

FCC 09-31 Notice of Inquiry GN Docket No. 09-51 - Broadband Plan for Our Future

**EXHIBIT TABLE to accompany the Comment of The EMR Policy Institute June 7, 2009**

No.	Name		City State	Info	TYPE
1	Litovitz, Theodore	PhD, Physics	Catholic University	Presentation used at Congressional Staff Briefing	
2				<i>Pathophysiology</i> , March 2009	Journal articles
3	Hillman, Donald	PhD Animal Science	East Lansing MI	Analysis of RF in home	Affidavit
4	Tully, Lisa	PhD Toxicology and Pharmacology	Boulder CO	Developing EHS test	Affidavit
5	Schou, John	PhD Agronomy Researcher	Cedar Falls IA	EHS symptoms wife had to move to WV	Affidavit
6	Schou, Diane	PhD Industrial Technology	Green Bank WV	Industrial Technology Severe EHS had to move to WV husband in IA	Affidavit
7	Bruno, William	PhD, Physics Researched at Los Alamos	Santa FE NM	Severe symptoms Comment in NAS record	Affidavit
8	Dauble, Janet	Non-profit organization	Frazier CA	MCS EHS support group founder increase in 10 yrs	Affidavit
9	Carney, Deborah	JD. BA-Human Biology	Golden CO	EMRPI VP CARE counsel Research subject	Affidavit
10	Fox, Nicols	Journalist	Renick WV	Documents severe EHS moved from ME to WV	Affidavit
11	Kleiber, Daniel	Farmer beekeeper	Waterloo WI	Type 1 diabetic documented insulin effects	Affidavit
12	Kleiber, Catherine	BA in biological science	Waterloo WI	Severe microwave sickness Dirty power and RF reactions Young children react as well	Affidavit
13	Savarin, Evelyn		Hampton NH	EHS from education exposure Documents with own meters	Affidavit

13B	Gherzi, Alex	Savarin's landlord	Hampton NH	Landlord to Savarin child can now sleep with WiFi off	Affidavit
14	Hurston, Ronald	M.D.	Wayland, MA	"It invites potentially tragic public health consequences."	Affidavit
15	Patton, Margaret	2-time cancer survivor	Wayland MA	Close to tower long legal battles to enforce zoning	Affidavit
16	Ide, Judith	Concerned citizen	Wayland, MA	Close to tower long legal battles to enforce bylaw	Affidavit
17	Lettieri, Linda	Liver cancer survivor	Fishkill NY	Had to leave job because cell tower was erected there	Affidavit
18	Pape, Beverly	Breast cancer	Dallas TX	Still in treatment for cancer EHS headaches cognition	Affidavit
19	Kayda, Valetta	2 brain tumors	Kelso WA	Tumor treatment caused EHS Moved 3 times already	Affidavit
20	Singer, Katie	EHS Reproductive health educator	Santa Fe, NM	Written 2 books on reproductive health has severe symptoms herself	Affidavit
21	DiGennaro JoTina	Substitute teacher Husband has prostate cancer	Bayville NY	Water tower antennas 50 ft from school deed covenant violated	Affidavit
22	Perrin, Madeleine	Mother of 2 young kids	Bayville NY	Can't get kids into another school tower 50ft away	Affidavit
23	Rollans, Marian & James	Farmers 39 years	Mt. Ulla NC	Fighting broadcast towers 3 cell towers close by EHS symptoms	Affidavit
24	Webster, Betsy	Concerned parent	Mt. Ulla NC	Fighting broadcast proposal 15 towers already nearby	
25	Davis, Ruth	EHS sufferer	Ouray CO	Notarized version to follow	Affidavit

26	Hinson, Katherine	Mother 15yr 13yr boys EHS	Plymouth VT	Left GA for boys' health	Affidavit
27	Russo, Kristin	Mother of 3 kids	Burlington MA	Water tower antenna at school Moved recently to avoid	Affidavit
28	Clark, Gayle	mother 14 yr old son	Sedgwick KS	WiFi at school and work Tower proposed near home	Affidavit
29	Hackett, Lucy	EHS Injury began in college	South Bend, IN	Difficulty finishing degree Antennas close to home and family now	Affidavit
30	Danner, Ruth		Juneau AK	2 WiMax towers proposed 4 co-locators proposed at church with daycare	Affidavit
31	Bubnis, Michelle	EHS neighbor's WiFi	Austin TX	many antennas One at church can no longer attend	Affidavit
32	Zack, Corina	Concerned citizen	Arlington Heights, IL	Antenna in church across the street from home	Affidavit
33	Reilly, Sarah	MCS EHS	Fairfax, CA	Has to move often 2003 WiFi brought it on	Affidavit
34	Frumberg, Maria	EHS Dr. Rea :letter	Plano, TX	Had to drop wireless TV access Letter from city shows no concern about WiFi	Affidavit
35	Ordogne, Kimberly	EHS	Plano, TX	Had to leave home Citywide WiFi No sympathy from city	Affidavit
36	Feudale, Elizabeth	MCS EHS Allergies immune problems	Allentown, PA	Cell towers nearby cannot tolerate home electronics	Affidavit
37	Olson, Veronica	Concerned parent	Plano, Texas	Concerned about citywide WiFi exposure to children	Affidavit
38	Hillman, Howard	Concerned citizen	Plano, Texas	Concerned about citywide WiFi exposure to children and immune-compromised people	Affidavit
39	Flynn, Angela	EHS came at job training near	Bethseda, MD	Moved to ease exposure EHS symptoms are Sleep muscle aches cognition	Affidavit

		antennas			
40	Lizik, Kyrie	EHS	Washington County WI	Smart meter aggravates Cannot use library – WiFi	Affidavit
41	Barris, Elizabeth	EHS documentary film maker	Santa Monica CA	Airport exposure an issue Must travel for work	Affidavit
42	Avola, JeanMarie	Concerned parent	Stoneham MA	Cell towers and WiFi in and near children’s schools	Affidavit
43	Kelley, Elizabeth	Bioelectromagnetics Society member	Tucson ARIZ	Cell towers and WiFi in neighborhood Son’s school has WiFi	Affidavit
44	Boca Raton, Florida	States of Colorado and Connecticut, Los Angeles County	Portland, Oregon Los Angeles public school district	<b>US states and municipalities are calling for revision of Section 704</b>	Proclamations and Resolutions
45	National Academies of Science	January 2008 Report		<i>Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication Devices (NAS Report)</i>	Research base inadequate for today’s exposures
46	FDA nominates RF	To National Toxicology Program		Radiofrequency Radiation Emissions of Wireless Communication Devices	Research does not address typical RF exposures
47		NTP 2005 Fact Sheet on RF research	US federal government	Underscores inadequacy of research upon which US RF safety limits are based	
48	Carpenter, MD, Sage, Cindy	<b><i>The BioInitiative Report</i></b>	<a href="http://www.bioinitiative.org">www.bioinitiative.org</a>	<i>A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF)</i>	On-line meta-analysis of EMR research
49 & 50	Carpenter and Sage	<b><i>Reviews in Environmental Health</i></b>	Peer-reviewed Scientific journal	<i>“Setting Prudent Health Policy for Electromagnetic Exposures”</i>	Journal article
51	Horst Eger, Klaus Uwe Hagen, Birgitt Lucas, Peter Vogel, and Helmut Voit	<i>Umwelt-Medizin-Gesellschaft</i> 17,4 2004,	Research requested by German federal government	“The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer”	Peer-reviewed Journal article
52	Carpenter	Amicus brief and	Review research	warn of the potential health consequences for	

	Olden Grigoriev Havas	statements on RF radiation and school children	and existing EMR safety limits	many students and staff if wireless technologies are deployed in their workplaces.	
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**Dr. Theodore Litovitz**

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# Biological Effects of Electromagnetic Fields

Since 1984 the BioElectromagnetics Group has been funded by:

**US Army Medical Command  
National Institute of Environmental Health Sciences  
EMX Corporation  
McGowan Charitable Foundation  
John T. LaMacchia Charitable Trust**

**FCC 09-31 Exhibit 1**

**ELECTROMAGNETIC FIELDS**



**BIOLOGICAL EFFECTS**



**HEALTH EFFECTS**

HAVE ANY BIOLOGICAL EFFECTS  
BEEN OBSERVED AFTER EXPOSURE  
TO  
NON-THERMAL ELECTROMAGNETIC  
FIELDS?

Many scientific publications have reported non-thermal biological effects at exposure levels below that considered “safe” by most government agencies.

# Biological Effects Induced by RFR

## Below Present Day Permissible Level

Standard for Cell Phone RFR (1.6 W/kg)

How Much Below The Standard ?

- 
- |                               |               |         |
|-------------------------------|---------------|---------|
| • Psychological Changes       | (.03 W/kg)    | 1/50    |
| • Affects Immune System       | (.015 W/kg)   | 1/100   |
| • Increases Calcium Efflux    | (.005 W/kg)   | 1/300   |
| • Induces DNA Damage          | (.0024W/kg)   | 1/600   |
| • Induces Stress Response     | (.001W/kg)    | 1/1600  |
| • Affects Blood Brain Barrier | (.0004W/kg)   | 1/4000  |
| • Affects Calcium in Heart    | (.00015W/kg)  | 1/10600 |
| • Enhances Cell Proliferation | (.000021W/kg) | 1/76000 |

Cellular telephone use **reduces melatonin** levels.

Annual Reviews of Bioelectromagnetic Research (1997)

**Cancer Morbidity is increased** by exposure to high frequency EM radiation.

Science of Total Environment (1996)

Mobile phones modulate response of **patterns of brain activity**.

Neuroreport (1998)

Exposure to 2450 MHz microwaves affects water maze **learning in the rat**.

Bioelectromagnetics (2000)

Long term exposure to 900 MHz EM fields can **enhance tumor incidence**.

Radiation Research (1997)

GSM phone radiation **affects auditory brainstem** response.

Neurobiology (1999)

Radiofrequency electromagnetic radiation **induces DNA strand breaks**.

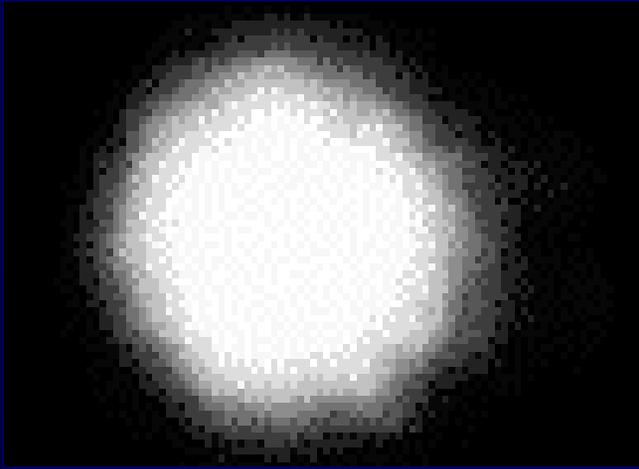
Bioelectromagnetics (1997)

# DNA Strand Breaks

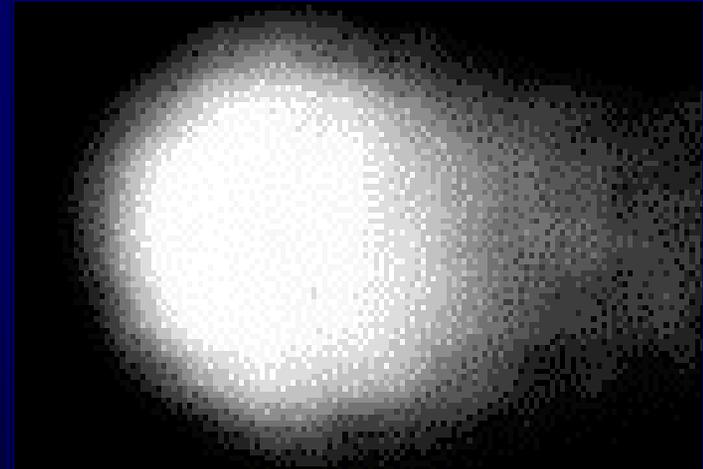
Exposure to 0.6 W/Kg Cell Phone Radiation

Lai et. al. University of Washington

## DNA Patterns



**Unexposed cells  
No Strand Breaks**



**EM exposed cells  
Strand Breaks Occur**

WHY IS THERE STILL SO MUCH  
CONTROVERSY OVER RFR  
SAFETY?

**REPLICATION  
PROBLEMS!!**

DOES THIS REPLICATION  
PROBLEM ONLY OCCUR  
IN  
BIOELECTROMAGNETIC  
EFFECTS?

**NO!**

Let's consider a problem involving  
drug toxicity.

# IS DRUG X HARMFUL ?

DOES IT INDUCE DEFORMED LIMBS IN NORWAY RAT EMBRYOS?

	Exp #1	Exp #2
Treated	60%	0 %
Controls	8%	0 %
Teratogen ??	YES	NO

STRAIN  
#1

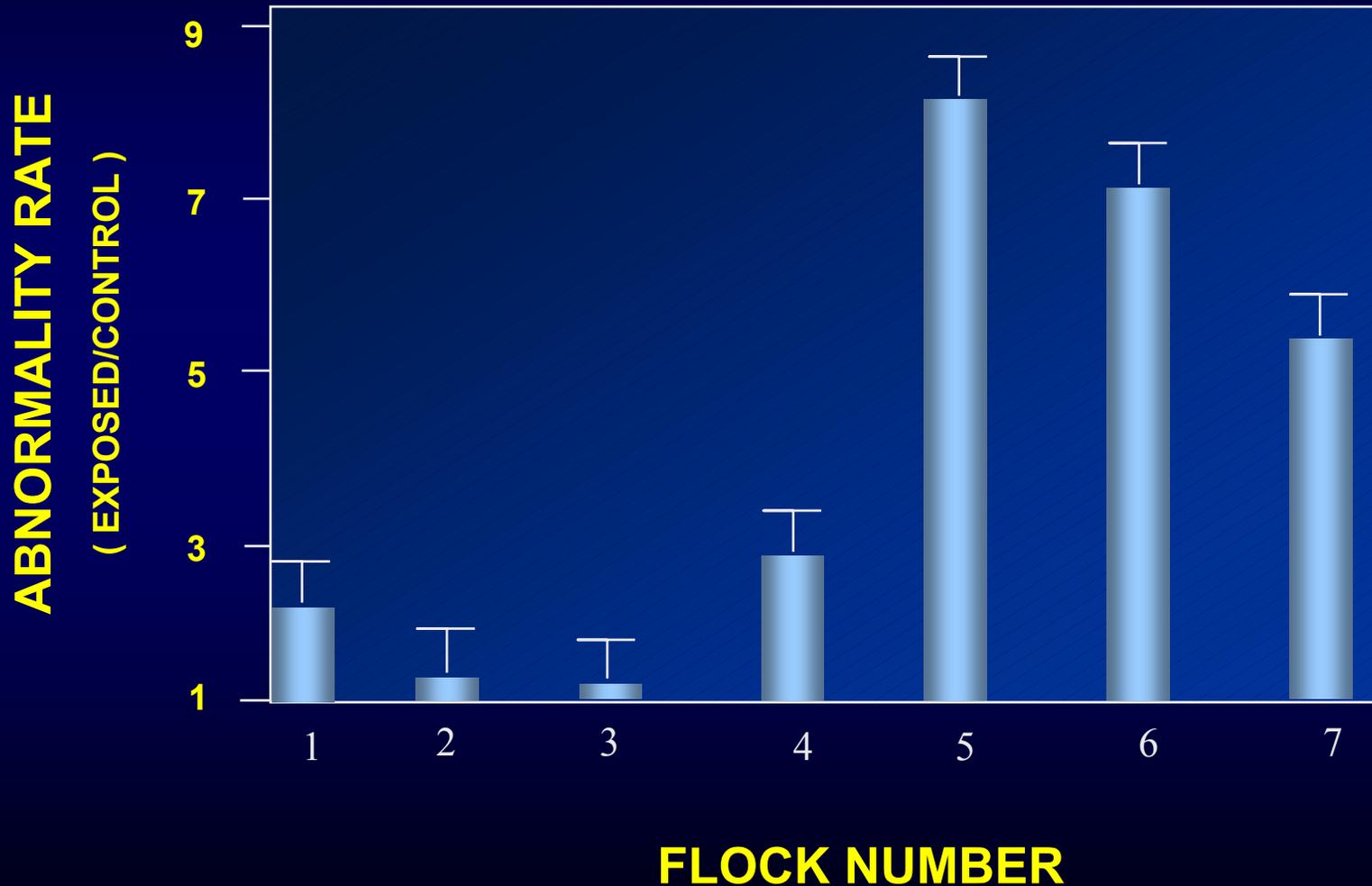
STRAIN  
#2

DRUG X = THALIDOMIDE

STRAIN #1 HAS A MUTANT GENE

# IS GENETICS A CONFOUNDER IN REPLICATION STUDIES?

## EMF INDUCED ABNORMALITIES IN CHICK EMBRYOS



# ***Electromagnetic Fields***

***Energy/Heat***

***Information***

***Biologic Cell***

**Weak, non-thermal electromagnetic fields  
can induce biological effects.**

**Present day safety standards  
do not take this into account!**

# **Weak Electromagnetic Fields Induce Biological Effects.**

**WHEN ARE THEY ADVERSE?**

**WHEN ARE THEY BENEFICIAL?**

**Everything is a poison.  
It is only a question of dose.**

Paracelsus 1493 - 1541

A single 30 minute exposure to an EM field can be beneficial

The same exposure occurring daily will be detrimental

# **SUMMARY**

**WEAK ELECTROMAGNETIC FIELDS CAN  
INDUCE NON-THERMAL BIOLOGICAL  
EFFECTS**

**THEY CAN BE ADVERSE**

**THEY CAN BE BENEFICIAL**

**THEY CAN BE INCONSEQUENTIAL**

**It is only a question of dose.**

**To protect public health we must determine  
the allowable dose for each of the above  
conditions.**



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## Preface

There is an old joke with a well-known punch line about a man who has just fallen from the 86th floor of the Empire State Building in New York. As he passes the 30th floor, he is heard saying to himself 'so far, so good'...

Most of us laugh because we know where the man is headed, and that he must know too. But, our laughter usually has a guilty edge. We know that many of us are guilty of occasionally displaying a 'so far, so good' attitude in our own lives. We think of the smoker who says that about the possibility of getting lung cancer or heart disease and who counts on beating the odds because he feels healthy at the moment. That smoker will not find out if he won the bet until many years later, and by then it is often too late. The 'so far, so good' attitude to health is so common that people even kid themselves about it. One smoker told me that smoking would only cut a few years off his life, and that he did not mind losing the last few years because they are usually not much fun anyway.

Unlike the optimist in the joke, whose end is virtually certain, many of us live like the smoker, playing the odds and reassuring ourselves 'so far, so good'. Diseases like cancer usually take many years to develop, and we try not to think how some of the things we do casually can affect the long-term odds by compromising the natural processes that protect us. We rely on our bodies to be strong and resilient all the time. Yet, we know there are limits to the body's natural ability to reverse damage to cells. We also know that there may be gaps in the ability of our genetic endowment to cope with damage. At some level, we all know it is just common sense to try to minimize damage to our bodies and maximize the ability to repair.

These opening paragraphs provide a quick introduction to the theme of this issue of Pathophysiology and a summary of the point of view of its authors. The public is currently interested in possible hazards from radio frequency (RF) due to cellphones, towers, WiFi, etc. The concern is certainly warranted, but we are surrounded by electromagnetic fields (EMFs) of many frequencies, and there are also significant biological effects and known risks from low frequency

EMF. The scientific problem is to determine the nature of EMF interaction with biological systems and develop ways of coping with harmful effects in all frequency ranges, as well as their cumulative effects. The practical problem is to minimize the harmful biological effects of all EMF.

The technical papers in this issue are devoted to an examination and an evaluation of evidence gathered by scientists regarding the effects of EMF, especially RF radiation, on living cells and on the health of human populations. The laboratory studies point to significant interactions of both power frequency and RF with cellular components, especially DNA. The epidemiological studies point to increased risk of developing certain cancers associated with long-term exposure to RF. Overall, the scientific evidence shows that the risk to health is significant, and that to deny it is like being in free-fall and thinking 'so far, so good'. We must recognize that there is a potential health problem, and that we must begin to deal with it responsibly as individuals and as a society.

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## EMF effects on DNA

M. Blank and R. Goodman (USA): Electromagnetic Fields Stress Living Cells

Exhibit 2

*Abbreviations:* EMF, electromagnetic fields; Hz, hertz (cycles/s the unit of frequency); ELF, extremely low frequency ( $3\text{--}3 \times 10^3$  Hz) power frequency is 50–60 Hz; RF, radio frequency (band width  $3 \times 10^3$  to  $3 \times 10^{11}$  Hz); UHF, ultrahigh frequency band the RF sub-division used for cell phones ( $3 \times 10^8$  to  $3 \times 10^9$  Hz).

J.L. Phillips, N.P. Singh and H. Lai (USA): Electromagnetic Fields and DNA damage

H.W. Rüdiger (Austria): Genotoxic effects of electromagnetic exposure in vitro

### EMF effects on the brain

H. Nittby, A. Brun, J. Eberhardt, L. Malmgren, B.R.R. Persson and L.G. Salford (Sweden): Increased blood–brain barrier permeability in mammalian brain seven days after exposure to the radiation from a GSM-900 mobile phone

L. Hardell, M. Carlberg and K Hansson Mild (Sweden): Epidemiological evidence for an association between use of wireless phones and tumor diseases

M. Kundi and H-P. Hutter (Austria): Mobile phone base stations – effects on wellbeing and health

L.L. Morgan: Estimating the risk of brain tumors from cellphone use: published case–control studies

### EMF in the environment

Z. Davanipour and E. Sobel: Long-term exposure to electromagnetic fields and the Risks of Alzheimer’s disease and breast cancer: Further biological research

O. Johansson: Disturbance of the immune system by electromagnetic fields: A potentially underlying cause for cellular damage and tissue repair reduction which could lead to disease and impairment disturbance

A.F. Pourlis: Reproductive and developmental effects of EMF in vertebrate animal models

A. Balmori: Electromagnetic pollution from phone masts: Effects on wildlife

P. Huttunen, O. Hänninen and R.Myllylä: FM-radio and TV tower signals can cause spontaneous hand movements near moving RF reflector

C. Blackman: Cell Phone Radiation: Evidence from ELF and RF studies supporting more inclusive risk identification and assessment

### Science as a guide to public policy

D. Gee: Late Lessons from early warnings: Towards realism and precaution with EMF?

C. Sage and D.O. Carpenter: Public Health Implications of Wireless Technologies

### Special Issue on EMF

Bioelectromagnetics, the study of biological effects of electromagnetic fields (EMF), is an interdisciplinary science with a technical literature that is not easily accessible to the non-specialist. To increase access of the public to the technical literature and to the health implications of the scientific findings, the Bioinitiative Report was organized by an international group of scientists and published online at [www.bioinitiative.org](http://www.bioinitiative.org) on August 31, 2007. The report has been widely read, and was cited in September 2008 by the European Parliament when it voted overwhelmingly that the current EMF safety standards were obsolete and needed to be reviewed.

This special issue of Pathophysiology includes scientific papers on the EMF issue by contributors to the Bioinitiative Report, as well as others, and is prepared for scientists who are not specialists in bioelectromagnetics. Each paper is independent and self-contained. To help the reader appreciate how the different subjects contribute to an understanding of the EMF issue, the papers are arranged in groups that emphasize key areas, and the role of science in analyzing the problem and evaluating possible solutions. The subject headings are:

- DNA to show biological effects at the sub-cellular level that occur at very low EMF thresholds and across frequency ranges of the EM spectrum. Interactions with DNA may account for many of the effects of EMF, and they raise the possibility that genetic damage due to EMF can lead to cancer.
- The Brain is exposed to radiation from mobile phone antennas, and laboratory studies show that the radiation causes leakage of the protective blood–brain barrier, as well as the death of neurons in the brain. Radiation emitted from base stations can affect all who are in the vicinity. Epidemiological studies have shown a relation between exposure to mobile phones, base-stations and the development of brain tumors. Some epidemiological studies have significant flaws in design, and the risk of brain cancer may be greater than reported in the published results.
- In addition to the risk of brain cancer, EMF in the environment may contribute to diseases like Alzheimer’s dementia and breast cancer in humans, as well as reproductive and developmental effects in animals in the wild. EMF affect the biochemical pathways and immunological mechanisms that link the different organ systems in our bodies and those of animals. The human body can act as an antenna for RF signals, and a small percentage of the population appears to be so sensitive to EMF that it interferes with their daily lives. In addition to the growing presence of EMF signals in the environment, the complexity of the signals may be important in altering biological responses. These are among the many factors that must be considered in approaching EMF safety issues.
- Science as a guide to public policy

Four centuries ago, when Francis Bacon envisioned a course for modern science, he expressed the idea that *knowledge is power that should be applied for the benefit of mankind*. It is in keeping with that ethical standard that the last two papers in this issue show how knowledge gained from scientific research can help solve problems arising from EMF in our environment. The first of these papers discusses the Precautionary Principle, its growing acceptance as a rational approach to environmental issues, and how past experience can help us deal with the EMF issue. The second paper, by the editors of the original BioInitiative Report, is an update on how best to deal with the challenge of EMF in the environ-

ment and, specifically, the problems accompanying wireless technologies.

We trust that the reviews and original research papers will increase awareness of the growing impact of EMF in the environment, and the need for modern society to deal expeditiously with the potential health problems brought to light by EMF research.

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22 January 2009



## Electromagnetic fields stress living cells

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Received 30 January 2009; accepted 30 January 2009

### Abstract

Electromagnetic fields (EMF), in both ELF (extremely low frequency) and radio frequency (RF) ranges, activate the cellular stress response, a protective mechanism that induces the expression of stress response genes, e.g., HSP70, and increased levels of stress proteins, e.g., hsp70. The 20 different stress protein families are evolutionarily conserved and act as ‘chaperones’ in the cell when they ‘help’ repair and refold damaged proteins and transport them across cell membranes. Induction of the stress response involves activation of DNA, and despite the large difference in energy between ELF and RF, the same cellular pathways respond in both frequency ranges. Specific DNA sequences on the promoter of the HSP70 stress gene are responsive to EMF, and studies with model biochemical systems suggest that EMF could interact directly with electrons in DNA. While low energy EMF interacts with DNA to induce the stress response, increasing EMF energy in the RF range can lead to breaks in DNA strands. It is clear that in order to protect living cells, EMF safety limits must be changed from the current thermal standard, based on energy, to one based on biological responses that occur long before the threshold for thermal changes.

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**Keywords:** DNA; Biosynthesis; Electromagnetic fields; ELF; RF

### 1. Electromagnetic fields (EMF) alter protein synthesis

Until recently, genetic information stored in DNA was considered essentially invulnerable to change as it was passed on from parent to progeny. Mutations, such as those caused by cosmic radiation at the most energetic end of the EM spectrum, were thought to be relatively infrequent. The model of gene regulation was believed to be that the negatively charged DNA was tightly wrapped up in the nucleus with positively charged histones, and that most genes were ‘turned off’ most of the time. Of course, different regions of the DNA code are being read more or less all the time to replenish essential

proteins that have broken down and those needed during cell division.

New insights into the structure and function of DNA have resulted from numerous, well-done laboratory studies. The demonstration that EMF induces gene expression and the synthesis of specific proteins [1,2] generated considerable controversy from power companies, government agencies, physicists, and most recently, cell phone companies. Physicists have insisted that the reported results were not possible because there was not enough energy in the power frequency range (ELF) to activate DNA. They were thinking solely of mechanical interaction with a large molecule and not of the large hydration energy tied up in protein and DNA structures that could be released by small changes in charge [3]. Of the biologists who accepted such results [4], most thought that the EMF interaction originated at, and was amplified by, the cell membrane and not with DNA.

It is now generally accepted that weak EMF in the power frequency range can activate DNA to synthesize proteins. An EMF reactive sequence in the DNA has been identified [5] and shown to be transferable to other gene promoters [6]. This DNA sequence acts as an EMF sensitive antenna

*Abbreviations:* EMF, electromagnetic fields; Hz, hertz; ELF, extremely low frequency; RF, radio frequency; MAPK, mitogen activated protein kinase; ERK1\2, extracellular signal regulated kinase; JNK, c-Jun-terminal kinase p38MAPK; SAPK, stress activated protein kinase; NADH, nicotinamide adenine dinucleotide dehydrogenase; ROS, reactive oxygen species.

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## Electromagnetic fields and DNA damage

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Received 24 October 2008; received in revised form 16 November 2008; accepted 16 November 2008

### Abstract

A major concern of the adverse effects of exposure to non-ionizing electromagnetic field (EMF) is cancer induction. Since the majority of cancers are initiated by damage to a cell's genome, studies have been carried out to investigate the effects of electromagnetic fields on DNA and chromosomal structure. Additionally, DNA damage can lead to changes in cellular functions and cell death. Single cell gel electrophoresis, also known as the 'comet assay', has been widely used in EMF research to determine DNA damage, reflected as single-strand breaks, double-strand breaks, and crosslinks. Studies have also been carried out to investigate chromosomal conformational changes and micronucleus formation in cells after exposure to EMF. This review describes the comet assay and its utility to qualitatively and quantitatively assess DNA damage, reviews studies that have investigated DNA strand breaks and other changes in DNA structure, and then discusses important lessons learned from our work in this area.

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**Keywords:** Electromagnetic field; DNA damage; Comet assay; Radiofrequency radiation; Cellular telephone

### 1. The comet assay for measurement of DNA strand breaks

DNA is continuously damaged by endogenous and exogenous factors and then repaired by DNA repair enzymes. Any imbalance in damage and repair and mistakes in repair result in accumulation of DNA damage. Eventually, this will lead to cell death, aging, or cancer. There are several types of DNA lesions. The common ones that can be detected easily are DNA strand breaks and DNA crosslinks. Strand breaks in DNA are produced by endogenous factors, such as free radicals generated by mitochondrial respiration and metabolism, and by exogenous agents, including UV, ionizing and non-ionizing radiation, and chemicals.

There are two types of DNA strand breaks: single- and double-strand breaks. DNA single-strand breaks include frank breaks and alkali labile sites, such as base modification, deamination, depurination, and alkylation. These are the most commonly assessed lesions of DNA. DNA double-strand breaks are very critical for cells and usually they are

lethal. DNA strand breaks have been correlated with cell death [1–5], aging [6–8] and cancer [9–13].

Several techniques have been developed to analyze single- and double-strand breaks. Most commonly used is microgel electrophoresis, also called the 'comet assay' or 'single cell gel electrophoresis'. This technique involves mixing cells with agarose, making microgels on a microscope slide, lysing cells in the microgels with salts and detergents, removing proteins from DNA by using proteinase K, unwinding/equilibrating and electrophoresing DNA (under highly alkaline condition for assessment of single-strand breaks or under neutral condition for assessment of DNA double-strand breaks), fixing the DNA, visualizing the DNA with a fluorescent dye, and then analyzing migration patterns of DNA from individual cells with an image analysis system.

