measures
May 2003	Florence, Italy - ICNIRP Standing Committee on Epidemiology
May 2003	Stockholm, Sweden - Swedish Radiation Protection Authority (SSI) Independent Scientific Group on EMF
March 2003	Monterey, California – BAC - EPRI Environment Sector Advisory Meeting
January 2003	London, UK - Royal Society, The EMF Biological Research Trust Workshop
January 2003	Vienna, Austria - UN Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) 51st Session
December 2002	Stockholm, Sweden - Swedish Radiation Protection Authority (SSI) Independent Scientific Group on EMF
November 2002	San Francisco, USA - ICNIRP Standing Committee on Epidemiology
November 2002	San Francisco, USA - California Department of Health Services, SAC
October 2002	Luxembourg - WHO / EC meeting on EMF activities
July 2002	Luxembourg - WHO / European Commission meeting
May 2002	Palo Alto, California - Reproductive Workshop
May 2002	Oakland, California - SAC, Meeting with Californian Department of Health Sciences,

April 2002	ILO, Geneva - Programme Committee Meeting for International Conference on Occupational Radiation Protection: Protecting Workers against Ionizing Radiation
March 2002	Vienna, Austria - IAEA, 12th Meeting of the Radiation Safety Standards Committee (RASSC)
March 2002	Paris, France - ICNIRP Epidemiology Standing Committee I
January 2002	Oakland, California, USA – SAC California Department of Health Sciences
February 2002	Collaborative Management Committee meeting for the International Cooperation to Establish Post Chernobyl Thyroid Tumor, Nucleic Acid and Data Banks (NISCTB)
February 2002	Washington, USA - Bioelectromagnetics Society Meeting
November 2001	Vienna, Austria- IAEA, Technical Committee Meeting to develop aspects of the technical basis for emergency response to radiation emergencies.
November 2001	Luxembourg - EMF Conference, European Commission
October 2001	Brussels, Belgium - EU Commission meeting on mobile phones
October 2001	Geneva, Switzerland, WHO, – IAEA, WHO Expert Advisory Group Meeting on "Follow up of delayed health consequences of acute accidental radiation exposure – lessons to be learned from their medical management
June 2001	International Agency for Research on Cancer (IARC) Monograph on the Evaluation of Carcinogenic Risk to Humans, working group member Vol. 80
May 2001	Cincinnati, USA, FDA Expert Working Group
May 2001	Geneva, Switzerland, WHO HQ – Geneva - International Advisory Committee Meeting on EMF

HONORS AND AWARDS:

2013 Hebrew University, Fellowship Jacob and Lena Joels Memorial Foundation
2010 Best Paper Journal of Risk Analysis
2004 Delta Omega
2001 EPRI Performance Recognition Award
1999 EPRI Performance Recognition Award
1998 EPRI Performance Recognition Award
1997 Teamwork
1997 Regional Marketing Award
1996 Chauncey Starr Award

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1996 Marketing Recognition Award
1995 EPRI Performance Recognition Award
1990 Innovation and Achievement in Environmental Research
1985 Merit Scholarship, UC Berkeley