The comet assay is a very sensitive method of detecting single- and double-strand breaks if specific criteria are met. Critical criteria include the following. Cells from tissue culture or laboratory animals should be handled with care to minimize DNA damage, for instance, by avoiding light and high temperature. When working with animals exposed to EMF *in vivo*, it is better to anesthetize the animals with CO<sub>2</sub> before harvesting tissues for assay. Antioxidants

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# Genotoxic effects of radiofrequency electromagnetic fields

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## Abstract

101 publications are exploited which have studied genotoxicity of radiofrequency electromagnetic fields (RF-EMF) *in vivo* and *in vitro*. Of these 49 report a genotoxic effect and 42 do not. In addition, 8 studies failed to detect an influence on the genetic material, but showed that RF-EMF enhanced the genotoxic action of other chemical or physical agents. The controversial results may in part be explained by the different cellular systems. Moreover, inconsistencies may depend from the variety of analytical methods being used, which differ considerably with respect to sensitivity and specificity. Taking altogether there is ample evidence that RF-EMF can alter the genetic material of exposed cells *in vivo* and *in vitro* and in more than one way. This genotoxic action may be mediated by microthermal effects in cellular structures, formation of free radicals, or an interaction with DNA-repair mechanisms.

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**Keywords:** Gene mutations; Cytogenetic effects; DNA fragmentation; Mechanisms of genotoxicity

## 1. Introduction

Alterations of genetic information in somatic cells are the key event in the process of carcinogenesis [1,2]. Consequently any agent, which has a genotoxic attribute is suspected also to be cancerogenic. This is the driving force behind the multitude of studies on genotoxicity of radiofrequency electromagnetic fields (RF-EMF), conducted so far. A total of 101 publications on genotoxicity studies of RF-EMF are exploited here, of which 49 report genotoxic effects, subsequently marked as GT(+) (Table 1), 43 do not (Table 2), and 9 find, that RF-EMF do not induce genotoxic events by itself but enhance the genotoxic action of other physical or chemical agents (Table 3). Thus, in contrast to several reviews in the past [3–6], it now became evident that non-thermal genotoxic effects of RF-EMF is convincingly demonstrated by a substantial number of published studies. The studies have been performed with a variety of different test systems – some studies used more than one test system – which will be assigned here to the three principle endpoints of a genotoxic action: (1) effect on chromosomes, (2) DNA fragmentation, and (3) gene mutations.

## 2. Effect on chromosomes

This group comprises the analysis of numerical or structural anomalies of metaphase chromosomes (CA), sister-chromatid-exchanges (SCEs), and formation of micronuclei (MN). Of the 21 studies using CA, 9 are CA-positive, 11 CA-negative, and 1 reports an RF-induced enhancement of genotoxicity by X-rays. In general proliferating cells are required for the study of chromosomal effects, however, micronuclei have also been analysed in polychromatic erythrocytes and in exfoliated cells, for instance from buccal smears [7,8]. Moreover, aneuploidy rates of distinct chromosomes as well as chromosomal translocations can also be studied in interphase nuclei using fluorescence in situ hybridization (FISH). While structural aberrations detected by conventional CA are mainly lethal to the cell, translocations are persistent and may be passed to the cellular progeny. Using FISH increased levels of aneuploidy of chromosome 1, 10, 11, and 17 have been reported in human blood lymphocytes after RF-EMF exposure [9]. In metaphase chromosomes FISH may increase the sensitivity of chromosomal analysis [10] but this has only once been used for RF-EMF studies [11].

CA brings about to detect a variety of chromosomal aberrations. In contrast, micronuclei originate only from acentric

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## Epidemiological evidence for an association between use of wireless phones and tumor diseases

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### Abstract

During recent years there has been increasing public concern on potential cancer risks from microwave emissions from wireless phones. We evaluated the scientific evidence for long-term mobile phone use and the association with certain tumors in case–control studies, mostly from the Hardell group in Sweden and the Interphone study group. Regarding brain tumors the meta-analysis yielded for glioma odds ratio (OR) = 1.0, 95% confidence interval (CI) = 0.9–1.1. OR increased to 1.3, 95% CI = 1.1–1.6 with 10 year latency period, with highest risk for ipsilateral exposure (same side as the tumor localisation), OR = 1.9, 95% CI = 1.4–2.4, lower for contralateral exposure (opposite side) OR = 1.2, 95% CI = 0.9–1.7. Regarding acoustic neuroma OR = 1.0, 95% CI = 0.8–1.1 was calculated increasing to OR = 1.3, 95% CI = 0.97–1.9 with 10 year latency period. For ipsilateral exposure OR = 1.6, 95% CI = 1.1–2.4, and for contralateral exposure OR = 1.2, 95% CI = 0.8–1.9 were found. Regarding meningioma no consistent pattern of an increased risk was found. Concerning age, highest risk was found in the age group <20 years at time of first use of wireless phones in the studies from the Hardell group. For salivary gland tumors, non-Hodgkin lymphoma and testicular cancer no consistent pattern of an association with use of wireless phones was found. One study on uveal melanoma yielded for probable/certain mobile phone use OR = 4.2, 95% CI = 1.2–14.5. One study on intratemporal facial nerve tumor was not possible to evaluate due to methodological shortcomings. In summary our review yielded a consistent pattern of an increased risk for glioma and acoustic neuroma after >10 year mobile phone use. We conclude that current standard for exposure to microwaves during mobile phone use is not safe for long-term exposure and needs to be revised.

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**Keywords:** Brain tumors; Glioma; Acoustic neuroma; Meningioma; Cellular phones; Cordless phones

### 1. Introduction

During the last decade there has been a rapid development of wireless technology and along with that an increased use of wireless telephone communication in the world. Most persons use mobile phones and cordless phones. Additionally most populations are exposed to radiofrequency/microwave (RF) radiation emissions from wireless devices such as cellular antennas and towers, broadcast transmission towers, voice and data transmission for cell phones, pagers and personal digital assistants and other sources of RF radiation.

Concerns of health risks have been raised, primarily an increased risk for brain tumors, since the brain is the near field

target organ for microwave exposure during mobile phone calls. Especially the ipsilateral brain (same side as the mobile phone has been used) is exposed, whereas the contralateral side (opposite side to the mobile phone) is much less exposed [1]. Thus, for risk analysis it is of vital importance to have information on the localisation of the tumor in the brain and which side of the head that has been predominantly used during phone calls.

Since Sweden was one of the first countries in the world to adopt this wireless technology a brief history is given in the following. First, analogue phones (NMT; Nordic Mobile Telephone System) were introduced on the market in the early 1980s using both 450 and 900 Megahertz (MHz) carrier waves. NMT 450 was used in Sweden since 1981 but closed down in December 31, 2007, whereas NMT 900 operated during 1986–2000.

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# Mobile phone base stations—Effects on wellbeing and health

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## Abstract

Studying effects of mobile phone base station signals on health have been discouraged by authoritative bodies like WHO International EMF Project and COST 281. WHO recommended studies around base stations in 2003 but again stated in 2006 that studies on cancer in relation to base station exposure are of low priority. As a result only few investigations of effects of base station exposure on health and wellbeing exist. Cross-sectional investigations of subjective health as a function of distance or measured field strength, despite differences in methods and robustness of study design, found indications for an effect of exposure that is likely independent of concerns and attributions. Experimental studies applying short-term exposure to base station signals gave various results, but there is weak evidence that UMTS and to a lesser degree GSM signals reduce wellbeing in persons that report to be sensitive to such exposures. Two ecological studies of cancer in the vicinity of base stations report both a strong increase of incidence within a radius of 350 and 400 m respectively. Due to the limitations inherent in this design no firm conclusions can be drawn, but the results underline the urgent need for a comprehensive investigation of this issue. Animal and in vitro studies are inconclusive to date. An increased incidence of DMBA induced mammary tumors in rats at a SAR of 1.4 W/kg in one experiment could not be replicated in a second trial. Indications of oxidative stress after low-level in vivo exposure of rats could not be supported by in vitro studies of human fibroblasts and glioblastoma cells.

From available evidence it is impossible to delineate a threshold below which no effect occurs, however, given the fact that studies reporting low exposure were invariably negative it is suggested that power densities around 0.5–1 mW/m<sup>2</sup> must be exceeded in order to observe an effect. The meager data base must be extended in the coming years. The difficulties of investigating long-term effects of base station exposure have been exaggerated, considering that base station and handset exposure have almost nothing in common both needs to be studied independently. It cannot be accepted that studying base stations is postponed until there is firm evidence for mobile phones.

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*Keywords:* Mobile phone base station; Performance; Cancer; In vitro studies; Microwaves

## 1. Introduction

Modern mobile telecommunication is based on a cellular system. Each cell is covered by a base station that keeps track of the mobile phones within its range, connects them to the telephone network and handles carry-over to the next base station if a customer is leaving the coverage area. Early mobile telecommunication systems had very large cells with tens of kilometers radius and were predominantly located along highways due to offering service mainly for car-phones. With the introduction of digital mobile phone systems cell sizes got much smaller and base stations were erected in densely

populated areas. The limited power of mobile phones made it necessary to reduce the distance to the customers. The cell size depends on (1) the radiation distance of the mobile phone; (2) the average number of connected calls; (3) the topographic characteristics of the covered area and the surrounding buildings, vegetation and other shielding objects; and (4) the type of antenna used. There are essentially three types of cells presently making up mobile telecommunication networks: (1) macro-cells in areas of average to low number of calls; (2) micro-cells in densely populated areas and areas with high telecommunication traffic density; (3) pico-cells within buildings, garages, etc. The types of antennas used, although hundreds of different models are operated, can be subdivided into: omni-directional antennas that radiate in all horizontal directions with the same power; sector antennas

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Review

Long-term exposure to magnetic fields and the risks of Alzheimer’s disease and breast cancer: Further biological research

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Received 1 November 2008; accepted 30 January 2009

Abstract

**Objective:** Extremely low frequency (ELF) and radio frequency (RF) magnetic fields (MFs) pervade our environment. Whether or not these magnetic fields are associated with increased risk of serious diseases, e.g., cancers and Alzheimer’s disease, is thus important when developing a rational public policy. The Bioinitiative Report was an effort by internationally recognized scientists who have spent significant time investigating the biological consequences of exposures to these magnetic fields to address this question. Our objective was to provide an unbiased review of the current knowledge and to provide our general and specific conclusions. **Results:** The evidence indicates that long-term significant occupational exposure to ELF MF may certainly increase the risk of both Alzheimer’s disease and breast cancer. There is now evidence that two relevant biological processes (increased production of amyloid beta and decreased production of melatonin) are influenced by high long-term ELF MF exposure that may lead to Alzheimer’s disease. There is further evidence that one of these biological processes (decreased melatonin production) may also lead to breast cancer. Finally, there is evidence that exposures to RF MF and ELF MF have similar biological consequences. **Conclusion:** It is important to mitigate ELF and RF MF exposures through equipment design changes and environmental placement of electrical equipment, e.g., AC/DC transformers. Further research related to these proposed and other biological processes is required.

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*Keywords:* Extremely low frequency (ELF); Magnetic fields (MFs); Amyloid beta (Aβ); Melatonin; Alzheimer’s disease (AD)

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# Reproductive and developmental effects of EMF in vertebrate animal models

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## Abstract

This paper reviews the literature data on the effects of electromagnetic fields (EMF), in the reproductive organs as well as in prenatal and postnatal development of vertebrate animals. Review articles which have been published till 2001, regarding the reproductive and developmental effects of the entire range of frequency of electromagnetic fields, were surveyed. Experimental studies which were published from 2001 onwards were summarized. Special focus on the effects of radiofrequencies related to mobile communication in the above mentioned topics has been made. According to the majority of the investigations, no strong effects resulted regarding the exposure to EMF of mobile telephony in the animal reproduction and development. However further research should be done in order to clarify many unknown aspects of the impact of EMF in the living organisms.

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**Keywords:** Electromagnetic fields (EMF); Mobile phones; Teratology; Endometrium; Testis

## 1. Introduction

During the 20th century, the exposure to electromagnetic fields (EMF) became an important source of concern about the possible effects in the living organisms. The artificial sources of electromagnetic radiation have risen tremendously because of the ongoing needs on electricity, telecommunications, and electronic devices. In this context, World Health Organisation (WHO) established in 1996 the International EMF project in order to assess health and environmental effects of exposure to EMF in the frequency range from 0 to 300 GHz. For the purpose of this paper this range will be divided into static (0 Hz), extremely low frequency (ELF > 0–300 kHz), intermediate frequencies (IF > 300–10 MHz) and radiofrequency (RF 10 MHz–300 GHz) fields [J. Juutilainen, Developmental effects of electromagnetic fields, *Bioelectromagnetics* 7 (2005) S107–S115]. The mobile phone technology is based on radiofrequency radiation with transmission of microwaves carrying frequencies between 880 and 1800 MHz [P.A. Valberg, T.E. van Deventer, M.H. Repacholi, Workgroup report:

base stations and wireless networks-radiofrequency (RF) exposures and health consequences, *Environ. Health Perspect.* 115 (2007) 416–424].

The mobile telephony revolution took place in the last decade. There is an increasing number of cell phone users all over the world. Also, new technologies which use the spectrum of high frequency emissions are incorporated in many aspects of telecommunications. As a consequence, there is a lot of interest about the possible effects of the radiation emitted from the machines which are engaged in the telephony such as hand phones, base stations and transmitters.

The biological effects of EMF have been and are being investigated on different levels of organization. On the level of human populations, epidemiological studies are used whereas, on the level of individuals human, animal and plant *in vivo* experiments are carried out. Furthermore, on the level of organs, tissues and cells *in vitro* investigations are employed. Finally, on the sub-cellular level, biochemical and molecular techniques are utilized.

From another point of view, many studies have been carried out or are in progress about the various effects of radiation emissions regarding the behaviour, cancer, central nervous system, sleep, children, cardiovascular system, immune function, reproduction and development [3].

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# Electromagnetic pollution from phone masts. Effects on wildlife

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## Abstract

A review on the impact of radiofrequency radiation from wireless telecommunications on wildlife is presented. Electromagnetic radiation is a form of environmental pollution which may hurt wildlife. Phone masts located in their living areas are irradiating continuously some species that could suffer long-term effects, like reduction of their natural defenses, deterioration of their health, problems in reproduction and reduction of their useful territory through habitat deterioration. Electromagnetic radiation can exert an aversive behavioral response in rats, bats and birds such as sparrows. Therefore microwave and radiofrequency pollution constitutes a potential cause for the decline of animal populations and deterioration of health of plants living near phone masts. To measure these effects urgent specific studies are necessary.

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*Keywords:* Effects on wildlife; Effects on birds; Electromagnetic radiation; Mammals; Microwaves; Mobile telecommunications; Non-thermal effects; Phone masts; Radiofrequencies

## 1. Introduction

Life has evolved under the influence of two omnipresent forces: gravity and electromagnetism. It should be expected that both play important roles in the functional activities of organisms [1]. Before the 1990's radiofrequencies were mainly from a few radio and television transmitters, located in remote areas and/or very high places. Since the introduction of wireless telecommunication in the 1990's the rollout of phone networks has caused a massive increase in electromagnetic pollution in cities and the countryside [2,3].

Multiple sources of mobile communication result in chronic exposure of a significant part of the wildlife (and man) to microwaves at non-thermal levels [4]. In recent years, wildlife has been chronically exposed to microwaves and RFR (Radiofrequency radiation) signals from various sources, including GSM and UMTS/3G wireless phones and base stations, WLAN (Wireless Local Area Networks), WPAN (Wireless Personal Area Networks such as Bluetooth), and DECT (Digital Enhanced (former European) Cordless Telecommunications) that are erected indiscriminately without studies of environmental impact measuring

long-term effects. These exposures are characterized by low intensities, varieties of signals, and long-term durations. The greater portion of this exposure is from mobile telecommunications (geometric mean in Vienna: 73% [5]). In Germany the GSM cellular phone tower radiation is the dominating high frequency source in residential areas [6]. Also GSM is the dominating high frequency source in the wilderness of Spain (personal observation).

Numerous experimental data have provided strong evidence of athermal microwave effects and have also indicated several regularities in these effects: dependence of frequency within specific frequency windows of "resonance-type"; dependence on modulation and polarization; dependence on intensity within specific intensity windows, including super-low power density comparable with intensities from base stations/masts [4,7–9]. Some studies have demonstrated different microwave effects depending on wavelength in the range of mm, cm or m [10,11]. Duration of exposure may be as important as power density. Biological effects resulting from electromagnetic field radiation might depend on dose, which indicates long-term accumulative effects [3,9,12]. Modulated and pulsed radiofrequencies seem to be more effective in producing effects [4,9]. Pulsed waves (in blasts), as well as certain low frequency modulations exert greater

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## FM-radio and TV tower signals can cause spontaneous hand movements near moving RF reflector

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### Abstract

For testing human sensitivity to radio frequency (RF) standing waves a movable reflecting wall was constructed. Radio waves from the radio-TV tower reflected back and formed a standing wave near the reflector. When the reflector was moved, the position of the maximums of the standing waves changed and the electromagnetic intensity changed in the body of the standing test subject. The computer with an AD-converter registered the signals of the hand movement transducer and the RF-meter with 100 MHz dipole antennas. A total of 29 adults of different ages were tested. There were 9 persons whose hand movement graphs included features like the RF-meter. Six showed responses that did not correlate with the RF-meter. There were also 14 persons who did not react at all. Sensitive persons seem to react to crossing standing waves of the FM-radio or TV broadcasting signals.

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**Keywords:** Sensorimotor responses; Radio frequency standing waves

### 1. Introduction

Radio frequency radiation (RFR) has been studied intensively in the near GHz region. Subjective symptoms, sleeping problems and cognitive performance have been reported in subjects living near mobile phone base stations [1]. In the recent past, frequencies of FM-radio and television (TV) signals have been much less studied even though these frequencies cause biological and health effects, too. The whole body resonance frequency of an average man and thus the maximum absorption of RF energy occur at 70–80 MHz [2]. This is near the frequencies used in very high frequency (VHF) broadcasting. The head and limbs absorb much more energy than the torso at frequencies above body resonance [3]. Greatest absorption in the head region of man occurs at a frequency of about 375 MHz [4]. Absorption is stronger for wave propagation from head to toe than it is when the electric field is parallel to the long axis. The authors [4] believed that the enhanced absorption in the head region may make

head resonance significant in the study of behavioral effects, blood–brain barrier permeability, cataractogenesis, and other microwave bioeffects. Even increased health risks like cancer, especially melanoma incidence, near FM broadcasting and television transmitters have been reported [5,6].

Nerve impulses initiate muscle contraction by calcium ion release from the sarcoplasmic reticulum, which takes place when electric nerve signals reach the plasma membrane and T-tubules of muscle fibers [7]. Voltage dependent Ca-channels open. Acetylcholine esterase (AChE) breaks down the acetylcholine, and Na-channels close [7]. It has been reported that the number of Ca<sup>2+</sup> ions liberated from hen's frontal brain depends on the modulation frequency of the weak VHF radiation, with a maximum at a frequency of 16 Hz, while an unmodulated field causes no ion release [2,8]. Multiple RF power-density windows in calcium ion release from brain tissue have presented [9]. A significant decrease in AChE activity has been found in rats exposed to radio frequency radiation of 147 MHz and its sub-harmonics 73.5 and 36.75 MHz amplitude modulated at 16 and 76 Hz. A decrease in AChE activity was independent of carrier wave frequencies [10].

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# Cell phone radiation: Evidence from ELF and RF studies supporting more inclusive risk identification and assessment<sup>☆</sup>

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## Abstract

Many national and international exposure standards for maximum radiation exposure from the use of cell phone and other similar portable devices are ultimately based on the production of heat particularly in regions of the head, that is, thermal effects (TE). The recent elevation in some countries of the allowable exposure, that is, averaging the exposure that occurs in a 6 min period over 10 g of tissue rather than over 1 g allows for greater heating in small portions of the 10-g volume compared to the exposure that would be allowed averaged over 1-g volume. There is concern that ‘hot’ spots, that is, momentary higher intensities, could occur in portions of the 10-g tissue piece, might have adverse consequences, particularly in brain tissue.

There is another concern about exposure to cell phone radiation that has been virtually ignored except for the National Council of Radiation Protection and Measurements (NCRP) advice given in a publication in 1986 [National Council for Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council for Radiation Protection and Measurements, 1986, 400 pp.]. This NCRP review and guidance explicitly acknowledge the existence of non-thermal effects (NTE), and included provisions for reduced maximum-allowable limits should certain radiation characteristics occur during the exposure.

If we are to take most current national and international exposure standards as completely protective of thermal injury for acute exposure only (6 min time period) then the recent evidence from epidemiological studies associating increases in brain and head cancers with increased cell phone use per day and per year over 8–12 years, raises concerns about the possible health consequences on NTE first acknowledged in the NCRP 1986 report [National Council for Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council for Radiation Protection and Measurements, 1986, 400 pp.].

This paper will review some of the salient evidence that demonstrates the existence of NTE and the exposure complexities that must be considered and understood to provide appropriate, more thorough evaluation and guidance for future studies and for assessment of potential health consequences. Unfortunately, this paper is necessary because most national and international reviews of the research area since the 1986 report [National Council for Radiation Protection and Measurements, Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, National Council for Radiation Protection and Measurements, 1986, 400 pp.] have not included scientists with expertise in NTE, or given appropriate attention to their requests to include NTE in the establishment of public-health-based radiation exposure standards. Thus, those standards are limited because they are not comprehensive.

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**Keywords:** Non-thermal effects; Electromagnetic fields; Exposure standards

## 1. Introduction

### 1.1. The current approach to exposure limits (based on heating and electric current flow in tissues)

It is universally accepted that radiofrequency radiation (RFR) can cause tissue heating (thermal effects, TE) and that extremely low-frequency (ELF) fields, e.g., 50

<sup>☆</sup> Disclaimer: The opinions expressed in this text are those of its author, and are not necessarily those of his employer, the U.S. Environmental Protection Agency.

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# Apparent decreases in Swedish public health indicators after 1997—Are they due to improved diagnostics or to environmental factors?

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## Abstract

The object of this work was to review recent trends in public health in Sweden. Data on different adverse health indicators were collected from official Swedish registries. We found that population health generally improved during the early 1990s but suddenly started to deteriorate from 1997 onwards. This quite dramatic change is not likely to be explained only by improved diagnostics but physical causes need immediately to be searched for. A connection with the increasing exposure of the population to GHz radiation from mobile phones, base stations and other communication technologies cannot be ruled out.

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**Keywords:** Alzheimer's disease; Heart malformations; Lung cancer; Melanoma; Prostata carcinoma; Traffic accidents; Mobile phone speech time

## 1. Introduction

During the first half of the 1990s, the Swedish population appeared increasingly healthy. Sick leave registrations decreased; in addition, lung cancer among older men steadily decreased and the incidence of prostate cancer levelled out, becoming stable or slightly decreasing between 1993 and 1997. In Stockholm, even the number of traffic accidents with injuries went down each year from 1985 to 1996. Mortality due to Alzheimer's disease increased in the early 1980s, but remained steady at 2.5–4 per 100,000 person-years (age standardized) from 1990 to 1997.

Objective of the present study: After 1997, public health appeared to decline markedly. Was this decrease the result of improvements in detection and diagnosis, or did maladies actually increase? In this paper, we take a look at several health trends, one by one, and analyze the suggested causes underlying the adverse health- and traffic safety indicators.

## 2. Materials and methods

All data were retrieved from the official databases of the National Health and Welfare Board (Socialstyrelsen; SoS) and of the Swedish Road Administration (Vägverket; VV). Hallberg and Johansson (2004) have presented worrying trends related to public health in Sweden [1]. Hallberg (2007) showed that many adverse health indicators were worse in sparsely populated areas, as hypothesized caused by higher average output power from mobile phones in those areas [2].

## 3. Results and discussion

1. Lung cancer among elderly men increased markedly beginning after 1997 (Fig. 1). For men aged 80–84 years, the incidence increased from 160 to 230/100,000. For men aged 85+, the incidence increased from 95 to a high of 180/100,000 in 2005. The SoS has not publicly offered any explanation for these increases or commented on this matter.
2. In 1997, the incidence of prostate cancer abruptly increased in all age groups (Fig. 2). In Stockholm, the number of cases in men aged 50–59 stayed fairly stable

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<sup>1</sup> This Research Institution was founded in 2001 and is registered by the Swedish National Patent and Registration Office.



# Public health implications of wireless technologies

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## Abstract

Global exposures to emerging wireless technologies from applications including mobile phones, cordless phones, DECT phones, WI-FI, WLAN, WiMAX, wireless internet, baby monitors, and others may present serious public health consequences. Evidence supporting a public health risk is documented in the BioInitiative Report. New, biologically based public exposure standards for chronic exposure to low-intensity exposures are warranted. Existing safety standards are obsolete because they are based solely on thermal effects from acute exposures. The rapidly expanding development of new wireless technologies and the long latency for the development of such serious diseases as brain cancers means that failure to take immediate action to reduce risks may result in an epidemic of potentially fatal diseases in the future. Regardless of whether or not the associations are causal, the strengths of the associations are sufficiently strong that in the opinion of the authors, taking action to reduce exposures is imperative, especially for the fetus and children. Such action is fully compatible with the precautionary principle, as enunciated by the Rio Declaration, the European Constitution Principle on Health (Section 3.1) and the European Union Treaties Article 174. © 2009 Elsevier Ireland Ltd. All rights reserved.

**Keywords:** Wireless technology; Brain cancer; Radiofrequency; Cell phones; Wireless antenna facilities; Childrens' health

## 1. Introduction and background

Exposure to electromagnetic fields (EMF) has been linked to a variety of adverse health outcomes that may have significant public health consequences [1–13]. The most serious health endpoints that have been reported to be associated with extremely low frequency (ELF) and/or RF include childhood and adult leukemia, childhood and adult brain tumors, and increased risk of the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS). In addition, there are reports of increased risk of breast cancer in both men and women, genotoxic effects (DNA damage and micronucleation), pathological leakage of the blood–brain barrier, altered immune function including increased allergic and inflammatory responses, miscarriage and some cardiovascular effects [1–13]. Insomnia (sleep disruption) is reported in studies of people living in very low-intensity RF environments with WI-FI and cell tower-level exposures [85–93]. Short-term effects on cognition, memory and learning, behavior, reaction time, attention and concentration, and altered

brainwave activity (altered EEG) are also reported in the scientific literature [94–107]. Biophysical mechanisms that may account for such effects can be found in various articles and reviews [136–144].

The public health implications of emerging wireless technologies are enormous because there has been a very rapid global deployment of both old and new forms in the last 15 years. In the United States, the deployment of wireless infrastructure has accelerated greatly in the last few years with 220,500 cell sites in 2008 [14–16]. Eighty-four percent of the population of the US own cell phones [16]. Annualized wireless revenues in 2008 will reach \$144 billion and US spending on wireless communications will reach \$212 billion by 2008. Based on the current 15% annual growth rate enjoyed by the wireless industry, in the next 5 years wireless will become a larger sector of the US economy than both the agriculture and automobile sectors. The annualized use of cell phones in the US is estimated to be 2.23 trillion minutes in 2008 [16]. There are 2.2 billion users of cell phones worldwide in 2008 [17] and many million more users of cordless phones.

Over 75 billion text messages were sent in the United States, compared with 7.2 billion in June 2005, according to

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CTIA, the Wireless Association, the leading industry trade group [16]. The consumer research company Nielsen Mobile, which tracked 50,000 individual customer accounts in the second quarter of this year, found that Americans each sent or received 357 text messages a month then, compared with 204 phone calls. That was the second consecutive quarter in which mobile texting significantly surpassed the number of voice calls [17].

The Electronics Industries Alliance (EIA) represents 80% of the \$550 billion US electronics industry “that provides two million jobs for American workers.” Its members include companies from the consumer electronics and telecommunications industries, among others [17].

There is intense industry competition for market share. Telecom taxes form an immense revenue generator for the government sector. Sale of the airwaves (auctions selling off wireless bandwidth) is a multi-million dollar industry for governments, and multi-billion dollar global advertising budgets are common. Lobbying dollars from the telecom-related industries are estimated to be \$300 million annually. The media is nearly silent on health issues, perhaps in part because of global advertising revenues that compromise journalistic independence and discourage balanced coverage of health, equity and economic issues.

## 2. Evidence supporting a public health risk

Even if there is only a small risk to health from chronic use of and exposure to wireless technologies, there is the potential for a profound public health impact. RF radiation now saturates the airwaves, resulting in exposure to both users and non-users. The effects are both short-term (sleep disruption, hormone disruption, impairment of cognitive function, concentration, attention, behavior, and well-being) and they are almost certainly long-term (generational impacts on health secondary to DNA damage, physiological stress, altered immune function, electrosensitivity, miscarriage risks, effects on sperm quality and motility leading to infertility, increased rates of cancer, and neurological diseases including Alzheimer’s disease and ALS—at least for ELF exposures). (Chapters 5–12 of the BioInitiative Report [1] and papers in this Supplement.)

There is credible scientific evidence that RF exposures cause changes in cell membrane function, metabolism and cellular signal communication, as well as activation of proto-oncogenes and triggering of the production of stress proteins at exposure levels below current regulatory limits. There is also generation of reactive oxygen species, which cause DNA damage, chromosomal aberrations and nerve cell death. A number of different effects on the central nervous system have also been documented, including activation of the endogenous opioid systems, changes in brain function including memory loss, slowed learning, motor dysfunction and performance impairment in children, and increased frequency of headaches, fatigue and sleep disorders. Melatonin secretion

is reduced, resulting in altered circadian rhythms and disruption of several physiological functions. (Chapters 5–12 of the BioInitiative Report [1] and papers in this Supplement.)

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable [1,19]. The young are also largely unable to remove themselves from such environments. Second-hand non-ionizing radiation, like second-hand smoke may be considered of public health concern based on the evidence at hand.

### 2.1. Malignant brain tumors

At present, the most persuasive evidence for cancer resulting from RF exposure is that there is a significantly increased risk of malignant glioma in individuals that have used a mobile phone for 10 or more years, with the risk being elevated only on the side of the head on which the phone is used regularly (ipsilateral use) [1,3,4,6–8,18]. While the risk for adults after 10 or more years of use is reported to be more than doubled, there is some evidence beginning to appear that indicates that the risk is greater if the individual begins to use a mobile phone at younger ages. Hardell et al. [18] reported higher odds ratios in the 20–29-year-old group than other age ranges after more than 5 years of use of either analog or cordless phones. Recently in a London symposium Hardell reported that after even just 1 or more years of use there is a 5.2-fold elevated risk in children who begin use of mobile phones before the age of 20 years, whereas for all ages the odds ratio was 1.4. Studies from Israel have found that the risk of parotid gland tumors (a salivary gland in the cheek) is increased with heavy cell phone use [7]. The risk of acoustic neuroma (a benign but space-occupying tumor on the auditory nerve) is also significantly increased on the ipsilateral side of the head after 10 or more years of mobile phone use [1,3]. This relationship has also been documented in some of the published reports of the WHO Interphone Study, a decade-long 13-country international assessment of cell phone risks and cancer [6,8].

Kundi reports that “(E)pidemiological evidence compiled in the last 10 years starts to indicate an increased risk, in particular for brain tumors (glioma, meningioma, acoustic neuroma), from mobile phone use. Considering biases that may have been operating in most studies the risk estimates are rather too low, although recall bias could have increased risk estimates. The net result, when considering the different errors and their impact is still an elevated risk” [19].

The latency for most brain tumors is 20 years or more when related to other environmental agents, for example, to X-ray exposure. Yet, for cell phone use the increased risks are occurring much sooner than twenty years, as early as 10 years for brain tumors in adults and with even shorter latencies in children. This suggests that we may currently be significantly underestimating the impact of current levels of

use of RF technology, since we do not know how long the average latency period really is. If it is 20 years, then the risk rate will likely be much higher than an overall doubling of risk for cell phone users if the peak comes later than 10 years. It may also signal very troubling risks for those who start using cell phones, and perhaps all wireless devices, in early childhood. We may not have proof of effect for decades until many hundreds of thousands of new cases of malignant gliomas are set in motion by long-term cell phone use.

The preliminary evidence that mobile phone use at younger ages may lead to greater risk than for older persons is of particular concern. There is a large body of evidence that childhood exposure to environmental agents poses greater risk to health than comparable exposure during adulthood [20,21]. There is reason to expect that children would be more susceptible to the effects of EMF exposure since they are growing, their rate of cellular activity and division is more rapid, and they may be more at risk for DNA damage and subsequent cancers. Growth and development of the central nervous system is still occurring well into the teenage years so that neurological changes may be of great importance to normal development, cognition, learning, and behavior.

A greater vulnerability of children to developing brain cancer from mobile phone use may be the consequence of a combination of patterns of use, stage of development and physical characteristics related to exposure. In addition to the fact that the brain continues to develop through the teen years, many young children and teenagers now spend very large periods of time using mobile phones. The brain is the main target organ of cell phones and cordless phones, with highest exposure to the same side as the phone is used. Further, due to anatomical reasons, the brain of a child is more exposed to RF radiation than the brain of an adult [22,23]. This is caused by the smaller brain size, a thinner pinna of the ear, thinner skin and thinner skull bone permitting deeper penetration into the child's brain. A recent French study showed that children absorb twice the RF from cell phone use as do adults [24].

In addition to concerns about cancer, there is evidence for short-term effects of RF exposure on cognition, memory and learning, behavior, reaction time, attention and concentration, altered brainwave activity (altered EEG) [95–108], and all of these effects argue for extreme caution with regard to exposure of children. The development of children into adults is characterized by faster cell division during growth, the long period needed to fully develop and mature all organ systems, and the need for properly synchronized neural development until early adulthood. Chronic, cumulative RF exposures may alter the normal growth and development of children and adversely affect their development and capacity for normal learning, nervous system development, behavior and judgment [1,97,102].

Prenatal exposure to EMF has been identified as a possible risk factor for childhood leukemia (1). Maternal use of cell phones has been reported to adversely affect fetal brain development, resulting in behavioral problems in those children by

the time they reach school age [25]. Their exposure is involuntary in all cases. Children are largely unable to remove themselves from exposures to harmful substances in their environments.

## 2.2. Plausible biological mechanisms for a relationship between RF exposure and cancer

### 2.2.1. DNA damage and oxidative stress

Damage to DNA from ELF and from RF cell phone frequencies at very low intensities (far below FCC and ICNIRP safety limits) has been demonstrated in many studies [1,2,26–35]. Both single- and double-strand DNA damage have been reported by various researchers in different laboratories. This is damage to the human genome, and can lead to mutations which can be inherited, or which can cause cancer, or both.

Non-ionizing radiation is assumed to be of too low energy to cause direct DNA damage. However both ELF and RF radiation induce reactive oxygen species, free radicals that react with cellular molecules including DNA. Free-radical production and/or the failure to repair DNA damage (secondary to damage to the enzymes that repair damage) created by such exposures can lead to mutations. Whether it is greater free-radical production, reduction in anti-oxidant protection or reduced repair capacity, the result will be altered DNA, increased risk of cancer, impaired or delayed healing, and premature aging [36–54]. Exposures have also been linked to decreased melatonin production, which is a plausible biological mechanism for decreased cancer surveillance in the body, and increased cancer risk [34,39,44,46,47,49,50,54]. An increased risk of cancers and a decrease in survival has been reported in numerous studies of ELF and RF [55–69].

### 2.2.2. Stress proteins (heat shock proteins or HSP)

Another well-documented effect of exposure to low-intensity ELF and RF is the creation of stress proteins (heat shock proteins) that signal a cell is being placed under physiological stress) [70–80]. The HSP response is generally associated with heat shock, exposure to toxic chemicals and heavy metals, and other environmental insults. HSP is a signal of cells in distress. Plants, animals and bacteria all produce stress proteins to survive environmental stressors like high temperatures, lack of oxygen, heavy metal poisoning, and oxidative stress.

We can now add ELF and RF exposures to this list of environmental stressors that cause a physiological stress response. Very low-level ELF and RF exposures can cause cells to produce stress proteins, meaning that the cell recognizes ELF and RF exposures as harmful. This is another important way in which scientists have documented that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards. An additional concern is that if the stress goes on too long, the protective effect is diminished. The reduced response with prolonged exposure means the cell is less protected against

damage, and this is why prolonged or chronic exposures may be harmful, even at very low intensities.

### 2.2.3. RF-induced gene expression changes

Many environment agents cause diseases, including cancer, not by direct damage to DNA but rather by up- or down-regulation of genes that regulate cell growth and function. Usually there are many genes whose expression is changed, and it is difficult to determine the exact changes responsible for the disease. Both ELF and RF exposures have been shown to result in altered gene expression. Olivares-Banuelos et al. [81] found that ELF exposure of chromaffin cells resulted in changed expression of 53 transcripts. Zhao et al. [82] investigated the gene expression profile of rat neurons exposed to 1800 MHz RF fields (2 W/kg) and found 24 up-regulated genes and 10 down-regulated genes after a 24-h exposure. The altered genes were involved in multiple cellular functions including cytoskeleton, signal transduction pathways and metabolism. Kariene et al. [83] exposed human skin to mobile phone radiation, and found by punch biopsy that 8 proteins were significantly altered in expression, consistent with gene induction. Several other studies have found altered gene expression following RF exposure, although none have been found that explain specific disease states [84].

DNA activation at very low ELF and RF levels, as in the stress response, and DNA damage (strand breaks and micronuclei) at higher levels, are molecular precursors to changes that are believed to lead to cancer. These, along with gene induction, provide plausible biological mechanisms linking exposure to cancer.

The biochemical pathways that are activated are the same for ELF and for RF exposures, and are non-thermal (do not require heating or induced electrical currents). This is true for the stress response, DNA damage, generation of reactive oxygen species as well as gene induction. Thus it is not surprising that the major cancers resulting from exposure to ELF and RF are the same, namely leukemia and brain cancer. The safety standards for both ELF and RF, based on protection from heating, are irrelevant and not protective. ELF exposure levels of only 5–10 mG have been shown to activate the stress response genes (<http://www.bioinitiative.org>, Sections 1 and 7 [1]).

## 3. Sleep, cognitive function and performance

The relationship of good sleep to cognition, performance and healing is well recognized. Sleep is a profoundly important factor in proper healing, anti-inflammatory benefits, reduction in physical symptoms of such as tendonitis, over-use syndrome, fatigue-induced lethargy, cognition and learning. Incomplete or slowed physiological recovery is common when sleep is impaired. Circadian rhythms that normalize stress hormone production (cortisol, for example) depend on synchronized sleep patterns.

People who are chronically exposed to low-level wireless antenna emissions report symptoms such as problems in sleeping (insomnia), as well as other symptoms that include fatigue, headache, dizziness, grogginess, lack of concentration, memory problems, ringing in the ears (tinnitus), problems with balance and orientation, and difficulty in multi-tasking [85–93,99]. In children, exposures to cell phone radiation have resulted in changes in brain oscillatory activity during some memory tasks [97,102]. Cognitive impairment, loss of mental concentration, distraction, speeded mental function but lowered accuracy, impaired judgment, delayed reaction time, spatial disorientation, dizziness, fatigue, headache, slower motor skills and reduced learning ability in children and adults have all been reported [85–108].

These symptoms are more common among “electrosensitive” individuals, although electrosensitivity has not been documented in double-blind tests of individual identifying themselves as being electrosensitive as compared to controls [109,110]. However people traveling to laboratories for testing are pre-exposed to a multitude of RF and ELF exposures, so they may already be symptomatic prior to actual testing. There is also evidence that RF exposures testing behavioral changes show delayed results; effects are observed after termination of RF exposure. This suggests a persistent change in the nervous system that may be evident only after time has passed, so is not observed during a short testing period.

### 3.1. Plausible biological mechanisms for neurobehavioral effects

#### 3.1.1. The melatonin hypothesis

While there remains controversy as to the degree that RF and ELF fields alter neurobehavioral function, emerging evidence provides a plausible mechanism for both effects on sleep and cognition. Sleep is controlled by the central circadian oscillator in the suprachiasmatic nucleus, located in the hypothalamus. The activity of this central circadian oscillator is, in turn, controlled by the hormone, melatonin, which is released from the pineal gland [111]. There is considerable evidence that ELF exposure reduces the release of melatonin from the pineal gland—see Section 12 of the Bioinitiative Report [1]. There has been less study of the effects of RF exposure on melatonin release, but investigations have demonstrated a reduced excretion of the urinary metabolite of melatonin among persons using a mobile phone for more than 25 min per day [112]. In a study of women living near to radio and television transmitters, Clark et al. [113] found no effect on urinary melatonin metabolite excretion among pre-menopausal women, but a strong effect in post-menopausal women.

The “melatonin hypothesis” also provides a possible basis for other reported effects of EMFs. Melatonin has important actions on learning and memory, and inhibits electrophysiological components of learning in some but not all areas of the brain [114,115]. Melatonin has properties as a free-radical scavenger and anti-oxidant [116], and consequently,

a reduction in melatonin levels would be expected to increase susceptibility to cancer and cellular damage. Melatonin could also be the key to understanding the relationship between EMF exposure and Alzheimer's disease. Noonan et al. [117] reported that there was an inverse relationship between excretion of the melatonin metabolite and the 1–42 amino acid form of amyloid beta in electric utility workers. This form of amyloid beta has been found to be elevated in Alzheimer's patients.

### 3.1.2. Blood–brain barrier alterations

Central nervous system effects of EMFs may also be secondary to damage to the blood–brain barrier (BBB). The blood–brain barrier is a critical structure that prevents toxins and other large molecules that are in peripheral blood from having access to the brain matter itself. Salford et al. [118] have reported that a 2-h exposure of rats to GSM-900 radiation with a SAR of 2–200 mW/kg resulted in nerve cell damage. In a follow-up study, Eberhardt et al. report that 2-h exposures to cell phone GSM microwave RF resulted in leakage of albumin across the blood–brain barrier and neuronal death [119]. Neuronal albumin uptake was significantly correlated to occurrence of damaged neurons when measured at 28 days post-exposure. The lowest exposure level was 0.12 mW/kg (0.00012 W/kg) for 2 h. The highest exposure level was 120 mW/kg (0.12 W/kg). The weakest exposure level showed the greatest effect in opening the BBB [118]. Earlier blood–brain studies by Salford and Schirmer [120,121] report similar effects.

## 4. What are sources of wireless radiation?

There are many overlapping sources of radiofrequency and microwave emissions in daily life, both from industrial sources (like cell towers) and from personal items [cell and cordless phones, personal digital assistants (PDAs), wireless routers, etc.]. Published data on typical levels found in some cities and from some sources are available at <http://www.bioinitiative.org> [1,122–124].

Cell phones are the single most important source of radiofrequency radiation to which we are exposed because of the relatively high exposure that results from the phone being held right against the head. Cell phones produce two types of emissions that should be considered. First, the radiofrequency radiation (typically microwave frequency radiation) is present. However, there is also the contribution of the switching battery pack that produces very high levels of extremely low frequency electromagnetic field [125–127].

Cordless telephones have not been widely recognized as similar in emissions to cell phones, but they can and do produce significant RF exposures. Since people tend to use them as substitutes for in-home and in-office corded or traditional telephones, they are often used for long periods of time. As the range of cordless phones has increased (the distance away that you can carry on a conversation is related to the power

output of the phone), the more powerful the RF signal will be. Hence, newer cordless phones may in some cases be similar to the power output of cell phones. The cumulative emissions from cell and cordless phones taken together should be recognized when considering the relative risks of wireless communication exposures.

PDAs such as the BlackBerry, Treo and iPhone units are 'souped-up' versions of the original voice communication devices (cell phones). They often produce far higher ELF emissions than do cell phones because they use energy from the battery very intensively for powering color displays and during data transmission functions (email, sending and receiving large files, photos, etc.) [125–127]. ELF emissions have been reported from PDAs at several tens to several hundreds of milligauss. Evidence of significantly elevated ELF fields during normal use of the PDA has public health relevance and has been reported in at least three scientific papers [125,128,129]. In the context of repetitive, chronic exposure to significantly elevated ELF pulses from PDAs worn on the body, relevant health studies point to a possible relationship between ELF exposure and cancer and pregnancy outcomes [130–133].

We include discussion of the ELF literature for two reasons. As mentioned above ELF activates the same biology as RF, it contributes to the total EMF burden of the body. In addition, PDAs and cell phones emit both radiofrequency/microwave radiation (RF) and extremely low frequency ELF from the battery switching of the device (the power source). Studies show that some devices produce excessively high ELF exposures during voice and data transmission. ELF is already classified as a 2B (Possible) Carcinogen by IARC, which means that ELF is indisputably an issue to consider in the wireless technology debate. ELF has been classified as a Group 2B carcinogen for all humans, not just children. The strongest evidence came from epidemiological studies on childhood leukemia, but the designation applies to all humans, both adults and children [1,25].

Wireless headsets that allow for conversations with cell phones at a distance from the head itself reduce the emissions. Depending on the type of wireless device, they may operate (transmit signal) only during conversations or they may be operational continuously. The cumulative dose of wireless headsets has not been well characterized under either form of use. Substantial cumulative RF exposure would be expected if the user wears a wireless headset that transmits a signal continuously during the day. However a critical factor is where the cell phone is placed. If worn on a belt with a headset, the exposure to the brain is reduced but the exposure to the pelvis may be significant.

Cell towers (called "masts" in Europe and Scandinavian countries) are wireless antenna facilities that transmit the cell phone signals within communities. They are another major source of RF exposures for the public. They differ from RF exposures from wireless devices like cell phones in that they produce much lower RF levels (generally 0.05 to 1–2  $\mu\text{W}/\text{cm}^2$  in the first several hundred feet around them) in comparison to several hundred microwatts per centimeter

squared for a cell phone held at the head. However they create a constant zone of elevated RF for up to 24 h per day, many hours per day, and the exposure is whole body rather than localized at the head. These facilities are the distribution system for wireless voice communications, internet connections and data transmission within communities. They are often erected on free-standing towers. They may be constructed on telephone poles or electrical poles. They may be built into the façade or rooftops of buildings behind wood screening. These are called stealth installations for wireless antenna facilities. Some installations are camouflaged to resemble ‘false trees or rocks’. They emit RF to provide cell service to specific “cells” or locations that receive the signal.

Other forms of wireless transmission that are common in areas providing cell service are wireless land area networks (WLAN), (WiMAX) and WIFI networks. Some cities are installing city-wide WIFI service to allow any user on the street to log into the internet (without cables or wire connections). WIFI installations may have a signal reach for a few hundred feet where WiMAX installations may transmit signal more than 10 miles, so produce a stronger RF emission for those in close proximity. Each type has its particular signal strength and intended coverage area, but what they have in common is the production of continuous RF exposure for those within the area. We do not know what the cumulative exposure (dose) might be for people living, working or going to school in continuously elevated RF fields, nor are the possible health implications yet known. However, based on studies of populations near cell sites in general, there is a constellation of generally observed health symptoms that are reported to occur [85–107]. In this regard it is important to note that children living near to AM radio transmitters have been found to elevated risks of leukemia [134,135]. While AM radio RF fields are lower in frequency than that common in mobile phones, this is a total body irradiation with RF. The fact that leukemia, not brain cancer, is apparent in these studies suggests that leukemia is the cancer seen at the lowest levels of both ELF and RF fields under the circumstances of whole-body exposure.

Commercial surveillance systems or security gates pose an additional source of strong RF exposures. They are ubiquitous in department stores, markets and shops at the entry and exit points to discourage shoplifting and theft of goods. Security gates can produce excessively high RF exposures (although transitory) and have been associated with interference with pacemakers in heart patients. The exposure levels may approach thermal public safety limits in intensity, although no one expects a person to stand between the security gate bars for more than 6 min (safety limits for uncontrolled public access are variable depending on the frequency, but are all averaged over a 6-min exposure period).

RFID chips (radiofrequency identification chips) are being widely used to track purchases and for security of pets, and in some cases to keep track of patients with Alzheimer’s disease and of children. RFID chips are implanted in fabrics, inserted in many types of commercial goods, and can be implanted

under the skin. They create a detectable signal to track the location of people and goods.

## 5. Problems with existing public health standards (safety limits)

If the existing standards were adequate none of the effects documented above should occur at levels to which people are regularly exposed. The fact that these effects are seen with our current ambient levels of exposure means that our existing public safety standards are obsolete. It also means that new, biologically based public exposure standards for wireless technologies are urgently needed. Whether it is feasible to achieve low enough levels that still work and also protect health against effects of chronic RF exposure – for all age groups – is uncertain. Whether we can protect the public and still allow the kinds of wireless technology uses we see today is unknown.

The nature of electromagnetic field interactions with biological systems has been well studied [136–144]. For purposes of standard-setting processes for both ELF and RF, the hypothesis that tissue damage can result only from heating is the fundamental flaw in the misguided efforts to understand the basic biological mechanisms leading to health effects.

The thermal standard is clearly untenable as a measure of dose when EMF stimuli that differ by many orders of magnitude in energy can stimulate the same biological response. In the ELF range, the same biological changes occur as in the RF, and no change in temperature can even be detected. With DNA interactions the same biological responses are stimulated in ELF and RF ranges even though the frequencies of the stimuli differ by many orders of magnitude. The effects of EMF on DNA to initiate the stress response or to cause molecular damage reflect the same biology in different frequency ranges. For this reason it should be possible to develop a scale based on DNA biology, and use it to define EMF dose in different parts of the EM spectrum. We also see a continuous scale in DNA experiments that focus on molecular damage where single and double strand breaks have long been known to occur in the ionizing range, and recent studies have shown similar effects in both ELF and RF ranges [144].

Existing standard-setting bodies that regulate wireless technologies, assume that there are no bioeffects of concern at exposure levels that do not cause measurable heating. However, it has been established beyond any reasonable doubt that bioeffects and some adverse health effects occur at far lower levels of RF and ELF exposure where no heating (or induced current) occurs; some effects are shown to occur a thousand times or more below the existing public safety limits. New, biologically based public exposure limits are urgently needed. New wireless technologies for cell and cordless phones, other wireless communication and data transmission systems affect living organisms in new ways that our antiquated safety limits have not foreseen, nor protected against.

The exposure of children to electromagnetic fields has not been studied extensively; in fact, the Federal Communications Commission (FCC) standards for exposure to radiofrequency radiation are based on the height, weight and stature of a 6-foot tall man, not scaled to children or adults of smaller stature. They do not take into account the unique susceptibility of growing children to exposures, nor are there studies of particular relevance to children.

In addition there is a problem in the consideration of the level of evidence taken into consideration by these bodies. There have not been adequate animal models shown to have cancer as an endpoint, and a perception that no single mechanism is proven to explain these associations. Thus these committees have tended to ignore or minimize the evidence for direct hazard to humans, and believe there is no proof of cause and effect. These bodies assume from the beginning that only conclusive scientific evidence (absolute proof) will be sufficient to warrant change, and refuse to take action on the basis of a growing body of evidence which provides early but consequential warning of risks.

The Radiofrequency Interagency Working Group of the US governmental agencies involved in RF matters (RFI-AWG) issued a Guidelines Statement in June of 1999 that concluded the present RF standard “may not adequately protect the public” [145]. The RFI-AWG identified fourteen (14) issues that they believe are needed in the planned revisions of ANSI/IEEE RF exposure guidelines including “to provide a strong and credible rationale to support RF exposure guidelines”. In particular, the RFI-AWG criticized the existing standards as not taking into account chronic, as opposed to acute exposures, modulated or pulsed radiation (digital or pulsed RF is proposed at this site), time-averaged measurements that may erase the unique characteristics of an intensity-modulated RF radiation that may be responsible for reported biologic effects, and stated the need for a comprehensive review of long-term, low-level exposure studies, neurological-behavioral effects and micronucleus assay studies (showing genetic damage from low-level RF) [145]. This important document from relevant US agencies questions existing standards in the following ways: (a) selection of an adverse effect level for chronic exposures not based on tissue heating and considering modulation effects; (b) recognition of different safety criteria for acute and chronic exposures at non-thermal or low-intensity levels; (c) recognition of deficiencies in using time-averaged measurements of RF that does not differentiate between intensity-modulated RF and continuous wave (CW) exposure, and *therefore may not adequately protect the public*; (d) having standards based on adult males rather than considering children to be the most vulnerable group.

## 6. Prudent public health responses

Emerging environmental health problems require preventative public health responses even where scientific and

medical uncertainties still exist, but where policy decisions today may greatly reduce human disease and societal costs tomorrow.

Policy decisions in public health must address some amount of uncertainty when balancing likely benefits and estimated costs. Although new insight will allow better appreciation of difficult issues, such as those occurring in environmental and occupational health, an expanded perspective may also enlarge the list of problems that need to be managed. Ignoring the problems carries its own costs (as deferring a decision is a decision in itself). With environmental and other public health problems becoming increasingly complex and international in scope, scientific documentation alone rarely justifies simple solutions [146].

Social issues regarding the controversy over public and occupational exposures to ELF and RF center on the resolute adherence to existing ICNIRP and FCC/IEEE standards by many countries, in the face of growing scientific evidence of health risks at far lower levels [10]. The composition of these committees, usually with excessive representation of the physics and engineering communities rather than public health professionals, results in a refusal to adopt biologically based exposure standards. Furthermore, there is widespread belief that governments are ignoring this evidence and there is widespread distrust of and lack of confidence in governments and their health agencies. The basis on which most review bodies and standard-setting agencies have avoided the conclusion that the science is strong enough to warrant new safety limits for ELF and RF is to require a demonstration of absolute proof before taking action. A causal level of evidence, or scientific certainty standard is implicit in nearly all reviews of the ELF and RF science, although this runs counter to good public health protection policies.

There is no question that global implementation of the safety standards proposed in the Bioinitiative Report, if implemented abruptly and without careful planning, have the potential to not only be very expensive but also disruptive of life and the economy as we know it. Action must be a balance of risk to cost to benefit. The major risk from maintaining the status quo is an increasing number of cancer cases, especially in young people, as well as neurobehavioral problems at increasing frequencies. The benefits of the status quo are expansion and continued development of communication technologies. But we suspect that the true costs of even existing technologies will only become much more apparent with time. Whether the costs of remedial action are worth the societal benefits is a formula that should reward precautionary behavior. Prudent corporate policies should be expected to address and avoid future risks and liabilities, otherwise, there is no market incentive to produce safe (and safer) products.

The deployment of new technologies is running ahead of any reasonable estimation of possible health impacts and estimates of probabilities, let alone a solid assessment of risk. However, what has been missing with regard to EMF has been an acknowledgement of the risk that is demonstrated by

the scientific studies. There is clear evidence of risk, although the magnitude of the risk is uncertain, and the magnitude of doing nothing on the health effects cost to society is similarly uncertain. This situation is very similar to our history of dealing with the hazards of smoking decades ago, where the power of the industry to influence governments and even conflicts of interest within the public health community delayed action for more than a generation, with consequent loss of life and enormous extra health care costs to society. New standards are warranted now, based on the totality of scientific evidence; the risks of taking no-action, the large population at risk, costs associated with ignoring the problem in new and upgraded site selection and construction, and the loss of public trust by ignoring the problem.

Direct medical and rehabilitative health costs associated with treatment for diseases that are reasonably related to wireless technologies may be very large. Although there is uncertainty involved in how much disease is related to wireless exposures, the mere scale of the problem with several billion users of cell phones and even larger impacts on bystander populations (from cell site exposures, from other WI-FI and wireless exposures in-home and commercial use, etc.) the associated public health costs will likely be monumental. Furthermore the costs to families with cancers, neurological diseases or learning disabilities in children related in part or in whole to wireless technologies extend beyond medical costs. They may reasonably extend to family disruption and family psychological problems, losses in job productivity and income loss.

The history of governments and their official health agencies to deal with emerging and newly identified risks to health is not good [147–149]. This is particularly true where industry investments in new products and technologies occur without full recognition, disclosure or even knowledge of possible health consequences. Large economic investments in polluting industries often make for perilously slow regulatory action, and the public health consequences may be very great as a result [150,151].

Free markets do not internalize the costs to society of “guessing wrong”. Unexpected or hidden health costs of new technologies may not be seen for many years, when the ability to recall or to identify the precise exposures related to disease outcomes is difficult or impossible. The penalty nearly always falls to the individual, the family or the taxpayer and not to the industry that benefits economically—at least in free-market economies. Thus, the profits go to industry but the costs may go to the individual who can suffer both diminished quality of life and health and economic disadvantage. If all disease endpoints that may be reasonably related to chronic exposure to electromagnetic fields are considered even a small attributable fraction for one or more industries, it will have enormous global impact on public health. The public health implications are immense. But they can be reduced by strong government and public health interventions providing information on alternatives to wireless technologies, public education campaigns, health advisories,

Table 1

Public health implications of wireless technologies argue for change in governmental and health agency actions.

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Secure US and EU legislative mandates for safer technologies for communication and data transmission, for security and surveillance needs.
Promote wired alternatives for voice and data communication (cable, fiber-optic)
Discourage or ban use of cell phones by children and young teen-agers
Provide permanent (unremovable) labels on cell phones “Not for use by children under the age of 16”
Implement national public education campaigns on health issues (cell phones, cordless phones, PDAs, wireless internet, city-wide WI-FI, WLAN and WiMAX exposures
Promote industry redesign for safer products: support innovation for alternatives and solutions
Slow or stop deployment of wireless technologies to discourage reliance on wireless technologies for communication and security needs
Put the burden of proof on industry to show “new wireless tech” is safe before deployment
Adopt and enforce restricted use areas for sensitive or more vulnerable segments of society including low-EMF environments in public areas and “No Cell” zones in airports, hospitals, schools
Acknowledge FCC and ICNIRP thermal safety standards are obsolete for wireless technologies
Appoint new standard-setting bodies familiar with biological effects to develop new guidelines for public safety limits.
Develop new biologically based standards that address low-intensity, chronic exposures
Require standard of evidence and level of proof = public health
Reject “causal” standard of evidence for taking action on science
Make industry financially liable for “guessing wrong” and ignoring health risks

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requirements for redesign of wireless devices, proscription of use of wireless devices by children and teenagers, strong and independent research programs on causes and prevention of EMF-related diseases, and consultation with all stakeholders on issues relating to involuntary exposures (bystander or second-hand radiation exposures from wireless technologies) (Table 1).

The scientific information contained in this Supplement argues for thresholds or guidelines that are substantially below current FCC and ICNIRP standards for localized exposures to wireless devices and for whole-body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research. No assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000–10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

It is likely that for both ELF and RF, as for other carcinogens, there is no threshold of exposure that is without risk, but the magnitude of the risk increases linearly with the level of exposure. Our society will not go back to the pre-electric and pre-wireless age, but the clear evidence of health hazards to the human population from exposure mandates that we develop ways in which to reduce exposure through education, new technologies and the establishment of biomedically based standards.

## 7. Conclusions and recommended actions

New ELF limits are warranted based on a public health analysis of the overall existing scientific evidence. These limits should reflect environmental levels of ELF that have been demonstrated to increase risk for childhood leukemia, and possibly other cancers and neurological diseases. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky. These levels are in the 2–4 milligauss (mG) range (0.2–0.4  $\mu$ T), not in the 10 s of mG or 100 s of mG. The existing ICNIRP limit is 1000 mG (100  $\mu$ T) and 904 mG (90.4  $\mu$ T) in the US for ELF is outdated and based on faulty assumptions. These limits are can no longer be said to be protective of public health and they should be replaced. A safety buffer or safety factor should also be applied to a new, biologically based ELF limit, and the conventional approach is to add a safety factor lower than the risk level.

While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1  $\mu$ T) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2  $\mu$ T) limit for all other new construction. It is also recommended that a 1 mG (0.1  $\mu$ T) limit be established for existing habitable space for children and/or women who are pregnant (because of the possible link between childhood leukemia and *in utero* exposure to ELF). This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1  $\mu$ T) limit to existing occupied space. “Establish” in this case probably means formal public advisories from relevant health agencies. While it is not realistic to reconstruct all existing electrical distribution systems, in the short-term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged. These limits should reflect the exposures that are commonly associated with increased risk of childhood leukemia (in the 2–5 mG (0.2–0.5  $\mu$ T) range for all children, and over 1.4 mG (0.14  $\mu$ T) for children age 6 and younger). Nearly all of

the occupational studies for adult cancers and neurological diseases report their highest exposure category is 4 mG (0.4  $\mu$ T) and above, so that new ELF limits should target the exposure ranges of interest, and not necessarily higher ranges.

Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

It is not prudent public health policy to wait any longer to adopt new public safety limits for ELF. These limits should reflect the exposures that are commonly associated with increased risk of childhood leukemia (in the 2–5 mG (0.2–0.5  $\mu$ T) range for all children, and over 1.4 mG (0.14  $\mu$ T) for children age 6 and younger). Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

The rapid deployment of new wireless technologies that chronically expose people to pulsed RF at levels reported to cause bioeffects, which in turn, could reasonably be presumed to lead to serious health impacts, is a public health concern. There is suggestive to strongly suggestive evidence that RF exposures may cause changes in cell membrane function, cell communication, metabolism, activation of proto-oncogenes and can trigger the production of stress proteins at exposure levels below current regulatory limits. Resulting effects can include DNA breaks and chromosome aberrations, cell death including death of brain neurons, increased free-radical production, activation of the endogenous opioid system, cell stress and premature aging, changes in brain function including memory loss, retarded learning, performance impairment in children, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion and cancers (BioInitiative Report Chapters 5–10, 12) [1].

This information now argues for thresholds or guidelines that are substantially below current FCC and ICNIRP standards for whole-body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research and no assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000–10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

A cautionary target level for pulsed RF exposures for ambient wireless that could be applied to RF sources from cell tower antennas, WI-FI, WI-MAX and other similar sources

is proposed. The recommended cautionary target level is 0.1 microwatts per centimeter squared ( $\mu\text{W}/\text{cm}^2$ ) (or 0.614 V per meter or V/m) for pulsed RF where these exposures affect the general public; this advisory is proportionate to the evidence and in accord with prudent public health policy. A precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. An outdoor precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  would mean an even lower exposure level inside buildings, perhaps as low as 0.01  $\mu\text{W}/\text{cm}^2$ . Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

Broadcast facilities that chronically expose nearby residents to elevated RF levels from AM, FM and television antenna transmission are also of public health concern given the potential for very high RF exposures near these facilities (antenna farms). RF levels can be in the 10 s to several 100 s of  $\mu\text{W}/\text{cm}^2$  in residential areas within half a mile of some broadcast sites (for example, Lookout Mountain, Colorado and Awbrey Butte, Bend, Oregon). Like wireless communication facilities, RF emissions from broadcast facilities that are located in, or expose residential populations and schools to elevated levels of RF will very likely need to be re-evaluated for safety.

For emissions from wireless devices (cell phones, personal digital assistant or PDA devices, etc.) there is enough evidence for increased risk of brain tumors and acoustic neuromas now to warrant intervention with respect to their use. Redesign of cell phones and PDAs could prevent direct head and eye exposure, for example, by designing new units so that they work only with a wired headset or on speakerphone mode.

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable. The young are also largely unable to remove themselves from such environments. Second-hand radiation, like second-hand smoke is an issue of public health concern based on the evidence at hand.

In summary, the following recommendations are made:

- ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG (0.2  $\mu\text{T}$ ) and above).
- While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG (0.1  $\mu\text{T}$ ) planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG (0.2  $\mu\text{T}$ ) limit for all other new construction. It is also recommended for that a 1 mG (0.1  $\mu\text{T}$ ) limit be established for existing habitable space for children and/or women who are pregnant. This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG (0.1  $\mu\text{T}$ ) limit to existing occupied space. “Establish” in this case probably means formal public advisories from relevant health agencies.
- While it is not realistic to reconstruct all existing electrical distributions systems, in the short-term; steps to reduce exposure from these existing systems need to be initiated and should be encouraged, especially in places where children spend time.
- A precautionary limit of 0.1  $\mu\text{W}/\text{cm}^2$  (which is also 0.614 V per meter) should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

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**To: Michael Copps, Acting FCC Chairman**

**Subject: Comment for Notice of Inquiry - A National Broadband Policy for our Future,  
GN Docket No. 09-51**

**From: Donald Hillman, East Lansing, Michigan**

**AFFIDAVIT OF DR. DONALD HILLMAN**

**Donald Hillman, having been duly sworn, states as follows:**

- 1. I am a Professor Emeritus at Michigan State University.**
- 2. I hold a Ph.D. in the Michigan State University Department of Animal Science.**
- 3. My career experience includes 60 years of work in the area of dairy animal science.**
- 4. I have studied the relationship of step potential electric current to milk production on dairy farms in Michigan, Wisconsin, Minnesota and Virginia since 1982.**
- 5. I learned that electric and magnetic fields (EMF) inhibited milk production of dairy cattle as reported by Appleman et al. in USDA-ARS Publication 696, 1991, section-page 3-16 and 3-17.**
- 6. Further, electropathic stress proliferated impairment of animal health resulting in financial losses to dairymen averaging \$2,629 per cow per year during the period of exposure to uncontrolled electricity commonly called stray voltage.**
- 7. Further, the decreases of milk production on low-voltage farms were positively correlated with powerline harmonic and radiofrequency currents.**
- 8. The voltages that were causing damage to dairy cattle were below the 1-Volt threshold erroneously considered safe by utility experts.**
- 9. Secondly, I measured electric and magnetic fields: milligauss, current, and frequencies of voltage from the neutral-to-ground wire of a Nextel cellular telephone**

**EXHIBIT 3**

**relay station mounted on and under the East Lansing City water tank, as permitted by the Federal Communications Act of 1996.**

- 10. Radiofrequency currents were recorded from the ground wire that was bonded to the city water system and transferred onto water pipes bonded to the ground wire in our home and the homes of ten neighbors.**
- 11. Utility engineers from Lansing Board of Water and Light confirmed my measurements, recorded the magnetic field radiated from the ground wire into the living room of our home for 24-hour periods on two occasions.**
- 12. The magnetic field range from 0-320 mG and averaged 97 milliGauss (standard deviation 37.9 mG).**
- 13. During five test experiments, while I was sitting on the sofa in our living room, my heart rate and blood pressure increased linearly as the magnetic field (mG) in the room, and radiated current (amperes) increased as recorded with ammeter from my body acting as antenna.**
- 14. Our findings concur with reports of radiated electrical energy resulting in cardiovascular effects on humans and animals found in some 25 credible bioelectric and medical journals. A full report is available at your request.**
- 15. The Federal Communications Act of 1996 and local promoters of the cell-phone tower failed to disclose that EMF generated by AC/DC switch mode devices from cellular telephone towers appear on the neutral wires and radiate into homes, schools, and workplaces .**

16. **Four residents living within 100 meters of the cell-phone tower in our neighborhood have arrhythmic hearts, two have pacemakers, and one has a defibrillator attached to his heart, while another suffers from nonHodgkins lymphoma; not coincidental.**
17. **Electromagnetic contamination of the living environment from electronic devices may account for the increased hypertension of citizens at every age from 20-85 years, with unknown cause as reported by the American Heart Association.**
18. **Further investigations must consider neuroendocrine effects of EMF on secretions of all glands that control physiological functions of human and animal bodies.**
19. **The permeability of biological tissue, (e.g. cattle and humans) to magnetic fields is essentially the same as air; therefore, assumptions of resistance based on specific absorption rate (SAR) of a gram of fat have little relevance for estimating the effects of electromagnetic fields on the health of living specimen.**
20. **I recommend that the FCC reevaluate effects of exposure to uncontrolled radiofrequency currents from all sources on human and animal health before promoting or permitting any further wireless EMF saturation of the living environment.**
21. **Federal Communication Commissioners must weigh the cost of radiofrequency electropathic stress to human suffering, additional medical and hospital insurance cost, and damage to the animal industry economy versus further uncontrolled expansion of Broadband until the financially vested interests have proven the safety of the product they wish to impose on an unsuspecting public.**
22. **I personally observed and was involved in such Tests and Measurements as set forth above.**



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AFFIDAVIT OF LISA TULLY

State of Colorado     ]  
                                  ]  
County of Boulder     ]     ss.

LISA TULLY being duly sworn deposes and says:

1. My name is Lisa Tully. I live at 27 Arrowleaf Ct., Boulder, CO 80304
2. I have a background in medical research with a PhD in Pharmacology and Toxicology from the Indiana School of Medicine. I am currently involved in developing a diagnostic test for electrohypersensitivity. It is such a new disease there is no test for it. More and more people are becoming sick, some are being severely debilitated.
3. I have reviewed some of the literature on the health problems associated with radio and microwave frequencies, which clearly demonstrates harmful biological effects at much lower exposures than the FCC standards for exposur. The FCC's current RF exposure guidelines are inadequate in light of the findings of current science.
3. Furthermore, because of the number of cell service carriers operating in our area, there are many overlapping signals and standards exist only for single source radiation, which does not exist. Therefore, individuals are being exposed to much higher levels.
4. I am very concerned about health effects of long-term continuous exposure to one or many signals, which has not been studied. We are in the midst of a frightening experiment.
5. I do not want to be exposed to the harmful frequencies produced by the government-sanctioned rollout of new technologies with insufficient safety standards.
6. We need stronger FCC standards and the enforcement of such standards to prevent be health hazards of this low level radiation over time.
7. I have a right to be safe in my home and workplace, and I have a right to current safety standards based on current science. These standards are not based on harmful biological effects.
8. I understand that the EMR Policy Institute is preparing comment to submit in the current Federal Communications Commission proceeding to develop the policy for providing high-speed internet service throughout the country - FCC 09-31, A National Broadband Plan for Our Future.

EXHIBIT 4

9. The undersigned hereby designate The EMR Policy Institute to speak on my behalf on this FCC proceeding for the purpose of defending our rights to be safe in our own home, in our schools and our workplaces and neighborhoods from the invasion into our home, schools and workplaces of signals that may cause harm to us.

16. I ask that the FCC accept this affidavit and the attached exhibits into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future, as it is material evidence of the existence of signals to which I am subject, yet without proper standards based on current science.

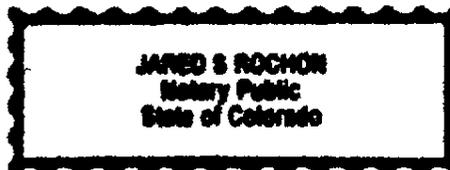
Sworn to before me

Lisa Tully  
Lisa Tully

*Lisa Tully*

This 2 day of June, 2009

Jared S. Rochon  
Notary Public



*expires: 08-28-2012*

AFFIDAVIT OF JOHN BERTEL SCHOU

State of Iowa ]

] ss.

County of Black Hawk ]

JOHN BERTEL SCHOU being duly sworn deposes and says:

1. My name is John Bertel Schou. I currently live at 6117 and 6621 West Ridgeway Avenue in Cedar Falls, Iowa 50613 with the latter being the farm address. My mailing address is P.O. Box 249, Cedar Falls, Iowa 50613.
2. I have been in Cedar Falls, Iowa for 29 years, prior to which I lived in St. Louis, Missouri.
3. My home is at 6117 West Ridgeway Avenue, Cedar Falls, Iowa. Our (my wife and myself) farm/business is located at 6621 West Ridgeway Avenue, Cedar Falls, Iowa where I both live and work and do research on the environment and especially on crop responses to treatments imposed on the soil and crops.
4. I am a research scientist with a doctorate in crops and soils known as agronomy from Michigan State University in or about 1973 and subsequently worked on a postdoctorate at Ohio State University at Wooster, Ohio for two years prior to working with Monsanto for five years in St. Louis, Missouri. I was a senior research scientist at Monsanto with field research on plant growth regulators at the corporate office in Creve Couer, Missouri.
5. While at Ohio State University my research was in the lab and field and dealt with carbon dioxide effects and plant growth regulator effects on soybeans. My doctorate work at Michigan State had been on the effects of several fertilizers on leaf and soil nitrate levels and included work with N15 materials that were analyzed on gas chromatographs and mass spectrometers.
6. I was in the medical corps with the United States Army and was trained at Fort Sam Houston, Texas and later taught in the Army Reserves Chemical- Biological- Radiological courses in Michigan and elsewhere.
7. Research conducted at ACRES – agricultural custom research and environmental studies has involved radiolabel work and testing for yields of crops as influenced by various fertilizer, herbicide, and growth regulator treatments including tillage and planting systems.

EXHIBIT 5

8. Since the realization that my wife Diane was able to detect and was influenced by radio frequencies even below detectable as well as detectable limits on meters we own and other meters we have worked with I have been aware of radio frequencies and electrical fields in our environment and studied their origins.
9. My personal symptoms which I am attributing to changes in the environment especially radio frequencies and electrical fields or similar are based on epidemiological approaches which are associating symptoms with environments. Conditions which I have and continue to associate with these conditions and for which I am working on studies to measure glucose level changes in myself. Conditions include: sleep disorder (apnea) which I have, eye floaters which come and go and especially go when out of the environments with radio frequencies, hair growth which also proliferates outside the radio frequency environments, and tinnitus (ringing in the ears) which also abates when out of higher level radio frequency environments. Measuring glucose levels in my system and especially the blood has shown higher levels around higher electrical environments.
10. I have seen Diane in a remote, low-level electrical environment in Nicaragua on the island of Ometepe where she responded with increased glucose sugar levels when close to a measured electrical field and this occurrence was repeated like five times. Her glucose sugar levels varied from 120 in low conditions to 160 in higher electrical environments. Insects also avoided these electrical fields as well. The fields were measured with meters we had and were in volts/meter square. I do not remember the readings as this was approximately four years ago while we were still new and studying the conditions she experienced.
11. I notice more frequently now the effects on AM radio in many areas where electrical fields illustrate the effects from power lines or other electrical sources.
12. It is logical from a scientist's view (my majors and minors were biochemistry and plant physiology and agronomy with approximately 60 hours of chemistry) that different people can react in many different ways as biological systems respond to low level effects of chemicals or electrical fields.
13. For safety from radio frequency fields it is recommended by me to go to buried cable and fiber optical systems which provide efficiencies, security, and protection from elements of the environment on the systems themselves.
14. I have missed living with my wife while I need to work in Iowa for an income on our research operations there and my wife needs to be protected and lives in the radio quiet zone of West Virginia. This separation for a major part of the year does affect our lives in many ways and causes hardships when we need to work together on projects and be together for social and personal companionship.
15. My concerns are that exposure levels are far too high and everyone is affected and only those with sensitized systems are showing the most visible effects now. In

other words they are the canaries in the coal mine showing the first visible symptoms of major problems for all. Scientists have warned it can be far worse than asbestos or smoking.

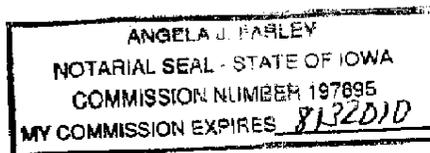
- 16. I recommend that measurements be made of intensities of electromagnetic and electrical fields and radio frequency information be made available through more use of meters and trained personnel that can associate the problems with the conditions in environments. The number and intensities of radio frequencies are increasing and pose challenges. If we as a society can help to improve people's lives the efforts are worth the investment of time and energy.
- 17. The proven method of removing many of the symptoms has been to remove the person from the conditions or turn off the source of the problem. This is not a welcome alternative to the communications, military, and power industries, but should be weighed in the balance of overall costs to the society. A balance should be able to be found and the effects are known to be real by all of the above groups. People who have symptoms need safe areas to retreat to and live in.
- 18. The FCC can and should be more proactive and do much more than sending out brochures, registering tower sites and ham radio operators, and holding meetings.
- 19. We understand that the EMR Policy Institute is preparing comments to submit in the current Federal Communication Commission proceeding to develop the policy for providing high-speed internet service throughout the country – FCC 09-31. A National Broadband Plan for Our Future.
- 20. The undersigned and all the persons in our household hereby designate The EMR Policy Institute to speak on our behalf on this FCC proceeding for the purpose of defending our rights to be safe in our own home, in our schools and in our workplaces and neighborhoods from the invasion into our home, schools and workplaces of signals that may cause harm to us, because the FCC's current RF exposure guidelines are inadequate in light of the findings of current science.
- 21. I ask that the FCC accept this affidavit and any attached exhibits into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future, as it is material evidence of the existence of signals to which my family and I are subject, yet without proper standards based on current science.

*John Bertel Schou*  
 \_\_\_\_\_  
 John Bertel Schou

Sworn to before me  
 This 4 day of June, 2009

*Angela J. Parsley* \_\_\_\_\_

Notary Public



AFFIDAVIT OF DIANE SCHOU

State of West Virginia     ]  
  ]     ss.  
County of Pocahontas     ]

DIANE SCHOU being duly sworn deposes and says:

1. My name is Diane Schou. I currently live at RR1, Wesley Chapel Road #58, Green Bank, West Virginia. My mailing address is P.O. Box 99, Green Bank, West Virginia 24944-0099.
2. I have been in Green Bank, West Virginia for 2.5 years, either sleeping in my vehicle or camping in a house that is not finished.
3. My previous home was at 6117 West Ridgeway Avenue, Cedar Falls, Iowa.
4. My husband, John Bertel Schou (Bert) and I have a research farm/business located at 6621 West Ridgeway Avenue, Cedar Falls, Iowa. Inside a converted barn, we have an office.
5. My husband is a scientist (Ph.D.) and does research in the environment. I have both a Ph.D. and M.S. in Industrial Technology and a B.S. in Human Ecology.
6. I was injured by electro-magnetic radiation and thus became aware of the correlation of technological trigger sources and the unfortunate health consequences. Within nine months after a new cell tower was activated, my health deteriorated and it was linked to emissions from that cell tower. I had to leave our family farm which meant living away from my husband who still farms there. The only documented, proven, repeatable solution to regain health is no exposure. I went to remote areas. It was stressful to abandon home, career and future/dreams in order to avoid exposure. Seven years ago I would not have believed in the seriousness of electro-smog. I am now in the quiet zone in West Virginia (Stewart, 2009), another remote area, safer, but not perfect. U.S. standards are grossly outdated and do not reflect current scientific research.
7. In 2002 cell tower (U.S. Cellular) was built about 1/3 mile from our home at 6117 West Ridgeway Avenue, which is also about 2/3 mile from our farm/office/lab at 6621 West Ridgeway Avenue. I did not like it, but I did not worry about it.
8. After the cell tower was built and activated, I became ill. By 2003 the symptoms then included rash, hair loss, wrinkled skin, changes in vision (difficulty focusing to read), fatigue, nausea, difficulty sleeping. These are the symptoms of radiation poisoning or radio-wave sickness.

EXHIBIT 6

9. When I became ill from a headache, I went to the doctor. Headaches are not normal for me.
10. My family doctor found other problems: thyroid changes and diabetes.
11. My husband and I observed and confirmed my health responses to the cell tower. We thought we discovered the cause. See [Exhibit A]. When driving home from the west, I experienced a small headache which kept growing as we continued eastward. This was unusual because I rarely got headaches and it was strange a headache started small and grew more and more painful. A sudden headache hit me when I drove home from Cedar Falls, heading south on Hudson Road, just past Union Road. Both of these headaches occurred again and again and again. I am not prone to headaches. The wallop headache occurred when I approached the top of a hill to the line-of-site to the cell tower.
12. We contacted U.S. Cellular, we thought we would get help, either the emissions turned off or directed away from us. A letter of denial was sent to us. We contacted FCC, they only sent us a brochure that was safe.
13. Changes in health appeared about nine months after the cell tower (U.S. Cellular) antennas were activated,
14. A radiation specialist deduced the headache may be warnings, the neurons/cells were either being injured or being killed. Two papers report this happening, there are many more: Firstenberg, A. (1997). *Microwaving our planet: the environmental impact of the wireless revolution* (2nd Edition ed.). Mendocino, CA: Cellular Phone Taskforce. Salford, L. G., Brun, A. E., Eberhardt, J. L., Malmgren, L., & Persson, B. R. (2003). Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. *Environ Health Perspect*, 111(7), 881-883; discussion A408.
15. The emissions (I learned is called non-ionizing radiation) from the cell tower (U.S. Cellular) near our home may have accumulated in my body to become overexposure. At that time, I found myself sensitive to and harmed by a cell towers owned/operated by U.S. Cellular. It seemed I did not feel headaches from AT&T, Cellular One, nor Verizon. I do not know why.
16. I continued living at home, but, was becoming unable to do many things.
17. One night in 2003, things came to a crisis. I could not sleep. It was about 2 a.m., my head was hurting. The situation had become unbearable. My husband got me immediately away. I did not pack. I've never been back except for one 20-minute visit.
18. I have lived or slept in my vehicle or a hatchback since (2003 to present).
19. Since I had not prepared to be away from home, I have been without many items. It has been difficult. Try to ask your husband to find and bring your items he has

never used and probably never looked at. It has been over six years. There were some successes, but there are still many voids.

20. To escape the cell phones (especially U.S. Cellular), I went to Norway (my son was a student there and at that time American and Norwegian cell phones and carriers were different). There I learned about radiofrequency effects and to how to measure frequencies using a spectrum analyzer.
21. After a couple of months of being away, I tried to return home. I did not feel any headaches. It was thrilling to be home! Unfortunately, in maybe 20 minutes, I felt the sickest I had ever been. Rash, headache, shaking. Was this radiation sickness? I tried to visit my doctor to confirm this, but the clinic and his associates were too busy.
22. At this point of re-injury, a new symptom: headaches when others used cell phones.
23. Sadly, I cannot go home without consequences of headaches, thyroid problems, rash, from the cell tower. Even a drive-by is too much radiation.
24. My husband and I searched remote areas in my vehicle looking for a place without cell phone reception. We wanted it to be a place where Bert could sleep and yet be able to continue his profession on the research farm/business.
25. I returned to Norway with my spectrum analyzer and returned to places where I had experienced discomfort. A Faraday cage at a Norwegian research facility was demonstrated to have a leak. A location in a shopping mall had an inappropriate antenna. In the corner of a room where I had felt better, the spectrum analyzer confirmed low levels of electromagnetic radiation. One night, I had a throbbing headache and the spectrum analyzer measured pulsing frequency spikes. I could turn off the scientific instrument, but the pounding headache did not go away. I had to find protection.
26. I learned about a community in Snowflake, Arizona where there were people who were electromagnetic radiation sensitive and or multiple chemical sensitive. It was one alternative to being ill or to remaining homeless. We traveled to Arizona, looked at other areas in Missouri, Arkansas, New Mexico, and especially Socorro the Very Large Array radio telescope.
27. In Snowflake, AZ, we visited Susan Molloy. Bert started coughing up blood not long after we had arrived. We left immediately for emergency at a hospital. By the time we got to emergency, the bleeding had stopped. We continued to California, driving up a mountain, the coughing bleeding started again. A trip to Mayo Clinic emergency diagnosed a ruptured blood vessel in Bert's lung. It was possible the higher altitudes triggered it. It was recommended we stay near the clinic for a few weeks. We used this time to explore, looking for a safe place free from electromagnetic radiation.

28. Bert found a small village and a campground surrounded by mountains. The tiny population would likely discourage a cell tower. We stayed there overnight; we extended our stay to three months, then to a year, then put a deposit on a park model for me to stay permanently.
29. With me in Arizona and our research farm in Iowa, my husband's only choice was to commute this long distance.
30. When I lived in a remote village in Arizona, I enjoyed the many activities (even though I was confined to that valley).
31. Eventually I became sensitive to electrical/magnetic fields, electrical appliances (coffee makers, vacuum cleaners), fluorescent lights, DC lights, ceiling fans, refrigerators, furnace blower motors, space heaters, electric water heaters, power lines, coffee makers, speakers, electrical instruments, electrical cords, power lines, small and large transformers. I could not go for walks (power lines and peoples air conditioners), when a person in another room ran a coffee maker, it hurt. I telephoned Bert and cried in pain when aircraft flew over.
32. In less than 24 hours, I returned to Sweden and Norway once more, to escape 60 Hz fields. Both Sweden and Norway electricity use 50 Hz. I was amazed to not feel pain from a coffee maker. Two electrical things still triggered pain: refrigerators and fluorescent lights.
33. I spent 3 ½ months searching for a humane place to live. I found some cell towers and cell phones injured me. Ones that did not, four days exposure, I developed a sensitivity to. Much of the time, I lived in a hatchback. I met many electromagnetic radiation sensitive/injured people. At one point, I reacted strongly to my notebook computer, that I had kept on and running nearby. Towards the end of the three months, I began reacting 50 Hz electrical devices.
34. Doctors reports of my injury from electromagnetic radiation are enclosed.  
[Exhibit B]
35. Return to United States. My sensitivity to 60 Hz had lessened. I try to be careful. I do not want to get back to that extreme sensitivity again.
36. I returned to Arizona and continued house hunting. When a cell phone booster antenna was put in nearby, the radiation sickness symptoms returned.
37. To bring me closer to my husband in Iowa, a system was created where I could be in a Faraday cage (blocking radiation from the cell tower).
38. When electrical transmission lines were installed near a Faraday cage my husband and friends built for me, the electromagnetic radiation emissions penetrated the shielding. Again I had to leave and once more I was homeless.

39. I went to the radio-quiet zone in West Virginia. I am tired of being homeless. Since the research farm cannot be moved there, my husband commutes from Iowa.
40. When people (tourists, visitors) bring cell phones, the electromagnetic radiation injures me. When some vehicles drive by, I feel pain. Possibly the vehicles have cell phones (and maybe GPS tracking emissions) which is harmful to me.
41. I had lost hair on my legs, under my arms, and in my pubic area. It grew back when I moved to Green Bank, West Virginia in the radio quiet zone.
42. When I leave the radio-quiet zone to where there is one or more cell towers, I get a rash, headache, ringing in the ears, fatigue, chest pain, diarrhea
43. I enclose a newspaper article describing my condition. [Exhibit C]
44. Concern: Wi-Fi has never been properly tested for safety.
45. Fiber optics instead of wireless communication / emissions would satisfy many safety concerns.
46. Concern: Electromagnetic radiation is not contained, it is invisible, permeates through walls, is far reaching and exposure is involuntary. It goes through curtains, walls, ceilings and floors. There is increasingly no place to escape exposure. Continual, persistent exposure becomes overexposure and health deteriorates.
47. I do not know of anyone who *chooses* to be exposed to electromagnetic radiation.
48. Concern: Use of technological devices has immediate gratification.
49. Concern: Please provide access to meters that can log and meters that can report (plus the necessary antennas) to us all frequencies and amplitudes (power levels). A correlation needs to be available between the immediate gratification of technological devices and immediate danger of invisible electromagnetic radiation.
50. Concern: Installing nationwide wireless broadband and broadband over powerlines has to be halted.
51. Concern: current Wi-Fi needs to be turned off.
52. Concern: Federal regulations should not mandate technologies while prohibiting the raising of health concerns. Example, if you were a manufacturer of a car and you knew the auto industry couldn't be sued, would that be right for the public? Example, if you were in the food industry and you knew you could not be sued for health reasons, how careful would the food industry be? In the advancement of technology, if you were an honest and helpful company, would

you even consider a bill with section 704 in the telecommunications act denying the right to health and wellbeing? Please rescind this bill. To force change while denying assurance of safety is wrong.

53. Electromagnetic radiation emissions are completely un-natural and present exposures never before experienced by life (animal or plant) on this planet. There is every reason to comprehend they are harmful. Please view and listen to:
- Belpomme, D., Adlkofer, F., Hardell, L., & Johansson, O. (2009). Electromagnetic fields on our health, Technologies sans fil: un nouvel enjeu sanitaire <[http://www.robindestoits.org/Colloque-au-SENAT-Electro-hypersensibilite-EHS-Appel-des-scientifiques-europeens-23-03-2009\\_a777.html](http://www.robindestoits.org/Colloque-au-SENAT-Electro-hypersensibilite-EHS-Appel-des-scientifiques-europeens-23-03-2009_a777.html)>: Robin Des-Toits: Colloque au SENAT - Electro-hypersensibilité (EHS) : VIDEO de l'appel des scientifiques européens - 23/03/2009. And see [Exhibit D]
54. I have long been sensitive to wireless communication. With the expansion of Wi-Fi, my problems are increasing.
55. Wireless internet now injures me. Symptoms include headache. The headache goes away when the emissions are turned off or I leave.
56. I have reacted to cell towers 10 miles away. A spectrum analyzer was used to verify radiation levels were present. Wireless broadband already gives no relief to those suffering.
57. Concern: My life and the lives of others are threatened.
58. Concern: Don't we have the right to life?
59. Sometimes the pain from electromagnetic radiation is instantaneous.
60. Sometimes the injury may not be felt instantly. (I describe it as similar to sun exposure and becoming severely sunburned, feeling it later. When severely sunburned, a little bit of sun or hot water or heat from an appliance is too much)
61. An amazingly very small amount (too little to measure) may injure.
62. Recovery may take minutes to weeks, *if the injured cells do heal*. Cells may remain injured (such as changes in RNA, DNA, chemistry, cell structure, or cancer) or die (dead cells are not cancer). [Exhibit E]
63. New symptoms – chest pain – has appeared.
64. When exposed to electromagnetic radiation, symptoms of mental confusion occur, including incorrect spelling, writing, using wrong words, problems in counting. Sometimes it is painful to think. I can forget how to move muscles to walk, how to write. Sometimes I'm not sure where I am and how to open the shower door to get out.

65. I have not been able to find a hospital for medical care that will not injure me with electromagnetic radiation
66. Concern: Medical facilities present severe problems for me and other sensitive people. An accident occurred; I was taken to emergency. In the X-ray room, I experienced acute pain from electromagnetic radiation and said so. The medical staff told me that the X-ray room was the safest place in the hospital. They did not believe me. I repeated something in the room was wrong! I had a painful headache likely from something in the room. I asked to reduce delays and to get me out quickly. A hospital person entered the room, heard me and remembered that a week earlier Nextel had installed an antenna for wireless communication in the X-ray room. Here was an unplanned double-blind study. It took days to recover from the likely up-close or overexposure.
67. When husband had triple by-pass surgery, I was unable to be there with him as the electromagnetic radiation exposure in the hospital setting would have made me ill.
68. Concern: Electromagnetic radiation can distort medical tests. The symptoms from electromagnetic radiation can actually confuse the proper treatment due to the effects from electromagnetic exposure such as Type 3 Diabetes.
- (Havas, M. (2008). Dirty electricity elevates blood sugar among electrically sensitive diabetics and may explain brittle diabetes. *Electromagn Biol Med*, 27(2), 135-146)
69. Concern: The functioning of medical personnel may be impaired by their exposure. An unexpected observation/experience led to my awareness of how staff could be unwittingly affected by electromagnetic radiation. My dentist and the assistant both commented how relaxed each felt doing the dental work (my tooth had broken and needed repair). They noted this comfortable/relaxed feeling was unusual. What was different? They had turned off all the compact fluorescent lights, keeping on only the incandescent operation light and the dentist's LED head gear, to accommodate my electromagnetic radiation disability in this minor emergency. These two professionals were unaware they may be electromagnetic radiation sensitive, yet each noticed their health was better without CFL lights. A second visit about a year later, the same response.
70. Concern: Doctors need to be trained to diagnose electromagnetic radiation injury. We are all being exposed to electromagnetic radiation and we are getting incrementally weakened from electromagnetic radiation whether they know it or not.
71. Concern: Medical facilities present severe problems for me and other sensitive people.
72. Where there is electromagnetic radiation, people sensitive/injured try to avoid exposure, they don't go. When I suspected I had a broken toe, I did not go to

emergency. The cell towers, cell phones, fluorescent lights, computers, wireless communication would likely cause greater damage. I did not obtain medical care when I had a red itchy eye (a person with conjunctivitis visited three days earlier). I did not obtain medical care when I had a fever, a cough and a sore throat (it felt like when I had the mumps as a child).

73. I did obtain medical care when I discovered a lump in my breast. Consequences of hospital experience was: mammography showed no cancer, 3 days diarrhea, 5 days tender breasts, 7 days headache. (20060804)
74. Concern: Accommodations are unavailable in hospitals.
75. University of Iowa Hospital and Clinic *"Absolutely no way will we be able to accommodate EMS people"* (20070108)
76. A facilities director at a major university hospital responded to my letter: *"Reading the documentation that was sent makes it clear that anyone with a sensitivity to high frequency electromagnetic radiation should **stay far away** from The University of Michigan Health System because we emit a lot of it between the various electronic systems that are in use."* While this is a statement that acknowledges the condition, it makes it impossible to enter the hospital for treatment.
77. In West Virginia I am unable to locate a hospital should there be an emergency. The West Virginia Institute of Occupational Medicine responded to my search for medical care: *"I am not able to locate any medical facilities that meet your needs. I am sorry and hope that you have recovered from your cut."* (20090621)
78. To be forced to live in a Faraday cage, a shield from wireless communication that people cannot turn off is inhumane. [Exhibit F] But worse yet, deterioration of health, from un-natural electromagnetic radiation is torture.
79. This past week there was an announcement that the airlines will be installing Wi-Fi in many of their aircraft. Radiofrequency is known to cause heart arrhythmias in some individuals. While this could be extremely discomfoting to passengers, reactions to electromagnetic radiation could be potentially serious if a pilot were affected; the results could be tragic.
80. Exposure symptoms include heart arrhythmias, headaches, fatigue, numbness, muscle spasms, rash, itching, vision changes, confusion, difficulty in multi-tasking, slowness in thinking, problems comprehending numbers correctly.
81. Passenger convenience is no excuse for taking unnecessary risk.
82. When further studies confirm the dangers of Wi-Fi, airlines may find themselves liable for installing technology that put passengers lives at risk.
83. To be unable to return home without being harmed and without anywhere to go, and not knowing where or when you can sleep that is safe I call homeless.

84. Escaping electromagnetic radiation means relinquishing comforts most Americans have taken for standard: hot water, heat, access to food, running water, our home, friends/family, occupation, our dreams/future. Survival is primary. Conditions, in my opinion, personal experience and observation of others, are inhumane.
85. People injured by electromagnetic radiation often forego technology and live in primitive conditions.
86. Concern: protected zones from current technology are urgently needed. Newer technologies (the technologies that emit invisible dirty electricity or electro-smog) will create desperate situations for the sensitive and will likely affect the health of everyone.
87. One convenience (that most people in the United States have and what I wanted but did not have) was hot running water to take a shower. Trying to find safe shelter over the past few years, I have had to gathered water from a waterfall from snow melting, when the snow disappeared from a puddle. When I got to a store (40+ miles one-way), I bought water or filled plastic jugs or pails with water. I heated the water to sponge bathe when facilities (such as a wood stove) were available. Sometimes I braved asking people if I could use their shower. A few people were understanding and volunteered use of their shower. Often I washed outdoors (watching and listening for approaching cars). Friends and family who came to visit found this intolerable and refused to use these primitive conditions.
88. Concern: government agencies are not protecting me. Economics and industry seems to have priority over health and life. Don't I have the right to life, the right to live without the invasion of invisible electromagnetic radiation, the right to a future?
89. Concern: exposure standards are inadequate and need to be readdressed using all relevant science, including the most current research which demonstrates, without question, the adverse effects of exposure to low levels of electromagnetic radiation.
90. Electromagnetic radiation injuries/sensitivities/health effects appear to be on the rise and ignored by the FCC.
91. Concern: the number of frequencies we are exposed to is increasing.
92. During the period when I was trying to find a safe shelter, my son felt stressed because his mother was homeless.
93. I am concerned about my husband's safety. Bert spends many hours farming and doing research. The plants do not wait for you to give them attention, weather has an unpredictable window. Because the cell tower emissions injured me, I am not there, I cannot check on him, take him meals, run to get parts, give

him assistance especially when the window of good weather is closing. Now he is on the farm alone, operating farm equipment. I am very concerned.

94. I could not make plans because I did not have security of knowing where I could stay or sleep. If there was electromagnetic radiation and if it made me ill, I needed to find somewhere else.
95. As a business owner, my husband needs to be at our farm. I was a co-owner and partner in our business. Yet, I could not be there, which was frustrating and economically devastating. What I had been doing in terms of management, is still undone.
96. Having been injured by electromagnetic radiation has created a financial strain. We sold half of our income producing farm to buy a house, so hopefully I will be able to live humanely in the radio quiet zone. Yet, my husband still lives in Iowa, because the research farm/business we built is there and it creates a financial strain for him to commute 2000 miles round trip. It creates a financial strain because I cannot help in areas that I managed. Overexposure from the U.S. Cellular cell towers electromagnetic radiation emissions disabled me. I am unable to be in environments that have a very small amount of electromagnetic radiation especially the kind from U.S. Cellular (extremely toxic, similar to a peanut allergy). Hence, I cannot pursue my career and my gifts, using the advanced degree I worked for.
97. Concern: Safe areas without electromagnetic radiation are seriously needed, areas near family, friends; safe areas where family, friends can live, so I and electromagnetic radiation injured persons do not have to be excluded. Better yet, the reverse, require wireless electromagnetic radiation be available inside phone booth like structures (keeping the emissions contained). People can enter the booths and use their devices.
98. Many normal activities present difficulties for me. Radiation from cellular, wireless, and cordless devices such as phones injure many electromagnetic radiation sensitive people. People have told me they experience sharp pains and sometimes progressive deafness. An old-fashioned corded telephone may be preferred. Using a speaker telephone at a distance is an option for some electromagnetic radiation sensitive people (including me).
99. Since cell phones, cordless telephones, and Wi-Fi can injure me. Please encourage the availability of corded telephones. I had no access to a telephone when I was homeless. The removal of pay phone and wired internet access leaves me (and others) with extremely limited to *no* communication options..
100. I had to climb over a seemingly tall snowdrift to call to make an appointment. I have had to stand in rain and use the telephone while trying to protect a document I needed for information. On Easter, my telephoning my family was scheduled. Still living in my vehicle, they could not call me. Standing at a cold

payphone was uncomfortable [Exhibit G], but was less painful and damaging than a cell phone.

101. In time consuming calls, the injury increases. I, the caller have to choose between the value of the telephone activity and the injury that is occurring.
102. I already react to Wi-Fi. I get some protection in the radio quiet zone in West Virginia, but it is not perfect, there are hot spots. Wireless broadband nationwide is a disaster happening.
103. We purchased an unfinished house in West Virginia in 2007. The interior was wall studs accessible for modifications for electromagnetic radiation protection. Unfortunately, there is not an expert here to help us design or build this protection effectively which meant we have to become knowledgeable.
104. Adaptations include putting electrical wires in conduits, burying distribution cable, putting electrical appliances at end of house the farthest distance away from living space, switch to turn off refrigerator (so I can access it). Fluorescent lights were removed from the basement because the electromagnetic radiation permeates the ceiling (and the floor of the room above) and injures me. I am still trying to solve heating in winter (either no heat or used a temporary wood stove, motors/fans/blowers injure me therefore no forced air nor heat pumps).
105. To date, I know of no one knowledgeable about heating systems that are safe for electromagnetic radiation sensitive/injured people like me. I am leaning towards radiators for the main floor and PEX floor heating for the second story. I do not know what to do with the always cool/cold basement, as the floor was already cement. As an injured person, forced air, motors, fans, blowers, electrical heaters are immensely painful. The common heat source in West Virginia is wood fed boilers. I doubt I have the strength to feed the fire with large logs. Trying to maintain a wood boiler during cold, snow, and rain would be very difficult for me. How will I manage when my husband is gone? He, himself, just had heart surgery.
106. Comment: One of the many inconveniences that many people injured by electromagnetic radiation is that they have had to leave their homes and their own beds. Since I left home and until May 2009, a month ago, I did not have a "normal" bed to sleep on.
107. We often receive indifference, ridicule or denials of health effects when we contact telephone industries, businesses, manufacturers, local, state and federal governments pleading for protection.
108. Concern: Measuring devices need to be available and results visible and logged so both you and we can measure and log the invisible man-generated electromagnetic radiation that we are exposed to.

109. Concern: It would be useful for people like me if someone would publish electrical field amplitudes, magnetic field amplitudes, and non-ionizing radiation frequencies and amplitudes on technological devices and appliances (in some device/appliance industries, this information is not required and hence is not measured), as well as the electromagnetic radiation environment in areas where one wishes to live.
110. There are many other people whose health responses have repeatedly been associated with certain trigger sources. Some people react seriously to electromagnetic radiation. The only collection of first hand reports of electromagnetic radiation injured people (that I know of). (Granlund-Lind, R., & Lind, J. (2005). *Black on White: Voices and Witnesses about Electrohypersensitivity. The Swedish experience* (J. Ganellen, Trans.). Sala, Sweden: Mimers Brunn Kunskapsförlaget PDF on-line: [www.feb.se/feb/blackonwhite-complete-book.pdf](http://www.feb.se/feb/blackonwhite-complete-book.pdf).) [Exhibit H]
111. When electromagnetic radiation emitting devices are installed, those of us sensitive to electromagnetic radiation have to move, leaving our family and friends and abandoning hope for a future, just trying to survive by avoiding injury from electro-magnetic radiation.
112. People with electromagnetic radiation sensitivity should have the right to: freedom from injury; freedom from threat; a right to a future
113. We understand that the EMR Policy Institute is preparing comments to submit in the current Federal Communications Commission proceeding to develop the policy for providing high-speed internet service throughout the country - FCC 09-31, A National Broadband Plan for Our Future.
114. The undersigned and all the persons in our household hereby designate The EMR Policy Institute to speak on our behalf on this FCC proceeding for the purpose of defending our rights to be safe in our own home, in our schools and our workplaces and neighborhoods from the invasion into our home, schools and workplaces of signals that may cause harm to us, because the FCC's current RF exposure guidelines are inadequate in light of the findings of current science.

I ask that the FCC accept this affidavit and the attached exhibits into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future, as it is material evidence of the existence of signals to which my family and I are subject, yet without proper standards based on current science

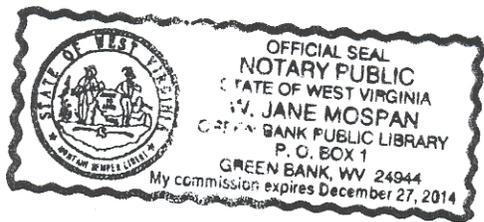
Diane D. Schou

Diane D. Schou, Ph.D.

Sworn to before me

This 5<sup>th</sup> day of June, 2009

Jane Mospan  
Notary Public



- 
- A Map of cell tower
  - B Letters from doctor
  - C Pocahontas Times
  - D Balmori
  - E Johansson paper
  - F Faraday cage photo
  - G Outdoor telephone
  - H black on white



Wide Northwest View



# Covenant Clinic

A member of the Wheaton Franciscan System in partnership with Schoitz Health Resources

602 Clay Street – P.O. Box 99  
Cedar Falls, IA 50613  
Phone 319/268-9600  
Fax: 319/268-9646

516 South Division Street  
Cedar Falls, IA 50613  
Phone 319/268-3550  
Fax: 319/268-3855

236 National Drive  
Waterloo, IA 50701  
Phone 319/272-0000  
Fax: 319/272-0016

January 17, 2006

## STATEMENT REGARDING SUBJECTIVE MEDICAL CONDITION

PATIENT NAME: SCHOU, DIANE D  
DOB: 02/27/1949

To Whom It May Concern:

Diane Schou has had symptoms that seem to have a definite relationship to the proximity of telephone transmission towers (and recently other electromagnetic activity). These symptoms have been predominantly headache, but have been enumerated by the patient to include: shaking, hair loss, sensitivities to cold and light, and fatigue.

Sincerely,



John Keiser, M.D.

JWK/lw

3819812

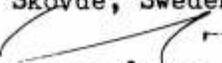
Statement about Diane Schou born in 27th of February 1949

I have spent two hours today talking with this patient, sitting in a valley close to my home where I have my office.

It is obvious that Diane is very sensitive to microwaves from mobile antennas and mobile phones, from power lines, fluorescent lights and other electric and electronic things.

Because of this sensitivity it is extremely difficult for Diane to find a place to stay.

Skövde, Sweden, 19th of August 2004

  
Ulrika Åberg

MD, specialist in child and youth psychiatry  
Stjärnvägen 29 with consultings rooms for amalgam  
SE 541 55 Skövde and electrosensitive patients  
Sweden

(+46) 500 43 36 42 phone

(+46) 500 43 45 31 fax

**Grace Ziem, M.D., Dr. P.H.**  
**Occupational and Environmental Health**  
**16926 Eyer's Valley Road**  
**Emmitsburg, MD 21727-9729**  
**Phone 301-241-4346 Fax 301-241-4348**  
**Website: chemicalinjury.net**

May 2, 2007

I did a detailed evaluation today on Diane Schou, Social Security [REDACTED], date of birth [REDACTED]

### **Medical History**

This very pleasant woman was in good health until the fall of 2002. She has a master's and Ph.D. degree in industrial technology and her husband is an agronomist. They were living in Iowa on a farm where her husband was able to conduct research related to his profession.

In the spring and summer of 2002 a cell tower for cellular phone transmission was built and activated close to their house with the transmission in line of sight with their house due to the terrain of the area. Rural cell towers require greater amplitude of radio frequency/electromagnetic power to be able to transmit to more distant locations.

In early fall she began to develop widespread hair loss, fatigue, rash and other symptoms, including frequent headaches which had never been a problem before.

Her son has professional training in physics and realized that many of her symptoms were compatible with those that could be induced by electromagnetic exposure. For example, her stabbing headaches on the back and top of the head would occur when she was within line of sight of the tower and improve or clear when she was in other locations. As she returned on repeated occasions from other locations, the headaches and other symptoms would develop when she was in line of sight of the tower, which would also be within exposure range.

As time went on her symptoms became increasingly severe such that she moved out of the house of April 2003. Unfortunately, by this time she had already developed chronic exacerbation to electromagnetic exposures. This regressed to involve many sources of electromagnetic transmission. She lived for a while in a park without significant problems until a cell tower was built in that location. At this time her symptoms again recurred and she had to move.

She spent 3½ months in Sweden a few years ago where most electrical devices are designed differently and had far fewer symptoms from electromagnetic exposure. She thus returned with improvement of symptoms but again experienced exacerbation with electromagnetic exposure.

### **Evaluation**

During my evaluation of several hours, she mentioned having a headache. I promptly opened the windows to allow fresh airflow. Unlike chemically injured patients, this did not improve her symptoms. I decided to determine whether there were electromagnetic emission sources that could be exacerbating this. I went out of my office without telling her what I intended to do. Near the wall directly behind where she was sitting in an adjacent room a laptop computer that had been used for computer-administered testing was on. I turned it off and entered the office about 30 seconds later.

She promptly asked me if I had done anything 30 seconds before, because she had noticed a prompt decline in her headache at that time. She had no way of knowing that I had turned off the computer.

Sometime later she again noticed onset of her headache. On this occasion I left the office to adjust the thermostat and thus cut off the air-conditioning. Again, she was not aware of what I had done. She again noticed significant improvement in her headache.

Her current symptoms include very significant fatigue, which can be very debilitating, recurring headaches, which are sometimes accompanied by significant reduction in vision, sometimes with significant balance disturbance, and some heightened light sensitivity. She also has intermittent episodes of dramatic slowing of her thinking process to a degree that impairs her ability to conduct functions which otherwise would be fairly automatic, such as difficulty thinking through the steps of taking a shower, eating a meal etc.

She is not able to utilize electric heat, has exacerbation with electric stoves, refrigerators, certain batteries such as for flashlights and other even moderate size batteries. She has obvious exacerbation with being near computers, air conditioners, baseboard heaters, fluorescent and energy saving lights: all this was directly observed in our office.

### **Physical Examination**

On exam her height is 5'6 ½ ", weight 218 #, blood pressure 120/78, pulse 64, respirations 14 and temperature 97.8°. Sinuses were nontender and thyroid was normal. No lymphadenopathy was detected. Heart was a normal sinus rhythm of 66 per minute without murmurs or ectopics and lungs were clear. She did have pain in the proximal interphalangeal joint of her right fourth finger with joint enlargement and reduction of range of motion and pain on motion. She did not exhibit widespread pain on palpation of other musculoskeletal areas except for the right second anterior rib space.

### **Neurologic Exam**

Her handgrip was somewhat reduced in grip strength with reduced endurance as tested by dynamometry. She had slight reduction in vibratory perception on the right at 128 cycles per second. She did not have resting tremor.

It should be noted that her physical exam was conducted a few hours after we had made maximum effort to reduce her electromagnetic exposure, and thus would greatly underestimate her response to such exposure.

### **Neurophysiologic Testing**

She had reduced simple reaction time on computer administered and analyzed testing. Her balance/sway testing was below predicted but technically within "normal range". Her visual contrast testing immediately following the computer exposure showed dramatic reduction in visual acuity of 20/40 in the right eye and 20/400 in the left eye. She had significant reduction of the visual contrast detection at this time in the macula and visual tract of the brain. I repeated this test

Re: Diane Schou  
May 3, 2007  
Page 3 of 3

several hours after maximum feasible reduction in electromagnetic exposure. At that time her visual acuity was 20/30 in the right eye and 20/25 in the left eye, documenting a very marked decline in visual acuity with electromagnetic exposure. In addition, several hours after reduction of electromagnetic exposure, her contrast testing showed significant improvement in the macula and visual tract of the brain.

### **Disability**

This patient has very significant disability. Her severe fatigue impairs her ability to climb stairs, in which she goes up a few steps, rests, goes up a few more steps and rests again etc. Her weakness and fatigue severely impair her ability to stand for an hour longer. It also interferes with her ability to do repetitive motion such as frequent bending, reaching, lifting, carrying, walking even relatively short distances, and doing household chores that require more than very minor energy, puts severe limitation on ability to wash floors, windows, vacuum etc. due to weakness and fatigue.

She has severe difficulty going to public places because of unpredictable exacerbations resulting in headache and unpredictable loss of vision and other neurologic and cognitive function with exposure to numerous electromagnetic sources. This impairs her ability to interact with people because her neurologic symptoms are exacerbated by cell phones, cordless phones and other devices in common use. Her weakness, fatigue, recurring headaches and very significant neurologic and visual exacerbation prohibit her from maintaining any regular work schedule.

She has limited ability to drive because of symptom exacerbation with power lines, cell towers and traffic control devices. She has not been able to locate a home thus far that she could tolerate. While she very much would like to pursue her work as a Ph.D. professional or other work, her history, which was validated by observations and test results in our office today, indicate the profound exacerbation related to electromagnetic sources. This encephalopathy (348.30), fatigue (780.79), and other effects of electromagnetic exposure (E926.0) render her totally disabled from all work.

Please feel free contact me for any questions or need for further documentation.

Sincerely,

  
Grace Ziem, M.D., Dr. P.H.

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Please feel free contact me for any questions or need for further documentation.

Sincerely,

  
Grace Ziem, M.D., Dr. P.H.

Please consider ways to establish access to means of communication for persons injured by electromagnetic radiation.

Radiation from cellular, wireless, and cordless devices injure many electromagnetic radiation sensitive people (radiation poison). They may not be able to tolerate being a distance away because these devices are becoming far reaching. These phones need to be turned off and batteries removed. Base stations unplugged and batteries removed.

Standing to talk at an outdoor payphone (a common resource): Exposed to inclement weather such as in down-pouring rain is logically wet and chilling but note taking on soaked paper (or exposing legal documents needed at the phone for reference) adds another challenge



The two photos showing access problems were taken Easter 2007. Communication with family via telephone during this special day has to be important. Other problems with this telephone was the telephone was frequently out-of-order. When it was repaired and is working, it is used often, even in bad weather. Access to telephone communication is a problem for electromagnetic sensitive persons. Telephones hurt; it seems it would be obvious that **communication via telephones by electromagnetic radiation injured people are not casual social calls.**

People with electromagnetic radiation injury should have the right to:

- Freedom from injury. Electromagnetic radiation (smog) is poisonous to people with electromagnetic radiation sensitivity.
- Freedom from threat. In addition to injury from electro-magnetic radiation, we received cruel condemnation when we contacted telephone industries, businesses, manufacturers, and local, state, federal governments pleading for protection.
- The right for a future.

When electromagnetic radiation emitting devices are installed, we, people with EMS, have to move, therefore closing our calendars and dreams, leaving our friends and becoming without hope for a future, just trying to survive

# ELECTRO-HYPERSENSITIVITY - THE SWEDISH EXPERIENCE

## Black on White

Voices and Witnesses about electro-hypersensitivity

Rigmor Granlund-Lind and John Lind, Stockholm, Sweden

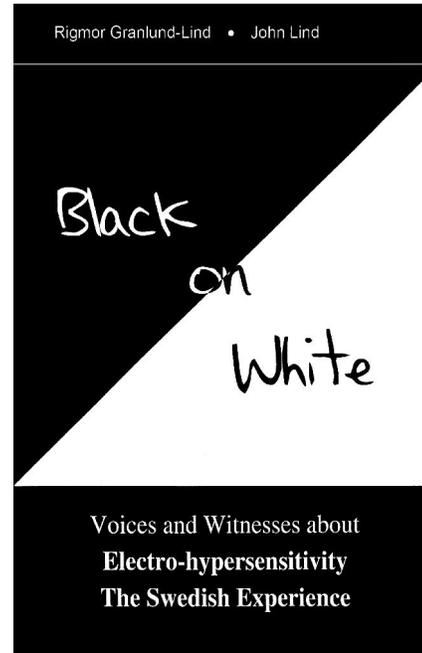
**What are the triggering factors of electro-hypersensitivity? What are the symptoms? What provokes them? What is the role of chemicals?**

Black on White is based on documents to the Council for Work Life Research in Sweden in March 2000 from more than 400 electro-hypersensitive people and from their relatives, doctors or engineers performing field reduction.

Here people explain what started their electro-hypersensitivity. They state the variety of factors giving symptoms. In 2000, symptoms were primarily caused by computers but to a large extent also by all electrical installations, fluorescent lights and low-energy lamps, cellular phones and base stations, radio, TV, cars, trains, airplanes, copiers and dental work such as removal of amalgam.

Among the symptoms skin problems top the list, followed by sensitivity to light, eye problems, problems with the heart and blood pressure, headaches, migraines, pain in joints and muscles, dizziness, concentration difficulties, nausea, memory disorders, endocrine reactions and many more. Other parts of the book are concerned with the role of chemicals, on the benefit of field reduction, on the “electro-refugees”, on the way health care institutions and political authorities deal with the problem.

The percentage of letterwriters with higher education was large – some of them were postgraduates and many were engineers – and they all had the ambition to describe their handicap in as much detail as possible for the benefit of future research.



### How to order the book Black on White:

The printed version of Black on White. Voices and Witnesses about electro-hypersensitivity (2005) is now available.

Mail address: [rigmor@gustafsson.info](mailto:rigmor@gustafsson.info)  
Telephone number: 0046 8 7451199

Price per book including postage charges:  
USD 18, EUR 15  
CAD 20, GBP 10

### International order:

Pre-paid order by postal giro together with your full delivery address to:  
Rigmor Lind  
IBAN SE48 3000 0000 0036 1112 1645 BIC NDEASESS

### Within Sweden:

100 SEK to Rigmor Lind,  
postal giro 361112-1645

**Do not forget to include you full delivery address!**



9. When my symptoms were at their worst, I unplugged my clock radio, which was on top of my dresser, in hopes that doing so might alleviate my tinnitus. There was no immediate change in my tinnitus, but in less than five seconds a muscle somewhere in my face relaxed. I had no previous awareness of any tightness, but had noticed previously that my face was becoming asymmetrical, and that sometimes it was hard to open my mouth fully.

10. I began unplugging all electronics in my home. My sleep improved somewhat. For at least a month I could not bring myself to believe I was being affected by these "weak" electromagnetic fields, thinking that if such effects were possible, they would have been discovered previously and addressed by government regulation. I began to pay attention to correlations with exposure. Several incidents eventually convinced me that electromagnetic fields were the actual cause. **A:** on a drive on a highway that I don't frequently use, my ears rang notably louder repeatedly, always just before a cell phone tower came into view. **B:** on a highway I drive frequently, I remarked to my companion that my ears started ringing, even though no tower was apparent. Just I was about to conclude that the ringing was sometimes spontaneous, I noticed some strange attachments to light poles around the opera house we were passing. My friend said they were just flag poles, but later measurements with a microwave detector confirmed they were strong microwave emitters (greater than 1 Volt/meter in the car). **C:** I drove past a cell tower and expected my ears to ring; they did not until a few seconds after I had passed the tower. The effect seemed not related to my anticipation of it, as I had stopped anticipating it by then. Other incidents not related to cell phone towers are described in paragraph 13 below.

11. I did a literature search to find out if tinnitus caused by microwaves had been reported. It had. The microwave hearing effect was first reported by Allan Frey in the early 1960's. The effect is a recognized phenomenon; Frey published a study of it in the journal Science in 1973. Although the effect is often described as sounding like clicks or buzzes, the character of the sound is said to depend on the modulation, such that any kind of sound is apparently possible. Some researchers describe the effect as tinnitus. The thresholds published by Frey were higher than my own, but were obtained with 80 decibels of background noise, and no long-term studies. Frey's thresholds are below the levels required for physiologically significant thermal heating.

12. Now I shield myself from microwaves when driving. I find that it takes much more stimulation now to get the same response (such as tinnitus), but after being close to a cell tower for a few minutes without protection I can become more sensitive for weeks. With shielding I have not noticed cell towers causing my ears to ring, but they will ring (more quietly) when driving in certain areas that have AC magnetic fields of about 1 milligauss or greater. If I go somewhere with low levels of radio-frequency radiation (less than 0.01 Volts per meter) and low AC magnetic fields (less than 0.05 milligauss), my tinnitus is usually gone, provided I was not acutely exposed in getting there.

13. Other experiences that convinced me electromagnetic fields were responsible for symptoms included: **D**: tinnitus starting within a couple seconds after I turned on a light controlled by a dimmer switch, and stopping within a few seconds after I turned it off again. **E**: I came home and while still near the front door felt my ears were ringing worse. I asked my wife what was on that could be affecting me. She said there was nothing. I assumed it must be just my ears. After enduring most of the evening in discomfort, I discovered she had left on a low-voltage light (which very likely had a switching power supply that contaminates house wiring with transients every 1/120 of a second) upstairs.

14. One of my neighbors (our townhouses shared a wall) had been using Wi-Fi since before 2007. Later I found out the neighbor on the other side also uses Wi-Fi. A few months ago I moved to my current address, where Wi-Fi is barely detectable. I immediately began sleeping better and my productivity at work improved dramatically. I still get tinnitus around computers, but it is not as bad as before. The reduced 60 Hz magnetic field and better air quality at the new house may be factors in my improvement..

15. I have continued to monitor sensations in my head and throughout my body. I find that I react to many (but not all) cordless phones, most microwave ovens (some from at least 15 feet away), probably almost all computers, Wi-Fi, most fluorescent lights, switching power supplies, and other electrical devices. I have not reacted to DC fields.

16. I have read some of the literature on provocation studies subjecting people claiming to be electrically sensitive to laboratory testing. In my professional opinion, the experiments by Dr. William Rea, published in the *Journal of Bioelectricity* in 1991 demonstrate the reality of these effects. Several subsequent studies by others did not find statistically significant effects. However, these did not, in the studies I read, follow Rea's carefully designed protocol. Any claim that these later studies prove the effects to be psychosomatic is unfounded. Experiments by N. Leitgeb et al., including "Investigation of electric current perception thresholds of different EHS groups" (*Bioelectromagnetics*, 2007), strongly support the opposite conclusion. A significantly increased fraction of people who claim sensitivity can detect smaller currents in their skin compared to most people.

17. Many other experiments show biological effects at low levels of exposure. I find Salford's experiments (*Environmental Health Perspectives*, 2003) showing long term nerve damage caused by short term microwave exposure in rats to be compelling. William Bise's experiments (published in the journal *Physiological Chemistry and Physics* in 1978), showing changes in human EEG at picowatts and femtowatts per square centimeter exposures are striking and should be assumed correct in the absence of evidence to the contrary. Many studies show effects on sleep caused by weak microwaves. These effects are complicated and not understood, but that doesn't make them any less real, especially to those of us who experience them on a daily basis.

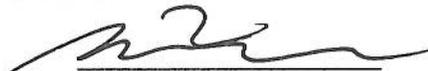
18. I know of several highly credible examples of people who respond to "weak" electromagnetic fields, that cannot be attributed to psychosomatic illness. These people include other scientists and engineers. Not every story is compelling, but in many cases the details of the observations, often with unexpected features that make sense on further analysis, make a convincing case. Another compelling example is of a child who is clearly affected by Wi-Fi, both in his behavior (including sleep problems) and his complaints of headaches, even though he seldom knows when he is being exposed (particularly when asleep).

19. The CDC last year expressed concerns about the epidemic of sleep problems in our country. Lack of sleep is expected to lead to many other serious health problems. The research on sleep effects from weak microwaves supports taking serious steps to reduce our microwave exposure, not increase it as more wireless broadband would do. Unless the federal government takes action to reduce our microwave exposure, our national health and productivity will, I expect, deteriorate more and more quickly. I fear for my own health, and the health and mental abilities of all of our children.

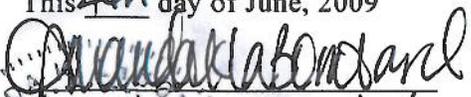
20. Recent research shows a strong correlation between Alzheimer's disease and living near extra-high voltage (EHV) power lines (Huss et al., Am. J. Epidemiology, 2008). Very recent studies indicate that Alzheimer's disease is caused in part by the widespread HSV-1 virus, but electromagnetic fields, which in many experiments affect the blood-brain-barrier, evidently help the virus enter the brain. That only EHV lines correlate with dementia suggests that the high frequency noise caused by corona sparks is the source of the problem. Note that the incidence of Alzheimer's went up nearly ten-fold in the late 1970's and early 1980's, just after microwave ovens (which all leak) became common.

21. I understand that the EMR Policy Institute is preparing comment to submit in the current Federal Communications Commission proceeding to develop the policy for providing high-speed internet service throughout the country - FCC 09-31, A National Broadband Plan for Our Future. I hereby designate The EMR Policy Institute to speak on my behalf on this FCC proceeding for the purpose of defending my rights to be safe in my own home and in public buildings.

22. I ask that the FCC accept this affidavit and the attached exhibits into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future, as it is material evidence of the existence of signals to which my family and I are subject, yet without proper standards based on current science.

  
William J. Bruno, Ph.D.

Sworn to before me  
This 4th day of June, 2009

  
Notary Public  
by 5/19/12





have flashing lights on top, etc. Her dentist cannot use a flashlight near her mouth because she will get lip, tooth and ear pain. One time she told me that her ears hurt when she goes to the library after they put in Wi-Fi. She is living a nightmare. I cannot imagine her being exposed to Wi-Fi 24/7 on top of all the rest.

10. I am very concerned for all our members in regard to Universal Wireless Broadband. I am certain that many of our Share, Care and Prayer members will suffer from that wireless exposure and I believe that many more Americans will become electrically sensitive.

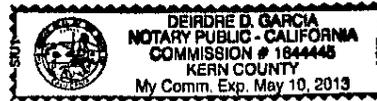
11. I am concerned that many more Americans will become chronically ill and not know why.

12. I am concerned for our country because I believe that many more people will become disabled, not be able to work and need care.

*Janet Dauble*  
Janet Dauble

Sworn to before me  
This \_\_\_\_\_ day of June, 2009  
\_\_\_\_\_  
Notary Public

State of California, County of Kern  
Subscribed and sworn to (or affirmed) before me on this  
4 day of June, 2009, by Janet Dauble  
proved to me on the basis of satisfactory evidence  
to be the person(s) who appeared before me.  
*Deirdre D. Garcia*  
(Signature of Notary)



**AFFIDAVIT OF DEBORAH CARNEY**

State of Colorado    ]  
                                  ]  
County of Jefferson    ]            ss.

Deborah Carney being duly sworn deposes and says:

1. My name is Deborah L.T. Carney. I live on Lookout Mountain at 21789 Cabrini Blvd, Golden, Jefferson County, Colorado.
2. My husband and I have lived at this address for 16 years. Our three children grew up here.
3. We live about one mile from high-powered TV and FM broadcast antennas.
4. The operation of these towers has given us concern ever since we discovered that we were at the same altitude as these high-powered beams of nonionizing radiation, our community has elevated brain tumor rates and that every resident with a brain tumor had a clear view to the towers. (Colorado Department of Public Health and the Environment's July 2004 findings that statistically significant elevated numbers of brain tumors exist in residents near the broadcast antennae towers atop Lookout Mountain.)
5. My concern increased when our community electrical engineers repeatedly measured RF in levels above the FCC limits and I discovered that the FCC almost entirely relies on broadcasters and other emitters to self police and self report.
6. I am an attorney with a B.A. in Human Biology from Stanford University.
7. I invested hundreds of hours studying the evolution of the FCC RF standards and current medical research on the subject.
8. I observed and heard the sworn testimony of the following physicians, scientists and experts to the Jefferson County Colorado Commissioners concerning the proposed rezoning of land for a high powered digital TV broadcast supertower for ABC, NBC, CBS and Twenver stations here.

NAME	TITLE	SPECIALTY	TOPIC	Hyperlink and CITATION
KELLY, Cindy	M. D.	Orthopedic Oncologist	Examination of Health Risks Electromagnetic Radiation	<a href="http://www.emrpolicy.org/litigation/caselaw/care/kelly.ppt">http://www.emrpolicy.org/litigation/caselaw/care/kelly.ppt</a> ; <a href="http://www.emrpolicy.org/litigation/caselaw/care/kelley_03.pdf">http://www.emrpolicy.org/litigation/caselaw/care/kelley_03.pdf</a> <a href="http://www.emrpolicy.org/litigation/caselaw/care/kelly_27apr99.pdf">http://www.emrpolicy.org/litigation/caselaw/care/kelly_27apr99.pdf</a>

EXHIBIT 9

				2003 R5608-26, 11729-36
<b>FRANKEL, Stephen</b>	<b>M.D.</b>	<b>Internal, Pulmonary, Critical Care -Cell Biology &amp; Cell Signal Transaction</b>	<b>Effects of RF Radiation on Human Health and Disease</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/frankel 03.pdf">http://www.emrpolicy.org/litigation/case law/care/frankel 03.pdf</a> ; <a href="http://www.emrpolicy.org/litigation/case law/care/Frankel.MD.ppt">http://www.emrpolicy.org/litigation/case law/care/Frankel.MD.ppt</a> 2003 R 5583, 11711-23
<b>WILKINS, Ross</b>	<b>M.D.</b>	<b>Orthopedic Oncologist Pres. Musculoskeletal Tumor Society</b>	<b>Epidemiology slow to react to evidence of harm-AIDS example</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/wilkins 1jul03.pdf">http://www.emrpolicy.org/litigation/case law/care/wilkins 1jul03.pdf</a> 2003 R 11659
<b>GOLD-SMITH</b>	<b>M. D.</b>	<b>Epidemiologist</b>	<b>The End of Innocence regarding RF</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/goldsmith 1jul03.pdf">http://www.emrpolicy.org/litigation/case law/care/goldsmith 1jul03.pdf</a> 2003 R 11660-1
<b>HOONTRAKOON, Raweewan</b>	<b>M. D.</b>	<b>Pediatrician &amp; Allergy</b>	<b>RF should be treated like vaccine preservative, if potential hazard avoid.</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/hoontrakoon 03.pdf">http://www.emrpolicy.org/litigation/case law/care/hoontrakoon 03.pdf</a> 2003 R 11931-2
<b>GRABOWSKI, Steven</b>	<b>M.D. M.P.H</b>	<b>Public Health Preventative Medicine</b>	<b>Do No Harm-Medical Code of Ethics should be followed here</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/grabowski 03.pdf">http://www.emrpolicy.org/litigation/case law/care/grabowski 03.pdf</a> 2003 R 11922-32
<b>PARDOS, George</b>	<b>M.D.</b>	<b>Ophthalmology</b>	<b>"Increased Sensitivity of Non Human Primate Eye to Microwave Radiation Following Ophthalmic Drug Pre-Treatment" by Henry A. Kues, Bioelectromagnetics 13:379-393 (1992)</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/Pardos.ppt">http://www.emrpolicy.org/litigation/case law/care/Pardos.ppt</a> <a href="http://www.emrpolicy.org/litigation/case law/care/pardos 27may99.pdf">http://www.emrpolicy.org/litigation/case law/care/pardos 27may99.pdf</a> 1999 R 6094-9
<b>POLAK, Paul</b>	<b>M.D.</b>	<b>Psychiatry</b>	<b>RF harms include severe sleep disturbance</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/polak 27apr99.pdf">http://www.emrpolicy.org/litigation/case law/care/polak 27apr99.pdf</a> 1999 R 6045-50
<b>REIF, John</b>	<b>D.V. M.</b>	<b>Principal Investigator</b>	<b>Health Effects</b>	<a href="http://www.emrpolicy.org/litigation/case law/care/Reif.ppt">http://www.emrpolicy.org/litigation/case law/care/Reif.ppt</a>

		of CSU Study of Lookout Mountain	Associated with Human Exposure to RF and 3 papers on the Lookout Mountain study	<a href="http://www.emrpolicy.org/litigation/case_law/care/reif_27may99.pdf">http://www.emrpolicy.org/litigation/case_law/care/reif_27may99.pdf</a> 1999 R 6100-8
LAI, Henry	Ph.D.	Bio-Engineering-U.W.	Biological/Health Effects of RF from RF Towers	<a href="http://www.emrpolicy.org/litigation/case_law/care/lai_27may99.pdf">http://www.emrpolicy.org/litigation/case_law/care/lai_27may99.pdf</a> 1999 R 6090-3
WITWER, John	M. D.	Radiology & State Rep.	An Increase in RF on Lookout Mountain should not be allowed	<a href="http://www.emrpolicy.org/litigation/case_law/care/witwer_27apr99.pdf">http://www.emrpolicy.org/litigation/case_law/care/witwer_27apr99.pdf</a> 1999 R 6058-60
LITOVITZ, Theodore	Ph.D.	Physics	Health Effects of RF at Levels below FCC Limits	<a href="http://www.emrpolicy.org/litigation/case_law/care/litovitz_1jul03.pdf">http://www.emrpolicy.org/litigation/case_law/care/litovitz_1jul03.pdf</a> ; <a href="http://www.emrpolicy.org/litigation/case_law/care/LitovitzCVFeb02.doc">http://www.emrpolicy.org/litigation/case_law/care/LitovitzCVFeb02.doc</a> 1999 R 1162-3
HOFFMAN	M. D.	Chief Medical Officer-Colo. Health Dept.	FCC RF limits do not protect from adverse consequences of long term exposure	<a href="http://www.emrpolicy.org/litigation/case_law/care/hoffman_27apr99.pdf">http://www.emrpolicy.org/litigation/case_law/care/hoffman_27apr99.pdf</a> 1999 R 6025-31
MATTSON, Roger	Ph.D.	Former director EPA Non Ionizing Division	No branch of government is watching out for RF hazards. EPA funding cut to \$25,000 for last 5 years	<a href="http://www.emrpolicy.org/litigation/case_law/care/mattson_27may99.pdf">http://www.emrpolicy.org/litigation/case_law/care/mattson_27may99.pdf</a> ; <a href="http://www.emrpolicy.org/litigation/case_law/care/mattson_03.pdf">http://www.emrpolicy.org/litigation/case_law/care/mattson_03.pdf</a> <a href="http://www.emrpolicy.org/litigation/case_law/care/mattson_jeffco_7.01.03.ppt">http://www.emrpolicy.org/litigation/case_law/care/mattson_jeffco_7.01.03.ppt</a> 2003 R 1178-84 1999 R 6176-84
OLINGER, Shirley		Nuclear Engineer	RF Health Hazards	<a href="http://www.emrpolicy.org/litigation/case_law/care/olinger_27may99.pdf">http://www.emrpolicy.org/litigation/case_law/care/olinger_27may99.pdf</a> 1999 R 6172-5
WYNES, Murry	Ph. D.	Immunology	RF Health Hazards and CSU study	<a href="http://www.emrpolicy.org/litigation/case_law/care/wynes_03.pdf">http://www.emrpolicy.org/litigation/case_law/care/wynes_03.pdf</a> 2003 R 11868-9

			shows that white cell counts increase with RF at levels below FCC limits	Affidavit- Jan. 26, 2007
<b>NOUFI, Rommel</b>	<b>Ph. D.</b>	<b>Physics and Chemistry</b>	Does not allow any RF exposure to staff at National Renewable Energy	<a href="http://www.emrpolicy.org/litigation/case law/care/noufi 29jun99.pdf">http://www.emrpolicy.org/litigation/case law/care/noufi 29jun99.pdf</a> 1999 R 6270-4
<b>CLARKE, Penny</b>	<b>Ph. D.</b>	<b>Electro Biologist and Health Physician</b>	U.of C. Oncologists & Scientists see adverse health effects from broadcast RF with potential to cause cancer.	<a href="http://www.emrpolicy.org/litigation/case law/care/cu oncologists %20letter.ppt">http://www.emrpolicy.org/litigation/case law/care/cu oncologists %20letter.ppt</a> <a href="http://www.emrpolicy.org/litigation/case law/care/clarke 03.pdf">http://www.emrpolicy.org/litigation/case law/care/clarke 03.pdf</a> 2003 R 11866-7
<b>MALLER, Jim</b>	<b>Ph. D.</b>	<b>Pharmacology</b>	Low Frequency RF produces DNA breaks that lead to cancer.	<a href="http://www.emrpolicy.org/litigation/case law/care/maller 03.pdf">http://www.emrpolicy.org/litigation/case law/care/maller 03.pdf</a> 2003 R 11820-1
<b>MARTIN, Jim</b>		<b>Electrical Engineer</b>	Children at Higher Risk from RF Radiation	<a href="http://www.emrpolicy.org/litigation/case law/care/martin.ppt">http://www.emrpolicy.org/litigation/case law/care/martin.ppt</a> <a href="http://www.emrpolicy.org/litigation/case law/care/martin 29jun99.pdf">http://www.emrpolicy.org/litigation/case law/care/martin 29jun99.pdf</a> <a href="http://www.emrpolicy.org/litigation/case law/care/martin 03.pdf">http://www.emrpolicy.org/litigation/case law/care/martin 03.pdf</a> 2003 R 11863-5

District Court, Jefferson County Colorado, 99 CV 2007. *Lake Cedar Group, LLC, v Board of County Commissioners of Jefferson County and Canyon Area Residents for the Environment, a Colorado nonprofit, Defendants-Interveners.* District Court, Jefferson County Colorado, 03-CV-3045. *City of Golden, CARE, et al v Jefferson County Board of County Commissioners and Lake Cedar Group, LLC*

9. These witnesses did not think the FCC RF standards adequately protected humans. I also conclude that the FCC RF standards do not protect against adverse health consequences to those exposed.

10. At two' clock AM in the last minutes of the 107<sup>th</sup> session, Congress voted in S. 4092, a hot lined bill, that took away my zoning protection on Lookout Mountain and allowed the broadcasters to construct a digital TV supertower that has increased the radiation levels into my home.

11. This supertower is now broadcasting radiation that trespasses into my home at levels that the experts testified in the Jefferson County zoning hearings was unsafe.

12. I have been a test subject in research on 300 residents in my community on the health effects of the Lookout Mountain broadcast antennas funded by the National Institute of Health. Several findings of significance are that as the amounts of electromagnetic radiation increase, the amounts of our white blood cells (T-Cells) increase as do estrogen levels in post menopausal women, even at levels 100 times under the FCC limits for broadcast radiation. Homes with wireless internet had elevated RF levels inside.

**“Radio frequency nonionizing radiation in a community exposed to radio and television broadcasting.”** Burch JB, Clark M, Yost MG, Fitzpatrick CT, Bach and AM, Ramaprasad J, Reif JS. Environ Health Perspect. 2006 Feb; 114(2):248-53.

**“Biomonitoring of Estrogen and Melatonin Metabolites Among Women Residing Near Radio and Television Broadcasting Transmitters.”** Clark M:L. Journal of Occupational & Environmental Medicine. 2007 Oct: 1149-1156.

**“Human Responses to Residential RF Exposure”** Reif, J.S., Burch, James, et al 2 ROI ES0008117-04 2005 Aug. “Human Responses to Residential RF Exposure.” John S. Reif, James B. Burch, Michael Yost Annette Bach and, Maggie Clark. August 23, 2005

13. I have asked the EPA officials why the EPA is not taking action to protect human health and investigated why the EPA shut down its office of Nonionizing Radiation.

14. I learned that the broadcasters were one of the industry members who pushed hard for the elimination of this office. I discovered that the EPA's funding for non-ionizing radiation has been virtually eliminated.

15. The EPA will not act unless the FCC specifically requests the EPA opinion on the safety of non-ionizing radiation.

16. The FCC has repeatedly refused to request that the EPA evaluate safety over the last decade.

17. I represented our community of 9,000 residents through CARE (Canyon Area Residents for the Environment) [www.c-a-r-e.org](http://www.c-a-r-e.org) in lawsuits, petitions and meetings with

the FCC opposing further licensing and permitting of high powered antennas in our community for over 10 years.

18. My extensive first hand experience with the FCC has led me to conclude that the FCC knows and cares nothing about human health or biology, seldom monitors the amount of RF being generated, acts only to promote the expansion of RF technology and is strongly biased towards industry desires.

19. "Hear no evil, See no evil, Speak no evil" aptly describes the FCC consideration of the health impact of RF on any living creature including human beings and the FCC's failure to adequately inquire into this area.

20. Our community's petitions to the FCC to stop licensing high powered antennas, for relief from blanketing interference and against Federal preemption of local zoning were ignored by the FCC.

21. I discovered and can document that the FCC had launched a strike force against our community's efforts opposing high-powered digital TV antennas with "Operation Buffalo Chips" where the FCC worked behind the scenes with the broadcasters to conceal from the community all the violations of Federal laws.

22. After learning how careless the FCC has been about the health impacts of high-powered RF, I have become increasingly alarmed about the expansion of wireless technologies using more and more frequencies and power heedless of long term health impacts because no Federal agency is acting to protect human health.

23. As a result of these concerns, I have volunteered as the Vice President of the EMR Policy Institute; have spoken at two Congressional Staff Briefings and the Presidents' Cancer Panel on the concerns of our community.

24. My presentation from the May 2007 Congressional Staff Meeting was submitted to the National Academies of Science Committee on Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices. This DVD of my briefing presentation was both shown and placed into the record of the August 2007 Washington DC NAS Workshop on this proceeding.

25. I am concerned that I may be becoming electro-hypersensitive. I now get head aches if I stay more than 15 minutes very near the TV Broadcast towers and after a few minutes on a cell phone.

26. At the current build out, there may soon be no place for the electrosensitive to live away from wireless RF.

27. Because of my concerns, I have installed shielding in our home and avoid using wireless technology whenever possible.

28. I do not want to be a guinea pig for the government-sanctioned rollout of new technologies with insufficient safety standards, or without sufficient knowledge about the long-term health effects of these wireless signals.

29. Without strong RF limits that actually protect health and the enforcement of such limits, I fear the hazards to our family's health of this low level radiation over time.

30. I am concerned about having to live next to antennas and transmitters if wireless internet is built out in our local environment. We have a right to be safe in our homes and our schools and workplaces, and we have a right to current safety standards that actually protect us from both immediate and cumulative health effects.

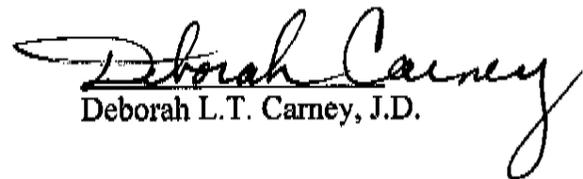
31. The EMR Policy Institute is preparing comment to submit in the current Federal Communications Commission proceeding to develop the policy for providing high-speed internet service throughout the country - FCC 09-31, A National Broadband Plan for Our Future.

32. The undersigned designates the EMR Policy Institute to speak on my behalf on this FCC proceeding for the purpose of defending my right to be safe in our own home, in my workplaces and neighborhoods from the invasion into our home, schools and workplaces of signals that may cause harm, because the FCC's current RF exposure guidelines are inadequate in light of the findings of current science.

33. I ask that the FCC accept this affidavit and the attached exhibits by hyperlink into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future GN Docket No. 09-51, as it is material evidence of the existence of signals to which my family and I are subject, yet without proper standards based on current science. The number of pages of this transcript testimony, PowerPoint presentations at hearings, studies, and FCC records would constitute would be prohibitively costly and voluminously cumbersome and hard to manage to copy to forward with this affidavit. However, if the Commission or any other entity requires hard copies, I will supply these upon request.

Sworn to before me

This 3<sup>rd</sup> day of June, 2009

  
Deborah L.T. Carney, J.D.



AFFIDAVIT OF NICOLS FOX

State of West Virginia

County of Greenbrier

Nicols Fox, being duly sworn deposes and says:

1. My name is Nicols Fox. I live at Windy Knoll, Brownstown Road, Renick, WV (Mailing address: HC 66, Box 461A, Renick, WV 24966)
2. I am a journalist of 28-years standing. For more than a decade I was a regular correspondent for The Economist magazine. My articles and essays have appeared in numerous US and international publications including The Washington Post and The New York Times. I am the author of four books, two of them on medical topics.
3. This affidavit is being composed on a manual typewriter because I can no longer use a computer. Nor can I be exposed to any electrical device. Exposure to radio-frequency radiation, especially wireless (wifi) or cell phone frequencies, produces documented and repeatable physiological effects that have had a serious detrimental impact on my health, my career and my life.
4. I have lived at my present address for only 10 months. Previously I lived on Mt. Desert Island, Maine, widely known as being one of the most beautiful places in America. I was forced to sell my business and my home, leave friends and a community that, over twenty-two years, I had grown to love, not just because of my growing electrical hypersensitivity, but because the progressive installation of wifi and the plan to turn the entire island into one wifi or "hot spot" zone presented a serious threat to, not simple my wellbeing, but to my life.
5. At great expensive and personal sacrifice, I had to move to an extremely rural area where cell phone reception is weak and for the moment there is no wireless. I have bought land and am building a small, off-the-grid house.
6. I am not looking forward to the struggle of using wood heat and oil lamps at my age and in poor health. But most of all, I fear that the proposed implementation of universal wireless broadband will threaten what little comfort and safety I have managed to achieve.
7. Since wireless broadcasts are no respecter of property rights; since I can not live in a house or on property that receives a wireless signal, I believe such broadcasts amount, under law, to a "taking."
8. My sensitivity began with exposure to an industrial-strength uninterruptable power supply (UPS) device that, over time, produced a sunburn-like effect on the right side of my body that first went away overnight, then only over the weekends, and then, not at all.

EXHIBIT 10

8. This continuous sunburn-like effect got my attention. I contacted an expert to find out what was going on. With his help I discovered that it was not my computer causing the problem (which I had suspected) but the UPS device. I unplugged it at once.

9. I was directed to the Swedish Association for the Electrosensitive (feb.se) where I learned about the condition. This site advised me to get off the computer.

10. I did not take that advice for two reasons: I earned my living at the computer, and the information from government sources was reassuring. The fields I was being exposed to were well below levels said to have any effect on the human body. While it was easy enough to find a few studies indicating that electric fields caused cellular changes, these were generally ignored or discredited in surveys conducted by governmental or non-governmental organizations. I put them out of my mind and continued to work.

11. One aspect of my condition was worrying, however. Could something with only a psychological cause produce a sunburn on only one side of my body? Nevertheless, with government standards to reassure me, I kept working.

12. My condition worsened. The sunburn vanished with the removal of the UPS device, but other symptoms appeared. First tingling and an unpleasant fizzy sensation. Then shooting pains. More severe pain in the hand that rested on the mouse. Burning on my face that caused me, almost unconsciously, to cover my face as well as I could with one hand or the other as I tried to work. Finally the pain in my hands, arms and shoulders became so severe that I would scream. Only then would I stop working.

13. I bought a new computer with an LCD screen. It helped only slightly. I bought a protective glove. Clumsy. I wore a protective scarf over my head. Little help. I changed careers. I opened an antiquarian bookstore. I made sure the shop had low EMF, at great expense. Soon everything about the antiquarian book business was on computers.

14. And then came wifi. At first I didn't know what was causing me such pain and fatigue. I didn't have a cash register--only a cash drawer. I had reduced my exposure to EMF to the greatest extent possible, and I was only getting worse.

15. Then my computer guy told me that my shop was picking up signals from the library and numerous other sources. Suddenly it made sense. I was no longer comfortable in the library, or in the grocery store next to it. Wifi was the problem. Out of it, I was fine.

16. I clung on for another year, becoming increasingly uncomfortable. Finally, I capitulated. I closed the shop and put my house on the market. As exposed as my house was to wifi, I couldn't even live there the last 10 months. I stayed at a friend's house.

17. By that time, I was discovering that wifi wasn't as benign as I was being told. I found there were many studies connecting radio-frequency radiation to adverse health effects. (Attachment 1)

18. I mentioned previously that two of my books were on medical topics, specifically, foodborne disease. While I am not a scientist, merely a journalist, I respect science and its methods. From the first triggering exposure even as my symptoms progressed, I was the skeptic. How could I be sure I wasn't inventing this in my mind? I was hard to convince.

19. The first real evidence was that I sometimes felt pain when I could discover no electric source; no source for emf. Then I got a gauss meter and found the problem: high fields in those areas produced by hidden sources that could be identified if I looked for them. (In one spot the circuit breaker was on the other side of the wall.)

20. My "denial" was made worse by my natural optimism. I wanted the symptoms to go away; I felt sure they eventually would. They did not. They worsened.

21. For some reason I also failed to make obvious connections. I suffered great pain while watching television and blamed it on the chair. Then, one night I cut off the TV and continued to sit there reading and noticed that the pain had vanished. Then, I cut it on and the pain came back. I could cut the pain off and on with the RCD.

22. Some sensitive people are always wary. On the contrary, I am usually hopeful that I will not experience symptoms. Therefore, they catch me by surprise--not when I have used a meter to detect sources, which I believe could produce what one was looking for, but using a meter to confirm a source only after I have experienced severe symptoms.

23. Still, that is not science. Science requires double-blind studies. My doctor and I conducted one unwittingly. I had been to her house (she became a friend) several times with no discomfort. Then, I became uncomfortable after only a few minutes on a subsequent visit. I tried to say nothing and endure the pain. Eventually, I had to tell her that I had to leave. Outside, we discussed what might be the possible source. Neighbors with wife? we speculated. I left. I was home only a minute when she called to apologize. Her son had been home over the weekend and had turned on the wifi. We both became believers.

24. A nearby town put in wireless. I was driving through showing a visiting friend the winter sights. Suddenly I was hit with such intense pain that I screamed, doubled over and stopped the car. She had to drive. Twice more I was hit with pain as I went through town. These proved to be wifi booster spots. I am afraid now to drive in areas I don't know well.

25. Am I the only one? It seems from a California study that there are millions of us. In 1998 the California Dept. of Health found 3.2 % of the population identified themselves as electrically hypersensitive. Clearly, we can't all be mad.

26. My health is now ruined. My pain has increased over the years from an unpleasant tingling to shooting nerve pains, to the present when proximity to something as innocuous, seemingly, as a turned-off, plugged-in lamp can cause severe muscle and joint pain in the nearest body part. I can use no electrical devices. I am able to talk for only a short period of time on an old land line before I experience discomfort, pain in my ear, and my voice becomes hoarse and rough, apparently due to some damage to my vocal chords from emf. I cannot watch TV or listen to the radio. Driving even an old car with fewer electronic gadgets is painful and exhausting. I have acute gastric reflux disease. I am exhausted much of the time and have an almost constant headache, as at the moment I can only lower my exposure rather than avoid it completely. I don't sleep well.

27. My world, already circumscribed, becomes smaller everyday. A restaurant, off the beaten path, with low incandescent lighting, no music system and no ceiling fans, will suddenly decide to install wifi and one more possibility for normal life vanishes.

28. Sometimes there is good news. While most libraries refuse to cut off their wifi, one has relented. If no one is using it they will cut it off for me while I look for a book--if no one comes in who wants it. This library situation is very hard for me as a writer and researcher. I'm afraid I get emotional just writing about it.

29. Visits to the doctor leave me exhausted and in pain. We are putting off medically indicated tests unless absolutely necessary because of the physical toll they take on my health. On a visit to the emergency room I turned off the lights, pulled plugs on all equipment, and still was in agony as my badly infected hand was treated. I went home exhausted, in pain, and ill.

30. When I think about the future I realize that retirement communities and nursing homes are out of the question. Nor can I visit my family, as they live in urban areas with universal--or nearly universal--wifi.

31. I have no social life to speak of. My career is ruined. I am too exhausted and sick to do any work on a regular basis. I am rapidly running out of money and because I took social security early when my poor health caused my income to fall I will not have enough to live on, neither can I file for disability since I am now of retirement age. I have no idea how I will survive.

32. In addition to those problems I do not know when the land I have bought will be "invaded" by cell towers or wireless. One day I might be safe; the next I might be sick. The future looks as grim and as frightening as any I could imagine. I am a refugee running from an invisible enemy that could attack at any moment.

33. I have only recently discovered that it has long been known in scientific circles that there are, indeed, biological effects not only from ELF fields but from low level, non-thermal, radio-frequency fields. (Attachment 2).

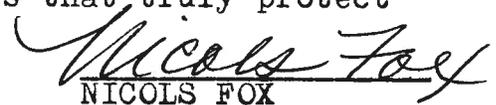
34. Russian studies (attachment 3) translated by the US Govt. in the 1970s addressed the adverse effects of exposure to non-thermal radio-frequency radiation. Several were excluded from the 1984 survey of Biological Effects of Radiofrequency Radiation conducted by the EPA and used to set exposure standards for the public. The criteria used for the study (attachment 4) appear designed, in fact, to exclude, rather than include relevant studies. Thus, the standards need to be readdressed using any and all studies that might call attention to potential health problems associated with exposure previously considered safe.

35. One excluded study describes the symptoms I have experienced almost precisely. (attachment 5) I experienced similar low heart bpm.

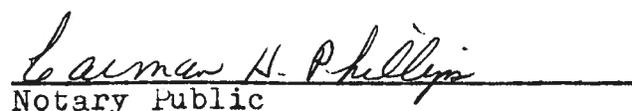
36. Wearing a Holter monitor for 24 hours demonstrated the irregularities (22,600 in 24 hours) + experienced during a period when I was exposed to wifi almost continuously. (attachment 6) My heart is rarely irregular now that I am living in a rural setting where I am seldom exposed, but in one exposure my heart dropped to 38 BPM, a rate measured by my neighbor.

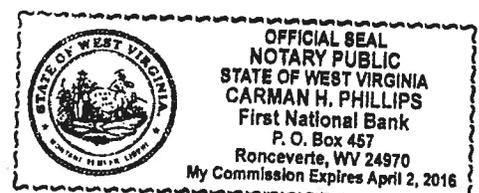
38. With the understanding that the EMR Policy Institute is preparing comment to submit in the current FCC proceeding to develop policy for providing high-speed internet service throughout the country (FCC 09-31, A National Broadband Plan for Our Future) I hereby designate the Institute to speak on my behalf, defending my right to be safe in my own home and on my own property, but also in all public settings of whatever kind and in private settings that are open to the public. I should not have to face pain, discomfort, and health effects that could be life threatening while doing ordinary activities because FCC's current exposure guidelines are inadequate in light of the findings of current science. Their adequacy in protecting all citizens from what would be continuous exposure is called into question, in fact, by the EPA. (Attachment 7)

39. My signature below confirms my approval of EMR Policy Institute's representation of me and I further ask that FCC accept this affidavit and the attached exhibits into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future as it is material evidence of the harm that is the result of signals to which I have been subjected for which the present standards are inadequate and not based on science both old and current that should be considered in setting standards that truly protect the public.

  
NICOLS FOX

Subscribed and sworn to and  
before a Notary Public, in  
and for the County and State  
aforesaid this 3rd day of June, 2009

  
Notary Public



## Appendix 2

## STUDIES SHOWING ADVERSE BIOLOGICAL EFFECTS OF RADIO FREQUENCY RADIATION AT LOW INTENSITIES.

Compiled by Dr. Henry Lai, University of Washington.

Source of literature and abstracts (Table 2):

(1) Balode, Z, Assessment of radio-frequency electromagnetic radiation by the micronucleus test in bovine peripheral erythrocytes. *Sci Total Environ* 180(1):81-85, 1996.

Previous bioindicative studies in the Skrunda Radio Location Station area have focused on the somatic influence of electromagnetic radiation on plants, but it is also important to study genetic effects. We have chosen cows as test animals for cytogenetical evaluation because they live in the same general exposure area as humans, are confined to specific locations and are chronically exposed to radiation. Blood samples were obtained from female Latvian Brown cows from a farm close to and in front of the Skrunda Radar and from cows in a control area. A simplified alternative to the Schiff method of DNA staining for identification of micronuclei in peripheral erythrocytes was applied. Microscopically, micronuclei in peripheral blood erythrocytes were round in shape and exhibited a strong red colour. They are easily detectable as the only coloured bodies in the uncoloured erythrocytes. From each individual animal 2000 erythrocytes were examined at a magnification of x 1000 for the presence of micronuclei. The counting of micronuclei in peripheral erythrocytes gave low average incidences, 0.6 per 1000 in the exposed group and 0.1 per 1000 in the control, but statistically significant ( $P < 0.01$ ) differences were found in the frequency distribution between the control and exposed groups.

(2) Boscol P, Di Sciascio MB, D'Ostilio S, Del Signore A, Reale M, Conti P, Bavazzano P, Paganelli R, Di Gioacchino M. Effects of electromagnetic fields produced by radiotelevision broadcasting stations on the immune system of women. *Sci Total Environ* 273(1-3):1-10, 2001.

The object of this study was to investigate the immune system of 19 women with a mean age of 35 years, for at least 2 years (mean = 13 years) exposed to electromagnetic fields (ELMFs) induced by radiotelevision broadcasting stations in their residential area. In September 1999, the ELMFs (with range 500 KHz-3 GHz) in the balconies of the homes of the women were (mean +/- S.D.) 4.3 +/- 1.4 V/m. Forty-seven women of similar age, smoking habits and atopy composed the control group, with a nearby resident ELMF exposure of < 1.8 V/m. Blood lead and urinary trans-trans muconic acid (a metabolite of benzene), markers of exposure to urban traffic, were higher in the control women. The ELMF exposed group showed a statistically significant reduction of blood NK CD16+/-CD56+, cytotoxic CD3(-)-CD8+, B and NK activated CD3(-)-HLA-DR+ and CD3(-)-CD25+ lymphocytes. 'In vitro' production of IL-2 and interferon-gamma (INF-gamma) by peripheral blood mononuclear cells (PBMC) of the ELMF exposed group, incubated either with or without phytohaemoagglutinin (PHA), was significantly lower; the 'in vitro' production of IL-2 was significantly correlated with blood CD16+/-CD56+ lymphocytes. The stimulation index (S.I.) of blastogenesis (ratio between cell proliferation with and without PHA) of PBMC of ELMF exposed women was lower than that of the control subjects. The S.I. of blastogenesis of the ELMF exposed group (but not blood NK lymphocytes and the 'in vitro' production of IL-2 and INF-gamma by PBMC) was significantly correlated with the ELMF levels. Blood lead and urinary trans-trans muconic acid were barely correlated with immune parameters: the urinary metabolite of benzene of the control group was only correlated with CD16+/-CD56+ cells indicating a slight effect of traffic on the immune system. In conclusion, this study demonstrates that high frequency ELMFs reduce cytotoxic activity in the peripheral blood of women without a dose-response effect.

(3) Chiang H, Yao GD, Fang QS, Wang KQ, Lu DZ, Zhou YK, Health effects of environmental electromagnetic fields. *J. Bioelectricity* 8:127-131, 1989.

We investigated the effects of exposure to environmental electromagnetic fields (EMFs) in 1170 subjects. Neutrophil phagocytosis was enhanced in the low-intensity exposure groups, but reduced significantly at relatively higher intensities. Visual reaction time was prolonged and the scores of short-term memory tests were lower in some high-intensity exposure groups. EMFs may affect the central nervous and immune systems in man.

(7) Dolk H, Shaddick G, Walls P, Grundy C, Thakrar B, Kleinschmidt I, Elliott P, Cancer incidence near radio and television transmitters in Great Britain. I. Sutton Coldfield transmitter. *Am J Epidemiol* 145(1):1-9, 1997.

A small area study of cancer incidence in 1974-1986 was carried out to investigate an unconfirmed report of a "cluster" of leukemias and lymphomas near the Sutton Coldfield television (TV) and frequency modulation (FM) radio transmitter in the West Midlands, England. The study used a national database of postcoded cancer registrations, and population and socioeconomic data from the 1981 census. Selected cancers were hematopoietic and lymphatic, brain, skin, eye, male breast, female breast, lung, colorectal, stomach, prostate, and bladder. Expected numbers of cancers in small areas were calculated by indirect standardization, with stratification for a small area socioeconomic index. The study area was defined as a 10 km radius circle around the transmitter, within which 10 bands of increasing distance from the transmitter were defined as a basis for testing for a decline in risk with distance, and an inner area was arbitrarily defined for descriptive purposes as a 2 km radius circle. The risk of adult leukemia within 2 km was 1.83 (95% confidence interval 1.22-2.74), and there was a significant decline in risk with distance from the transmitter ( $p = 0.001$ ). These findings appeared to be consistent over the periods 1974-1980, 1981-1986, and were probably largely independent of the initially reported cluster, which appeared to concern mainly a later period. In the context of variability of leukemia risk across census wards in the West Midlands as a whole, the Sutton Coldfield findings were unusual. A significant decline in risk with distance was also found for skin cancer, possibly related to residual socioeconomic confounding, and for bladder cancer. Study of other radio and TV transmitters in Great Britain is required to put the present results in wider context. No causal implications can be made from a single cluster investigation of this kind.

(8) Dutta SK, Ghosh B, Blackman CF, Radiofrequency radiation-induced calcium ion efflux enhancement from human and other neuroblastoma cells in culture. *Bioelectromagnetics* 1989;10(2):197-202

To test the generality of radiofrequency radiation-induced changes in  $^{45}\text{Ca}^{2+}$  efflux from avian and feline brain tissues, human neuroblastoma cells were exposed to electromagnetic radiation at 147 MHz, amplitude-modulated (AM) at 16 Hz, at specific absorption rates (SAR) of 0.1, 0.05, 0.01, 0.005, 0.001, and 0.0005 W/kg. Significant  $^{45}\text{Ca}^{2+}$  efflux was obtained at SAR values of 0.05 and 0.005 W/kg. Enhanced efflux at 0.05 W/kg peaked at the 13-16 Hz and at the 57.5-60 Hz modulation ranges. A Chinese hamster-mouse hybrid neuroblastoma was also shown to exhibit enhanced radiation-induced  $^{45}\text{Ca}^{2+}$  efflux at an SAR of 0.05 W/kg, using 147 MHz, AM at 16 Hz. These results confirm that amplitude-modulated radiofrequency radiation can induce responses in cells of nervous tissue origin from widely different animal species, including humans. The results are also consistent with the reports of similar findings in avian and feline brain tissues and indicate the general nature of the phenomenon.

(9) Fesenko, EE, Makar, VR, Novoselova, EG, Sadovnikov, VB, Microwaves and cellular immunity. I. Effect of whole body microwave irradiation on tumor necrosis factor production in mouse cells. *Bioelectrochem Bioenerg* 49(1):29-35, 1999.

Whole body microwave sinusoidal irradiation of male NMRI mice with 8.15-18 GHz (1 Hz within) at a power density of  $1 \text{ microW/cm}^2$  caused a significant enhancement of TNF production in peritoneal macrophages and splenic T lymphocytes. Microwave radiation affected T cells, facilitating their capacity to proliferate in response to mitogenic stimulation. The exposure duration necessary for the stimulation of cellular immunity ranged from 5 h to 3 days. Chronic irradiation of mice for 7 days produced the decreasing of TNF production in peritoneal macrophages. The exposure of mice for 24 h increased the TNF production and immune proliferative response, and these stimulatory effects persisted over 3 days after the termination of exposure. Microwave treatment increased the endogenously produced TNF more effectively than did lipopolysaccharide, one of the most potential stimuli of synthesis of this cytokine. The role of microwaves as a factor interfering with the process of cell immunity is discussed.

(10) Hjollund NH, Bonde JP, Skotte J, Semen analysis of personnel operating military radar equipment. *Reprod Toxicol* 11(6):897, 1997.

This is a preliminary survey of semen quality among Danish military personnel operating mobile ground-to-air missile units that use several microwave emitting radar systems. The maximal mean exposure was estimated to be

sham-exposed cells. These effects can be considered to be athermal, since the field strength was much lower than the safety standard for absence of heat generation by microwave fields. There was no significant response in the case of Hsp-27.

**(15) Lebedeva NN, Sulimov AV, Sulimova OP, Kotrovskaya TI, Gailus T, Cellular phone electromagnetic field effects on bioelectric activity of human brain. *Crit Rev Biomed Eng* 28(1-2):323-337, 2000.**

24 volunteers participated in the experiments. The investigation of EEG reactions to cellular phone (EMF frequency 902.4 MHz and intensity 0.06 mW/cm<sup>2</sup>) was conducted. Two experiments were performed with each subject--cellular phone exposure and Placebo Duration of the experiment was 60 min: 15 min--background; 15 min--EMF exposure or Placebo; 30 min--after exposure. EEG was recorded in 16 standard leads with "eyes open" and "eyes closed". Special software with non-linear dynamics was developed for EEG analyses. One parameter, multichannel (global) correlation dimension, was calculated. The changes of these parameters can be evidence of brain functional state changes. As a result of EEG record processing, a significant increase of global correlation dimension during the exposure and after exposure period was discovered, more pronounced in the case of "eyes closed". That can be viewed as the manifestation of cortex activation under phone EMF exposure.

**(16) Magras, IN, Xenos, TD, RF radiation-induced changes in the prenatal development of mice. *Bioelectromagnetics* 18(6):455-461, 1997.**

The possible effects of radiofrequency (RF) radiation on prenatal development has been investigated in mice. This study consisted of RF level measurements and in vivo experiments at several places around an "antenna park." At these locations RF power densities between 168 nW/cm<sup>2</sup> and 1053 nW/cm<sup>2</sup> were measured. Twelve pairs of mice, divided in two groups, were placed in locations of different power densities and were repeatedly mated five times. One hundred eighteen newborns were collected. They were measured, weighed, and examined macro- and microscopically. A progressive decrease in the number of newborns per dam was observed, which ended in irreversible infertility. The prenatal development of the newborns, however, evaluated by the crown-rump length, the body weight, and the number of the lumbar, sacral, and coccygeal vertebrae, was improved.

**(17) Mann, K, Wagner, P, Brunn, G, Hassan, F, Hiemke, C, Roschke, J, Effects of pulsed high-frequency electromagnetic fields on the neuroendocrine system. *Neuroendocrinology* 67(2):139-144, 1998.**

The influence of pulsed high-frequency electromagnetic fields emitted from a circularly polarized antenna on the neuroendocrine system in healthy humans was investigated (900 MHz electromagnetic field, pulsed with 217 Hz, average power density 0.02 mW/cm<sup>2</sup>). Nocturnal hormone profiles of growth hormone (GH), cortisol, luteinizing hormone (LH) and melatonin were determined under polysomnographic control. An alteration in the hypothalamo-pituitary-adrenal axis activity was found with a slight, transient elevation in the cortisol serum level immediately after onset of field exposure which persisted for 1 h. For GH, LH and melatonin, no significant effects were found under exposure to the field compared to the placebo condition, regarding both total hormone production during the entire night and dynamic characteristics of the secretion pattern. Also the evaluation of the sleep EEG data revealed no significant alterations under field exposure, although there was a trend to an REM suppressive effect. The results indicate that weak high-frequency electromagnetic fields have no effects on nocturnal hormone secretion except for a slight elevation in cortisol production which is transient, pointing to an adaptation of the organism to the stimulus.

**(18) Marinelli F, La Sala D, Ciccotti G, Cattini L, Trimarchi C, Putti S, Zamparelli A, Giuliani L, Tomassetti G, Cinti C. Exposure to 900 MHz electromagnetic field induces an unbalance between pro-apoptotic and pro-survival signals in T-lymphoblastoid leukemia CCRF-CEM cells. *J Cell Physiol*. 198(2):324-332, 2004.**

It has been recently established that low-frequency electromagnetic field (EMFs) exposure induces biological changes and could be associated with increased incidence of cancer, while the issue remains unresolved as to whether high-frequency EMFs can have hazardous effect on health. Epidemiological studies on association between childhood cancers, particularly leukemia and brain cancer, and exposure to low- and high-frequency EMF suggested an etiological role of EMFs in inducing adverse health effects. To investigate whether exposure to high-frequency EMFs could affect in vitro cell survival, we cultured acute T-lymphoblastoid leukemia cells (CCRF-CEM) in the

lymphocytes increased after microwave exposure. The activation of cellular immunity was observed within 3 days after exposure. The diet containing lipid-soluble nutrients (beta-carotene, alpha-tocopherol and ubiquinone Q9) increased the activity of macrophages and T cells from irradiated mice. These results demonstrate that irradiation with low-power density microwaves stimulates the immune potential of macrophages and T cells, and the antioxidant treatment enhances the effect of microwaves, in particular at later terms, when the effect of irradiation is reduced.

**(23) Novoselova EG, Ogay VB, Sorokina OV, Glushkova OV, Sinotova OA, Fesenko EE. The production of tumor necrosis factor in cells of tumor-bearing mice after total-body microwave irradiation and antioxidant diet. *Electromag. Biol. Med.* 23:167-180, 2004.**

The effects of repeated treatment with weak microwaves (MW) (8.15–18 GHz,  $1 \mu\text{W}/\text{cm}^2$ , 1.5 h daily) and diet with antioxidants (AO) ( $\beta$ -carotene,  $\alpha$ -tocopherol, and ubiquinone Q<sub>9</sub>) on production of tumor necrosis factor (TNF) in macrophages and T lymphocytes of healthy and tumor-bearing mice (TBM) were studied. Tumor size and mortality of TBM were also followed. Microwave radiation and antioxidant diet stimulated production of TNF in cells from healthy mice. At early stages, tumor growth induced TNF production in mouse cells; however, this effect decreased as tumors grew. In TBM exposed to MW, TNF production was higher than in unirradiated TBM. Oppositely, AO diet induced TNF production in healthy mice but did not affect TNF secretion in TBM. Accordingly, prolonged treatment of TBM to MW, but not to AO diet, decreased tumor growth rate and increased overall animal longevity. These results suggest that diminished tumor growth rate due to extremely low-level MW exposure of mice carrying tumors, at least in part, was caused by enhancement in TNF production and accumulation of plasma TNF.

**(24) Park SK, Ha M, Im H-J. Ecological study on residences in the vicinity of AM radio broadcasting towers and cancer death: preliminary observations in Korea. *International Archives of Occupational and Environmental Health* 77(6):387-394, 2004.**

*Objectives* Public health concern about the health effects of radio-frequency electromagnetic fields (RF-EMFs) has increased with the increase in public exposure. This study was to evaluate some health effect of RF exposure by the AM radio broadcasting towers in Korea.

*Methods* We calculated cancer mortality rates using Korean death certificates over the period of 1994–1995 and population census data in ten RF-exposed areas, defined as regions that included AM radio broadcasting towers of over 100 kW, and in control areas, defined as regions without a radio broadcasting tower inside and at least 2 km away from the towers.

*Results* All cancers-mortality was significantly higher in the exposed areas [direct standardized mortality rate ratio (MRR) = 1.29, 95%CI=1.12–1.49]. When grouped by each exposed area and by electrical power, MRRs for two sites of 100 kW, one site of 250 kW and one site of 500 kW, for all subjects, and for one site of 100 kW and two sites of 250 kW, for male subjects, showed statistically significant increases without increasing trends according to the groups of electric power. Leukemia mortality was higher in exposed areas (MRR=1.70, 95% CI=0.84–3.45), especially among young adults aged under 30 years (0–14 years age group, MRR=2.29, 95% CI=1.05–5.98; 15–29 age group, MRR=2.44, 95% CI=1.07–5.24).

*Conclusions* We observed higher mortality rates for all cancers and leukemia in some age groups in the area near the AM radio broadcasting towers. Although these findings do not prove a causal link between cancer and RF exposure from AM radio broadcasting towers, it does suggest that further analytical studies on this topic are needed in Korea.

**(25) Persson BRR, Salford LG, Brun A, Blood-brain barrier permeability in rats exposed to electromagnetic fields used in wireless communication. *Wireless Network* 3:455-461, 1997.**

Biological effects of radio frequency electromagnetic fields (EMF) on the blood-brain barrier (BBB) have been studied in Fischer 344 rats of both sexes. The rats were not anesthetised during the exposure. The brains were perfused with saline for 3–4 minutes, and thereafter perfusion fixed with 4% formaldehyde for 5–6 minutes. Whole coronal sections of the brains were dehydrated and embedded in paraffin and sectioned at 5 micrometers. Albumin and fibrinogen were demonstrated immunochemically and classified as normal versus pathological leakage. In the present investigation we exposed male and female Fischer 344 rats in a Transverse Electromagnetic Transmission

(embryogenesis, pre-implantation) and days 4-7 p.c. (early organogenesis, peri-implantation). Relative expression and localization of bone morphogenetic proteins (BMP) and their receptors (BMPR), members of a molecular family currently considered as major endocrine and autocrine morphogens and known to be involved in renal development, were investigated in newborn kidneys from RFR exposed and sham irradiated (control) rats. Semi-quantitative duplex RT-PCR for BMP-4, -7, BMPR-IA, -IB, and -II showed increased BMP-4 and BMPR-IA, and decreased BMPR-II relative expression in newborn kidneys. These changes were statistically significant for BMP-4, BMPR-IA, and -II after exposure on days 1-3 p.c. ( $P < .001$  each), and for BMP-4 and BMPR-IA after exposure on days 4-7 p.c. ( $P < .001$  and  $P = .005$ , respectively). Immunohistochemistry and in situ hybridization (ISH) showed aberrant expression and localization of these molecules at the histological level. Our findings suggest that GSM-like RFR interferes with gene expression during early gestation and results in aberrations of BMP expression in the newborn. These molecular changes do not appear to affect renal organogenesis and may reflect a delay in the development of this organ. The differences of relative BMP expression after different time periods of exposure indicate the importance of timing for GSM-like RFR effects on embryonic development.

**(29) Salford LG, Brun AR, Eberhardt JL, Malmgren L, Persson BRR, Nerve cell damage in mammalian brain after exposure to microwaves from GSM mobile phones. *Environ Health Persp Online* January 29, 2003.**

The possible risks of radio-frequency electromagnetic fields for the human body is a growing concern for the society. We have earlier shown that weak pulsed microwaves give rise to a significant leakage of albumin through the blood-brain barrier (BBB). Now we have investigated whether a pathological leakage over the BBB might be combined with damage to the neurons. Three groups of each 8 rats were exposed for 2 hours to GSM mobile phone electromagnetic fields of different strengths. We found, and present here for the first time, highly significant ( $p < 0.002$ ) evidence for neuronal damage in both the cortex, the hippocampus and the basal ganglia in the brains of exposed rats.

**(30) Santini R, Santini P, Danze JM, Le Ruz P, Seigne M. Study of the health of people living in the vicinity of mobile phone base stations: I. Influence of distance and sex. *Pathol Biol (Paris)* 50(6):369-373, 2002. [Article in French]**

A survey study using questionnaire was conducted in 530 people (270 men, 260 women) living or not in vicinity of cellular phone base stations, on 18 Non Specific Health Symptoms. Comparisons of complaints frequencies (CHI-SQUARE test with Yates correction) in relation with distance from base station and sex, show significant ( $p < 0.05$ ) increase as compared to people living  $> 300$  m or not exposed to base station, till 300 m for tiredness, 200 m for headache, sleep disturbance, discomfort, etc. 100 m for irritability, depression, loss of memory, dizziness, libido decrease, etc. Women significantly more often than men ( $p < 0.05$ ) complained of headache, nausea, loss of appetite, sleep disturbance, depression, discomfort and visual perturbations. This first study on symptoms experienced by people living in vicinity of base stations shows that, in view of radioprotection, minimal distance of people from cellular phone base stations should not be  $< 300$  m.

**(31) Sarimov R, Malmgren L.O.G., Markova, E., Persson, B.R.R., Belyaev, I.Y. Nonthermal GSM microwaves affect chromatin conformation in human lymphocytes similar to heat shock. *IEEE Trans Plasma Sci* 32:1600-1608, 2004.**

Here we investigated whether microwaves (MWs) of Global System for Mobile Communication (GSM) induce changes in chromatin conformation in human lymphocytes. Effects of MWs were studied at different frequencies in the range of 895-915 MHz in experiments with lymphocytes from seven healthy persons. Exposure was performed in transverse electromagnetic transmission line cell (TEM-cell) using a GSM test-mobile phone. All standard modulations included 2 W output power in the pulses, specific absorbed rate (SAR) being 5.4 mW/kg. Changes in chromatin conformation, which are indicative of stress response and genotoxic effects, were measured by the method of anomalous viscosity time dependencies (AVTD). Heat shock and treatment with the genotoxic agent camptothecin, were used as positive controls. 30-min exposure to MWs at 900 and 905 MHz resulted in statistically significant condensation of chromatin in lymphocytes from 1 of 3 tested donors. This condensation was similar to effects of heat shock within the temperature window of 40/spl deg/C-44/spl deg/C. Analysis of pooled data from all donors showed statistically significant effect of 30-min exposure to MWs. Stronger effects of MWs was found following 1-h exposure. In replicated experiments, cells from four out of five donors responded to 905 MHz.

**(35) Stark KD, Krebs T, Altpeter E, Manz B, Griot C, Abelin T, Absence of chronic effect of exposure to short-wave radio broadcast signal on salivary melatonin concentrations in dairy cattle. *J Pineal Res* 22(4):171-176, 1997.**

A pilot study was conducted to investigate the influence of electromagnetic fields in the short-wave range (3-30 MHz) radio transmitter signals on salivary melatonin concentration in dairy cattle. The hypothesis to be tested was whether EMF exposure would lower salivary melatonin concentrations, and whether removal of the EMF source would be followed by higher concentration levels. For this pilot study, a controlled intervention trial was designed. Two commercial dairy herds at two farms were compared, one located at a distance of 500 m (exposed), the other at a distance of 4,000 m (unexposed) from the transmitter. At each farm, five cows were monitored with respect to their salivary melatonin concentrations over a period of ten consecutive days. Saliva samples were collected at two-hour intervals during the dark phase of the night. As an additional intervention, the short-wave transmitter was switched off during three of the ten days (off phase). The samples were analyzed using a radioimmunoassay. The average nightly field strength readings were 21-fold greater on the exposed farm (1.59 mA/m) than on the control farm (0.076 mA/m).

The mean values of the two initial nights did not show a statistically significant difference between exposed and unexposed cows. Therefore, a chronic melatonin reduction effect seemed unlikely. *However, on the first night of re-exposure after the transmitter had been off for three days, the difference in salivary melatonin concentration between the two farms (3.89 pg/ml, CI: 2.04, 7.41) was statistically significant, indicating a two- to seven-fold increase of melatonin concentration. Thus, a delayed acute effect of EMF on melatonin concentration cannot completely be excluded.* However, results should be interpreted with caution and further trials are required in order to confirm the results.

**(36) Tattersall JE, Scott IR, Wood SJ, Nettell JJ, Bevir MK, Wang Z, Somasiri NP, Chen X. Effects of low intensity radiofrequency electromagnetic fields on electrical activity in rat hippocampal slices. *Brain Res* 904(1):43-53, 2001.**

Slices of rat hippocampus were exposed to 700 MHz continuous wave radiofrequency (RF) fields (25.2-71.0 V m(-1), 5-15 min exposure) in a stripline waveguide. At low field intensities, the predominant effect on the electrically evoked field potential in CA1 was a potentiation of the amplitude of the population spike by up to 20%, but higher intensity fields could produce either increases or decreases of up to 120 and 80%, respectively, in the amplitude of the population spike. To eliminate the possibility of RF-induced artefacts due to the metal stimulating electrode, the effect of RF exposure on spontaneous epileptiform activity induced in CA3 by 4-aminopyridine (50-100 µM) was investigated. Exposure to RF fields (50.0 V m(-1)) reduced or abolished epileptiform bursting in 36% of slices tested. The maximum field intensity used in these experiments, 71.0 V m(-1), was calculated to produce a specific absorption rate (SAR) of between 0.0016 and 0.0044 W kg(-1) in the slices. Measurements with a Luxtron fibreoptic probe confirmed that there was no detectable temperature change (+/-0.1 degrees C) during a 15 min exposure to this field intensity. Furthermore, imposed temperature changes of up to 1 degrees C failed to mimic the effects of RF exposure. These results suggest that low-intensity RF fields can modulate the excitability of hippocampal tissue in vitro in the absence of gross thermal effects. The changes in excitability may be consistent with reported behavioural effects of RF fields.

**(37) Vangelova K, Israel M, Mihaylov S. The effect of low level radiofrequency electromagnetic radiation on the excretion rates of stress hormones in operators during 24-hour shifts. *Cent Eur J Public Health* 10(1-2):24-28, 2002.**

The aim of the study was to investigate the effect of long term exposure to low level radiofrequency (RF) electromagnetic (EM) radiation on the excretion rates of stress hormones in satellite station operators during 24-hour shifts. Twelve male operators at a satellite station for TV communications and space research were studied during 24-hour shifts. Dosimetric evaluation of the exposure was carried out and showed low level exposure with specific absorption of 0.1127 J.kg-1. A control group of 12 unexposed male operators with similar job task and the same shift system were studied, too. The 11-oxycorticosteroids (11-OCS), adrenaline and noradrenaline were followed by spectrofluorimetric methods on 3-hour intervals during the 24-hour shifts. The data were analyzed by tests for interindividual analysis, Cosinor analysis and analysis of variance (ANOVA). Significant increase in the 24-hour excretion of 11-OCS and disorders in its circadian rhythm, manifested by increase in the mesor, decrease in the amplitude and shift in the acrophase were found in the exposed operators. The changes in the excretion rates of the

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**Health Effects of Exposure to EMF**

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## **8. GLOSSARY**

This section includes technical terms and definitions used within the document. The definitions are given in alphabetical order.

**Alpha-band/waves:** A specific frequency range (8-13 Hz) of the human EEG activity which is associated with relaxed wakefulness.

**Conductivity:** A property of a material that determines the magnitude of the electric current density when an electric field is impressed on the material.

**Confounding factor (confounder):** A confounding factor in an epidemiological study is a variable which is related to one or more of the variables defined in a study. The confounder may mask an actual association or falsely demonstrate an apparent association between the study variables where no real association between them exists. If confounding factors are not measured and considered, bias may result in the conclusion of the study.

**Contralateral:** On the opposite from another structure.

**Contralateral use of mobile phone:** Preferred side of the head during mobile phone use corresponds to the side of the head opposite to the tumour.

**Crossover design:** A cross over design is a special situation where a separate comparison group is not present. Instead, each subject receives both treatments or is exposed to both sham and active exposure and the outcomes under the two conditions are compared within the same subjects. Thus, the subject serves as his/her own control. Ideally in a crossover design, a subject is randomly assigned to a specific treatment/exposure order.

**Dielectric properties:** In the context of this document the properties of a materials conductivity and permeability.

**Double-blind (study):** Blinding is used to prevent conscious as well as subconscious bias (e.g. by expectations) in research. In a double-blinded study the participants as well as the researchers are unaware of (blind to) the nature of the treatment (e.g. a new drug or placebo) or the exposure condition (e.g. the exposure under study or sham) that the participants receive in the study.

**Ecological studies:** An ecological or correlational study is one in which the unit of analysis is an aggregate of individuals and information is collected on this group rather than on individual members. The association between a summary measure of disease and a summary measure of exposure is studied. An error of reasoning occurs when conclusions are drawn about individuals from data that are associated with groups, as relationships observed for groups may not necessarily hold for individuals.

**Electric field strength (E):** The magnitude of a field vector at a point that represents the force (F) on a charge (q). E is defined as  $E = F/q$  and is expressed in units of Volt per meter (V/m).

**Electroencephalogram (EEG):** Extracellular recording of the electrical activity of the cerebral cortex.

**Electromagnetic field:** Electromagnetic phenomena expressed in vector functions of space and time.

**Electromagnetic radiation:** The propagation of energy in the form of electromagnetic waves through space.

**EMF:** Electromagnetic field.

**Exposure:** Exposure occurs wherever a person is subjected to electric, magnetic or electromagnetic fields or contact currents other than those originating from physiological processes in the body.

## FOREWORD

Moscow O BIOLOGICHESKOM DEYSTVII ELEKTROMAGNITNYKH POLEY RADIOCHASTOT in Russian 1973 p 5

[Article by Academician A.I. Berg]

[Text] The problem pertaining to the influence exerted on the human organism by radiofrequency electromagnetic fields, which are a factor of the industrial environment and of every-day living conditions, continues not only to be important but also acquires special significance in view of developments in science and technology. This applies, first of all, to very low intensity radiofrequencies, particularly the superhigh frequencies.

During the last 20 years numerous studies have been published in the Soviet Union and abroad dealing with this problem. Among these studies a significant place is held by the work conducted at the Laboratory of Radiofrequency Electromagnetic Waves of the Order of the Red Banner of Labor Institute of Labor Hygiene and Occupational Diseases of the Academy of Medical Sciences USSR.

This, the fourth, collection describing the work of this laboratory covers results obtained during the 1968-1972 period and undoubtedly represents a fundamentally new outlook. Contained are results of studies and investigations on hygienic standards during a period of extensive application of safety measures developed by Soviet scientists for improving the sanitary level of industrial sites. Results are also presented on in-depth studies on the mechanism of action of electromagnetic fields, including those at the level of fine physiological regulation, which are of interest not only in biology and medicine, but also in the sense of bionics.

It cannot be doubted that the publication of the present compendium will have a profound effect on a wide circle of scientific and practical workers in the biomedical, engineering and technical fields.

JPRS 63321

30 October 1974

## BIOLOGICAL EFFECTS OF RADIOFREQUENCY ELECTROMAGNETIC FIELDS

Moscow O BIOLOGICHESKOM DEYSTVII ELEKTROMAGNITNYKH POLEY  
RADIOCHASTOT in Russian No 4, 1973

[Book edited by Z. V. Gordon, signed to press 14 December 1973,  
400 copies]

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## **Section 2 Approach**

**Joe A. Elder  
Daniel F. Cahill**

### **2.1 General Approach**

Although a comprehensive literature review is useful, it is even more desirable if the body of literature is consolidated, analyzed, and synthesized into a statement or statements that relate the presence or absence of biological effects to a meaningful exposure parameter such as dose rate (SAR). To this end, our general approach is essentially as follows:

1. The reports are evaluated for their scientific quality and utility. Acceptable reports contain adequate descriptions of appropriate physical and biological systems and tests.
2. The credible reports are then examined for the relation between the RF energy absorbed and the presence or absence of biological effects in the experimental systems.

### **2.2 Specific Approach**

The literature evaluated for this document includes English-language publications, numerous English translations of Soviet research reports obtained through the U.S. Joint Publications Research Service, and selected technical reports translated from Polish, French, Italian, and Russian.

The extant literature base numbers over 5000 citations, but considerably fewer are valuable in developing exposure guidelines for the following reasons.

1. A large fraction of the literature is available only in Slavic languages.
2. The research reports are uneven in quality and usefulness because authors often failed to include sufficient experimental details to allow reviewers to estimate critical exposure parameters such as incident field intensity, dose rate, or dose.
3. In many review articles, equal currency is given to the conclusions from properly designed and executed studies and to those from less stringently conducted research. Because these uncritical reviews have contributed to the general confusion over the health risks associated with RF radiation,

we have relied on original research papers rather than review articles and have chosen to be highly selective in our review.

In reviewing the literature we first evaluate descriptions of frequency, exposure parameters, RF source, experimental species, age, sex, environmental and biological controls, and the statistics employed; and whether actual data are displayed or merely referred to in the text. Many pre-1970 reports are deficient in one or more of these key areas and are either rejected outright if the flaws are judged fatal, or are segregated into the category of reports with "unresolved issues." Reports that provide adequate descriptions of these parameters are further scrutinized for the appropriateness of biological systems, tests, sample sizes, controls, and statistics employed, as well as substantiation of their conclusions. Reports that clear this second hurdle are credible reports, but are considered usable only if biological results are linked explicitly or implicitly to SAR data from the description of the exposure parameters. Reports that fail to provide these parameters are also assigned to the "unresolved issues" category.

### **2.3 Major Sections**

Four major sections follow. They are Physical Principles of Electromagnetic Field Interactions (Sec. 3), Effect of RF-Radiation Exposure on Body Temperature (Sec. 4), Biological Effects of RF Radiation (Sec. 5), and Summary and Conclusions (Sec. 6).

The first part of Sec. 3 presents some introductory information on electromagnetic field theory. Next, RF-field interactions with both simple and complex biological objects, such as the human body, are discussed and, most important, definitions of RF dosimetric terms are given. The mechanisms of RF interactions with biological systems, particularly molecular systems, are discussed. The remaining two major subsections described experimental methods and dosimetric methods used in state-of-the-art research on the biological effects of RF radiation.

Since the absorption of RF energy by biological species can lead to an increase in the temperature of body tissues, it is important to understand how

animals, including man, regulate the additional thermal input of RF-radiation exposure, both physiologically and behaviorally. Section 4 is an introduction to the subject of thermoregulation in both animals and human beings and, in addition, discusses the specific effects of RF radiation on thermoregulatory processes. Also, a description is included of the mathematical models that are being used to predict increases in temperature and activation of thermoregulatory effectors in human beings in simulated RF fields.

Section 5 is a review of the main body of literature on the biological effects of RF radiation. The section contains ten subsections, each of which represents a biological discipline or major research area, ranging from subcellular systems to human beings. In each of the ten areas, the conclusions and generalizations that can be drawn from the review of the literature are presented.

In Sec. 6, the major conclusions and generalizations of Secs. 3, 4, and 5 are presented. Next, many of the reports are tabulated by biological variable and dose rate (SAR). In summary, the reported consequences of the interaction between RF radiation and biological systems are examined from two perspectives (whole-body-averaged SAR and RF-energy-induced core temperature increases) in order to analyze, synthesize, and consolidate the review data into statements that relate biological effects to a meaningful exposure parameter (dose rate or SAR).

UDC 613.62:/614.87:537.868.029.64/

## THE CLINIC, PATHOGENESIS, TREATMENT, AND OUTCOME OF RADIOWAVE SICKNESS

Moscow O BIOLOGICHESKOM DEYSTVII ELEKTROMAGNITNYKH POLEY  
RADIOCHASTOT in Russian 1973 pp 43-48

/Article by M.N. Sadchikova and K.V. Glotova/

/Text/ The results of long years of clinical observations have demonstrated that prolonged work under conditions of exposure to SHF electromagnetic waves of significant intensities (up to several mW/sq cm), may result in the development of an occupational disease -- the radiowave sickness. Three essential syndromes of this disease have been identified: the asthenic syndrome, the astheno-vegetative syndrome with vascular dysfunction, and the hypothalamic syndrome. Studies on the mechanism of the neurovascular impairment have revealed the significant role of the deep structures of brain, including the hypothalamic regions. Essential principles have been formulated to cover drug therapy, and late results of treatment.

Many studies are available in the literature which deal with the biological effects of superhigh frequency electromagnetic fields on the human and animal organisms.

The results of clinical studies conducted by a number of authors /N.V. Tyagin, 1960, 1962, 1963, 1965, 1971; A.G. Panov and N.V. Tyagin, 1966; N.V. Uspenskaya, 1961, 1963; Ye. V. Gembitskiy, 1962, 1970; V.N. Gur'yev, 1962, 1963; I.R. Ramzen-Evdokimov and V.A. Sorokin, 1970; E. Klimkova-Deutschova, 1957, 1963; and others/, as well as our own observations, indicate that prolonged work under conditions in which the individual is exposed to SHF electromagnetic fields may lead to the development of a disease entity, the clinical picture of which is characterized by changes in the functional state of the nervous and the cardiovascular systems.

However, up to the present time, a number of questions dealing with the clinical aspects, pathogenesis, and treatment of this disease have not been adequately studied.

Studies which have been conducted over a period of many years at the clinic of the Institute of Labor Hygiene and Occupational Diseases of the Academy of Medical Sciences USSR on a large group of people who were employed in the radio industry, have made it possible to elucidate the nature of the effects of SHF electromagnetic fields of different intensities on the states of the nervous, cardiovascular, neurohumoral, endocrine-metabolic, and other systems, and have also made it possible to investigate the sequence of clinical manifestations of this disease, as well as to classify it and isolate an independent nosologic disease entity -- the radiowave sickness.

These investigations have convinced us that a profound professional pathology arises frequently in people who have, for long periods of time, been employed under conditions where they came into contact with sources of SHF electromagnetic energy and where the intensity of irradiation may attain several milliwatts per square centimeter.

A decrease in the incidence of occupational pathology is observed under the effects of SHF electromagnetic fields of low intensity which do not exceed a hundredth of a milliwatt per square centimeter, and during exposure to more intense radiation for short periods of time.

Simultaneously, vegetative vascular dysfunctions continue to be detected which are related primarily to the increased excitability of the sympathetic branch of the vegetative nervous system.

Exposure to SHF electromagnetic fields of even smaller intensity (from fractions to units of microwatt/square centimeter) do not evoke changes in the state of health of the workers, which could be connected to the exposure.

We have determined that in this professional pathology changes in the central nervous system are of primary importance, particularly in its vegetative branches, and in the cardiovascular system, which are characterized by a unique clinical symptomatology with two forms of vegetative reactions which are determined by dysfunction in the interaction between the excitability of the sympathetic and the parasympathetic branches of the central autonomic formations in the brain, and the state of the cortical processes.

On the basis of our own observations, and the data in the literature, the clinical picture of radiowave sickness may be represented by the following three syndromes.

The asthenic syndrome is encountered in the initial stages of the disease. It seems to be largely based on "exhaustion" of the central nervous system. The vegetative changes are totally defined with dominance of vagotonia, arterial hypotension, and bradycardia. On the whole, the syndrome has a favorable outcome, and does not decrease the work capacity of the patients for long periods of time.

✓ The astheno-vegetative syndrome with vascular dysfunction is the most frequently encountered entity, and is usually seen in moderate and severe stages of the disease. The clinical picture of this syndrome is marked by more pronounced asthenic phenomena and primary features attributed to vegetative dysfunctions which are related to elevated excitability of the sympathetic branch of the vegetative nervous system, vascular instability with hypertension, and vasospasms. The latter factors frequently ~~determine~~ the severity of the disease.

At a given stage of the increasing pathological phenomena, the hypothalamic syndrome (vegetative vascular form) arises, which is characterized by the development of paroxysmal states in the form of sympathoadrenal crises. The course of the astheno-vegetative and the hypothalamic syndromes are protracted, and frequently lead to decreased work capability.

In advance stages of the disease, with increasing asthenic phenomena, emotional and vegetative vascular instability, and particularly in cases characterized by paroxysmal states, a clinical picture of ischemic heart disease develops, along with hypertension, and sometimes changes in the dynamics of brain circulation which sharply decrease the work capability of the patients.

The fact that vasospastic phenomena are encountered in moderate and advanced stages of the radiowave sickness has been supported by instrumental investigations. Thus, the results of rheographic investigations of cerebral hemodynamics have demonstrated a decrease in pulse volume, and increased tone of intra- and extracranial blood vessels which are returned to the normal state by the nitroglycerin test. Mechanocardiographic data have indicated increased tone of muscular vessels, and an increase in peripheral resistance.

Electroencephalographic and certain biochemical studies are in agreement with the clinical features of the radiowave disease and its course. During initial stages of the disease the patients may evidence desynchronization of the alpha activity, a stability in the alpha rhythm, or desynchronization of the alpha rhythm; in moderate and advanced stages of the disease, bilateral synchronous discharges of the theta and delta waves are evident, and sometimes diffuse slow waves are detected, particularly under the influence of hyperventilation which indicates that the subcortical structures are involved in the pathological process.

Changes in the carbohydrate metabolism correlate well with the tendencies in the vegetative reactions, particularly in the changes of the sugar curves following glucose loading. Thus, in the vegetative vascular changes resulting in vagotonia, we encounter depressed curves, while in vegetative vascular dysfunctions which result in sympathetic tone along with sympathoadrenal crises, we encounter so-called diabetic or double-peaked sugar curves. Changes in the sugar curves may be related to impairment of the mechanisms responsible for the regulation of homeostasis, and primarily this would involve deficiencies in the hypothalamus - hypophysis-adrenal cortex system. In order to evaluate the functional state of this change we investigated the levels of certain mediators of the nervous system, such as blood levels of histamine and acetylcholine, urinary levels of epinephrine and norepinephrine, as well as the glucocorticoid function of the adrenal glands.

Blood levels of histamine in patients with radiowave sickness are elevated. Changes in the concentration of acetylcholine are less pronounced; however, they are accompanied by changes in the activity of cholinesterase.

In moderate and pronounced stages of the disease the ratio of epinephrine and norepinephrine is decreased along with normal parameters -- actual variations and mean values -- for the levels of catecholamines in 24 hour urine samples. In paroxysmal states a sharp variation is evident in the secretion of adrenalin, and a definite rhythm in the excretion of norepinephrine characterized by increased secretion of norepinephrine in the evening and at night, which points to dysfunction in the mechanisms responsible for the regulation of the activity of the sympathoadrenal system.

Results of investigations on the glucocorticoid function of the adrenal glands -- conducted by S.P. Korenevskaya -- have

pointed to definite changes in the levels and relationships of cortisol, cortisone, and their tetrahydro derivatives. Changes in the relationships between the levels of tetrahydro derivatives of cortisol and cortisone, as well as between cortisol and cortisone, indicate dysfunctions in the mechanisms responsible for the transformation of cortisol into cortisone.

Subcutaneous administration of small doses of epinephrine (0.3 ml of 0.1% solution) elicits marked autonomic vascular reactions in the patients, as well as more distinct changes in the daily dynamics of catecholamine excretion, and impairment in the glucocorticoid function of the adrenal glands.

Development of pronounced vegetative vascular reactions in patients with radiowave sickness in response to the administration of small doses of epinephrine suggests significant impairment in the vegetative formations of the brain. These findings make it seem likely that the dysfunctions of the functional state of the sympathoadrenal system and the glucocorticoid function of the adrenal glands in patients with radiowave disease are the sequelae of primary lesions in the deep structures of the brain which are responsible for the central regulation of the neurohumoral and the neurohormonal processes in the organism. The investigations which have been conducted are in agreement with the clinical and electroencephalographic findings on the involvement of the deep structures of the brain, including in part the hypothalamic structures. Furthermore, dysfunction of the hypothalamic-hypophyseal-adrenal cortical system which arises on the basis of neurasthenia may be highly important in the pathogenic mechanisms responsible for the development of the clinical symptoms of the radiowave sickness.

On the basis of the pathogenic mechanisms of radiowave disease, treatment of the neurovascular dysfunctions should be conducted with consideration of the etiology of the disease, the state of the cortical function, and the predominant type of vegetative reaction which is involved in the development of a given syndrome, as well as the general state of the patient, and individual peculiarities. This has been covered in the publications of Ye. V. Gembitskiy [1970].

Analysis of the results obtained with hospital treatment of 152 patients (129 men, 23 women, of relatively young age - 80% up to 40 years of age) helped elucidate the principles of drug therapy of patients with various clinical syndromes of the radiowave disease.

Patients with asthenic syndrome should be treated with analeptic and sedative therapy (bromine preparations, leonorus, valerian, hawthorn, korvalol [transliteration]) in combination with stimulants (sodium arsenate, strychnine nitrate, securenin, tincture of ginsen root, pankrotin [transliteration], and others). When vagotonia predominates the vegetative vascular dysfunction, treatment should be instituted with cholinolytic drugs (atropine, amizil [transliteration]) as well as preparations with combined effects (belloyd, bellaspon [both transliterations]), and small doses of subcutaneous insulin followed by intravenous glucose infusion.

Therapy should include therapeutic gymnastics, massage, hydrotherapy (cold baths, circulating shower baths) as well as psychotherapeutic talks.

In the case of patients with astheno-vegetative syndrome and hypothalamic syndrome, and which also evidence marked vegetative vascular dysfunction and sympathoadrenal crises, they should, in addition to analeptic and sedative therapy, receive weak tranquilizers (seduksen, elenium, trioksazin [all transliterations]) and antihistamines (dimedrol, pipol'fen, suprastin [all transliterations]) which potentiate their actions as well as vasodilators. Of the large arsenal of modern vasodilators, preference should be given to magnesium sulfate which also possesses sedative qualities in combination with reserpine which is a weak tranquilizer, and hypotensive ganglionic blocking agent. In the presence of persistent hypertension, agents must be included which act directly on the vascular wall (papaverine, eufillin [transliterated], no-shpa [transliteration]). Patients with coronary insufficiency should receive preparations which improve coronary circulation and myocardial metabolism (validol, nitroglycerin, intensain, panangin, izoptin [all transliterations]) as well as analgesics (injections of anal'gin [transliteration]).

Excellent therapeutic effects are obtained by injections of ATP, vitamins of group B, glutamic acid, oxygen therapy which improve the metabolism of amines and oxidative processes in the organism.

In view of the elevated reactivity of the patients, the selection of the appropriate therapeutic agents and doses requires a highly individualized approach. Particular care must be exercised in assigning drugs with narcotic action.

In cases of sympathoadrenal crises, sympatholytic drugs (small doses of chlorpromazine or propazin [transliteration])

are recommended in combination with injections of vasodilators and analgesics.

The effectiveness of treatment is determined not only by the use of the proper drugs but also by the duration of the course of treatment, and the appropriate type of job placement.

Superior therapeutic results are obtained in patients with the asthenic syndrome in whom clinical improvement appears in two to three weeks. Following discharge from the hospital, 54 patients (out of 61) with the asthenic syndrome returned to their previous work; 7 were assigned to other types of jobs.

It was more difficult to achieve therapeutic effects in patients with astheno-vegetative and hypothalamic syndromes. Following a three- to six-week period of treatment, 35 of the 80 patients with the astheno-vegetative syndrome returned for their previous work and 7 were assigned to different types of work. In the case of 28 patients with the astheno-vegetative syndrome, and 2 patients with the hypothalamic syndromes, temporary release from work had to be obtained for occupational reasons for periods of 1 to 2 months; simultaneously, these patients underwent further treatment under ambulatory conditions or at sanatoria or health resorts. Eleven patients with the astheno-vegetative syndrome, and eight patients with the hypothalamic syndrome, were classified as Group III occupational invalids.

Further studies were conducted on a group of 100 patients. The periods of observation lasted from one to ten years, but in the majority of cases the observations were conducted for three to six years. At the time of the last examination most of the patients were between from 40 to 45 years of age.

The results of the investigations showed that despite repeated courses of treatment, temporary relief from irradiation, the course of the disease became progressively more severe as the patients returned to their previous conditions of work, and this was particularly evident in patients with astheno-vegetative and hypothalamic syndromes (Table 1, group A). Paroxysmal states are frequently noted in such patients, and in advance cases hypertension and ischemic heart disease appear. The work capacity of such individuals becomes limited, and in consequence, they were either classified as Group III, or even Group II occupational invalids, or else they were assigned to different tasks without an adverse change in their classification rating.

At the same time, cessation of work under conditions of irradiation, results essentially in the stabilization of the process (Table 1, group B).

Therefore, the results of our long-term followup indicate that in moderate and severe forms of the disease, which are characterized by the development of the astheno-vegetative and the hypothalamic syndromes, work under conditions of exposure to irradiation should be terminated.

Individuals with initial forms of the disease may return to previous conditions of work under the condition that they be carefully followed and periodically undergo repeated courses of treatment.

Timely job placement of the patients, along with therapeutic and prophylactic measures, create conditions which lead to improvement in the state of health and prolong the work activity of patients with radiowave sickness.

MOUNT DESERT ISLAND HOSPITAL  
CARDIOPULMONARY SERVICES

7/11/08  
6

Patient Information

Name: <b>FOX, NICHOLS</b>	Scan Number:
ID #: <b>D21109=66352</b> Age: <b>65</b> Sex: <b>Unknown</b>	Date Recorded: <b>06/19/2008 14:23:56</b>
Referring Physician: <b>K. KOTAS, MD</b>	Date Processed: <b>06/23/2008</b>
Indications: <b>DYSRHYTHMIA, PVCs</b>	Date Of Birth: <b>09/14/1942</b>
Medications:	
Recorder: <b>H12.Cont.3.14</b> Recorder No:	Hookup Tech: <b>LTS</b> Analyst: <b>RMT</b>

Scan Criteria

SVPB Prematurity: <b>20 %</b>	Pause: <b>2000 msec</b>	Tachycardia: <b>100 BPM</b>
ST Segment Elevation: <b>200 µV</b>	Long RR/Pause: <b>All Beats</b>	Bradycardia: <b>60 BPM</b>
ST Segment Depression: <b>100 µV</b>	Pause Excluded From HR: <b>No</b>	Minimum Tachy/Brady: <b>3 min</b>

Summary Statistics

Total QRS: <b>113581</b>	Recording Duration: <b>24 hr, 0 min</b>	Analyzed Data: <b>24 hr, 0 min</b>
<b>Rate Statistics:</b>		
Min Rate: <b>54</b> at <b>17:15:38</b>	<b>Tachycardia/Bradycardia Episodes:</b>	
Max Rate: <b>129</b> at <b>11:52:33</b>	Longest Tachycardia: <b>0:08:45, 108 BPM Avg</b> at <b>12:52:06</b>	
Mean Rate: <b>79</b>	Fastest Tachycardia: <b>0:04:20, 113 BPM Avg</b> at <b>11:51:06</b>	
	Longest Bradycardia: <b>0:07:15, 59 BPM Avg</b> at <b>23:13:56</b>	
	Slowest Bradycardia: <b>0:03:45, 59 BPM Avg</b> at <b>23:01:31</b>	
<b>Supraventricular Ectopy:</b>		
AFib (Time%)/peak avg. rate: <b>(0) / 0 BPM</b>	<b>Ventricular Ectopy:</b>	
Singles: <b>38</b>	Singles: <b>22610</b>	
Couplets: <b>2</b>	Couplets: <b>35</b>	
Runs: <b>0</b>	Runs: <b>0</b>	
Total: <b>42</b>	R on T: <b>1</b>	
	Total: <b>22681</b>	

MOUNT DESERT ISLAND HOSPITAL						BAR HARBOR, ME	
Name	Number	Sex	Age	Admit	Disc.	F/C	Type
FOX NICOLS	D21109	F	65	06/19/08	06/19/08	MB5	O/P
DOB: 09/14/1942 M/R#: 035112		Physician: KOTAS KATH RM:					
HOLTER MONITOR INTERPRET & RE 93227				COMPLETE-06/19/08 15:00 RMT 66352			

INTERPRETATION: This patient reported chest constriction on two occasions, and on each occasion she was in sinus rhythm with no ST segment shifts. The patient reported irregular heart rate and palpitations on several occasions. At these times she was having unifocal ventricular premature complexes of varying frequency.

The basic rhythm is normal sinus rhythm with normal PR, QRS and QT intervals. There was a rather marked degree of ventricular ectopic activity with more than 22,000 ventricular premature complexes in 24 hours. The vast majority of these ventricular premature complexes came from a single focus and there were frequent episodes of pairing. There were no episodes of non-sustained ventricular tachycardia.

In summary, this tracing shows a rather marked degree of ventricular ectopic activity with at least 30 episodes of pairing in 24 hours. Evaluation for underlying causes is recommended. During episodes of chest constriction, there were no ST segment shifts.

Edward Gilmore, M.D./ds DD. 06/24/08 0858 DT: 06/24/08 1057

Reviewing Physician

*E. Gilmore*  
E.B. GILMORE, MD

*6-24-08*  
*dis covered*  
*[Signature]*

ATTACHMENT 7



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

MAR 8 2002

OFFICE OF  
AIR AND RADIATION

Janet Newton  
President  
The EMR Network  
P.O. Box 221  
Marshfield, VT 05658

Dear Ms. Newton:

Thank you for your letter of January 31, 2002, to the Environmental Protection Agency Administrator Whitman, in which you express your concerns about non-thermal effects of radiofrequency (RF) radiation and the adequacy of the Federal Communications Commission's RF radiation exposure guidelines. The Administrator has asked us to critically examine the issues you bring to our attention, and we will be responding to you shortly.

We appreciate your interest in the matter of non-thermal RF exposure, possible health risks, and Federal government responsibility to protect human health.

Sincerely,

A handwritten signature in black ink, appearing to read "Frank Marciniowski".

Frank Marciniowski, Director  
Radiation Protection Division



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**  
WASHINGTON, D.C. 20460

JUL 16 2002

OFFICE OF  
AIR AND RADIATION

**Ms. Janet Newton**  
**President**  
**The EMR Network**  
**P.O. Box 221**  
**Marshfield, VT 05658**

**Dear Ms. Newton:**

This is in reply to your letter of January 31, 2002, to the Environmental Protection Agency (EPA) Administrator Whitman, in which you express your concerns about the adequacy of the Federal Communications Commission's (FCC) radiofrequency (RF) radiation exposure guidelines and nonthermal effects of radiofrequency radiation. Another issue that you raise in your letter is the FCC's claim that EPA shares responsibility for recommending RF radiation protection guidelines to the FCC. I hope that my reply will clarify EPA's position with regard to these concerns. I believe that it is correct to say that there is uncertainty about whether or not current guidelines adequately treat nonthermal, prolonged exposures (exposures that may continue on an intermittent basis for many years). The explanation that follows is basically a summary of statements that have been made in other EPA documents and correspondence.

The guidelines currently used by the FCC were adopted by the FCC in 1996. The guidelines were recommended by EPA, with certain reservations, in a letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation (enclosed).

The FCC's current exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations. They are believed to protect against injury that may be caused by acute exposures that result in tissue heating or electric shock and burn. The hazard level (for frequencies generally at or greater than 3 MHz) is based on a specific absorption dose-rate, SAR, associated with an effect

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that results from an increase in body temperature. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. Therefore, the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified.

These guidelines are based on findings of an adverse effect level of 4 watts per kilogram (W/kg) body weight. This SAR was observed in laboratory research involving acute exposures that elevated the body temperature of animals, including nonhuman primates. The exposure guidelines did not consider information that addresses nonthermal, prolonged exposures, i.e., from research showing effects with implications for possible adversity in situations involving chronic/prolonged, low-level (nonthermal) exposures. Relatively few chronic, low-level exposure studies of laboratory animals and epidemiological studies of human populations have been reported and the majority of these studies do not show obvious adverse health effects. However, there are reports that suggest that potentially adverse health effects, such as cancer, may occur. Since EPA's comments were submitted to the FCC in 1993, the number of studies reporting effects associated with both acute and chronic low-level exposure to RF radiation has increased.

While there is general, although not unanimous, agreement that the database on low-level, long-term exposures is not sufficient to provide a basis for standards development, some contemporary guidelines state explicitly that their adverse-effect level is based on an increase in body temperature and do not claim that the exposure limits protect against both thermal and nonthermal effects. The FCC does not claim that their exposure guidelines provide protection for exposures to which the 4 W/kg SAR basis does not apply, i.e., exposures below the 4 W/kg threshold level that are chronic/prolonged and nonthermal. However, exposures that comply with the FCC's guidelines generally have been represented as "safe" by many of the RF system operators and service providers who must comply with them, even though there is uncertainty about possible risk from nonthermal, intermittent exposures that may continue for years.

The 4 W/kg SAR, a whole-body average, time-average dose-rate, is used to derive dose-rate and exposure limits for situations involving RF radiation exposure of a person's entire body from a relatively remote radiating source. Most people's greatest exposures result from the use of personal communications devices that expose the head. In summary, the current exposure guidelines used by the FCC are based on the effects resulting from whole-body heating, not exposure of and effect on critical organs including the brain and the eyes. In addition, the maximum permitted local SAR limit of 1.6 W/kg for critical organs of the body is related directly to the permitted whole body average SAR (0.08 W/kg), with no explanation given other than to limit heating.

I also have enclosed a letter written in June of 1999 to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group, in which the members of the Radiofrequency Interagency Work Group (RFIAWG) identified certain issues that they had determined needed to be addressed in order to provide a strong and credible rationale to support RF exposure guidelines.

Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures. When developing exposure standards for other physical agents such as toxic substances, health risk uncertainties, with emphasis given to sensitive populations, are often considered. Incorporating information on exposure scenarios involving repeated short duration/nonthermal exposures that may continue over very long periods of time (years), with an exposed population that includes children, the elderly, and people with various debilitating physical and medical conditions, could be beneficial in delineating appropriate protective exposure guidelines.

I appreciate the opportunity to be of service and trust that the information provided is helpful. If you have further questions, my phone number is (202) 564-9235 and e-mail address is [hankin.norbert@epa.gov](mailto:hankin.norbert@epa.gov).

Sincerely,



Norbert Hankin  
Center for Science and Risk Assessment  
Radiation Protection Division

**Enclosures:**

- 1) letter to Thomas P. Stanley, Chief Engineer, Office of Engineering and Technology, Federal Communications Commission, November 9, 1993, in response to the FCC's request for comments on their Notice of Proposed Rulemaking (NPRM), Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation
- 2) June 1999 letter to Mr. Richard Tell, Chair, IEEE SCC28 (SC4) Risk Assessment Work Group from the Radiofrequency Radiation Interagency Work Group



poorly in bad high frequency environments. We do not want to have them involuntarily exposed to a pollutant that has such profound detrimental effects on them.

9. I am a beekeeper. My bees are healthy at this time. I am concerned that an increase in transmitted microwave and radiowave radiation would interfere with their navigational abilities, impair their immune systems, and therefore decrease the health and vigor of my hives. Please see *The Birds, the Bees and Electromagnetic Pollution* by Dr. Andrew Goldsworthy May 2009, Exhibit A, for more information.

10. Because of the serious effects exposure to high frequencies has on our health, we do not own a cellphone, cordless phones, wireless router, baby monitors, or subscribe to wireless internet.

11. My personal experience has shown me how serious the effects of exposure to high frequencies can be. Over the years I have only occasionally had time to read the research on high frequency exposure. I recently read the paper by Halberg and Johannsen in *Pathophysiology* [Ö. Hallberg, O. Johansson, Apparent decreases in Swedish public health indicators after 1997—Are they due to improved diagnostics or to environmental factors? *Pathophysiology*(2009)]. I believe that paper alone should raise enough doubts for you to halt expansion of wireless internet and expansion of other wireless communications until safety standards to protect the public health during continuous exposure to high frequencies from all sources including transmitted and electrical pollution. For more information about electrical pollution as a potent source of high frequency exposure please see [www.electricalpollution.com](http://www.electricalpollution.com).

12. I am very concerned that a continued increase in levels of transmitted radiowave and microwave radiation will be very detrimental to my health and that of my family and will further impair our ability to live a normal life.

13. Because of the number of cell service carriers and wireless internet providers operating in our area, we have many overlapping signals from them and the associated cellphones and wireless internet routers and we are concerned that there are insufficient safety standards to manage the exposure of our family to these signals.

14. As a result, we are concerned about the long-term and short-term health effects of continuous exposure to all these signals.

15. We do not want to be guinea pigs for the government-sanctioned rollout of new technologies with insufficient safety standards. We do not want to continue to be part of the experiment being involuntarily carried out on the American people verifying the results of decades old research showing that the long-term health effects of these wireless signals can be profound and dangerous.

16. Without conservative safety standards designed to protect the public health of our entire population during continuous exposures from all detrimental health effects and the

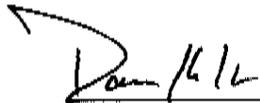
rigorous enforcement of such standards, we fear the hazards to our family's health of this low level radiation over time.

17. We are concerned about having to live next to antennas and transmitters if wireless internet is built out in our local environment. We have a right to be safe in our homes and our schools and workplaces, and we have a right to current safety standards based on current science, not mistaken assumptions (the thermal model) and wishful thinking.

18. We understand that the EMR Policy Institute is preparing comment to submit in the current Federal Communications Commission proceeding to develop the policy for providing high-speed internet service throughout the country - FCC 09-31, A National Broadband Plan for Our Future.

19. The undersigned and all the persons in our household hereby designate The EMR Policy Institute to speak on our behalf on this FCC proceeding for the purpose of defending our rights to be safe in our own home, in our schools and our workplaces and neighborhoods from the invasion into our home, schools and workplaces of signals that may cause harm to us, because the FCC's current RF exposure guidelines are inadequate in light of the findings of current science.

20. I ask that the FCC accept this affidavit and the attached exhibit into evidence for consideration under FCC 09-31, A National Broadband Plan for Our Future, as it is material evidence of the existence of signals to which my family and I are subject, yet without proper standards based on current science.

  
\_\_\_\_\_  
Daniel Kleiber

Sworn to before me

This 05 day of June, 2009

  
Notary Public Exp. 5-13-12  
County of Jefferson  
State of Wisconsin



## Exhibit A

### **The Birds, the Bees and Electromagnetic Pollution**

**Dr. Andrew Goldsworthy**

**May 2009**

### **How electromagnetic fields can disrupt both solar and magnetic bee navigation and reduce immunity to disease all in one go**

Many of our birds are disappearing mysteriously from the urban environment and our bees are now under serious threat. There is increasing evidence that at least some of this is due to electromagnetic pollution such as that from cell towers, cell phones, DECT cordless phones and Wifi. It appears capable of interfering with their navigation systems and also their circadian rhythms, which in turn reduces their resistance to disease. The most probable reason is that these animals use a group of magnetically-sensitive substances called *cryptochromes* for magnetic and solar navigation and also to control the activity of their immune systems.

Birds are very sensitive to electromagnetic fields and some may find the electromagnetically polluted urban environment no longer tolerable. Migratory birds may also lose their sense of direction and never reach their intended destination, perhaps just falling into the sea on the way. Bees are even more under threat and are extremely important to us. Without bee pollination, there would be very few brightly colored or scented flowers in the countryside or in our gardens and many of our crops would be devastated. We would be left just with crops that are wind pollinated (mostly cereals) that do not on their own provide a healthy balanced diet, nor do they act as host to the friendly nitrogen fixing bacteria that are essential to the sustainable fertility of our soil. This may be a very heavy price to pay for our unrestricted use of cell phones and other forms of wireless communication.

### **What are cryptochromes?**

The cryptochromes are a group of pigments found in virtually all animals, plants and many bacteria. They consist of a flavin (a derivative of vitamin B2) folic acid and protein. Like all pigments, they get their colour by absorbing light at specific wavelengths. The cryptochromes absorb blue-green and ultra-violet light and use its energy to drive *photochemical reactions* where light energy is converted to chemical energy. The earliest cryptochromes used this energy to repair damaged DNA. However, more modern ones have evolved in both animals and plants where they measure light to reset their biological clocks. In some animals, they also sense the direction of the Earth's magnetic field. Unfortunately, cryptochromes are very badly affected by weak oscillating electromagnetic fields that are orders of magnitude weaker than the Earth's steady magnetic field. This can disrupt both solar and magnetic navigation, which can account for colony collapse disorder in bees, the loss of some migratory birds and butterflies and a weakening of the immune system in many more organisms.

### **How cryptochrome measures light**

The energy of light is used to transfer an electron from one part of the cryptochrome molecule to another to form a pair of what chemists call *free radicals*. The electron finds its way back of its own accord to restore the *status quo*, but this takes longer and results in an accumulation of cryptochrome in the free radical form. It soon reaches equilibrium when the rate of free radical formation equals its rate of destruction, at which point the proportion in the free radical form is a measure of the current brightness of the light.

### **How cryptochrome senses magnetic fields**

This depends on the fact that free radicals are affected by magnetic fields. Steady magnetic fields delay the return of the displaced electron so that there is an even greater accumulation of cryptochrome in the free radical form. This can be sensed by the cell in the same way as it senses the effect of light. The direction of the field can be found by having an array of cryptochrome molecules oriented in different directions, as they would be in the compound eye of an insect or in the retina of a vertebrate's eye. Most of the cryptochrome is found in the eyes, but it is quite distinct from the regular visual pigments (rhodopsins) that are used in normal vision. However, their combined effect gives the animal the potential to "see" the direction of the magnetic field, possibly as an extra colour superimposed on its field of vision.

### **Oscillating magnetic fields severely disrupt cryptochrome function.**

Ritz and co-workers (Nature Vol. 429 13th May 2004 pp 177-180) showed that, provided they were given light of the wavelengths absorbed by cryptochrome, robins could orient themselves for navigation in the Earth's magnetic field. However, this was severely disrupted by the application of extremely weak alternating electromagnetic fields. A broad spectrum of frequencies between 0.1-10MHz at field strengths as little as 0.085 microtesla (about 500 times weaker than the Earth's field) made the birds completely unable to respond to the Earth's field! The quantum mechanics of the process suggest that these alternating fields are likely to be perceived as a blinding "*magnetic light*" that blots out the bird's "*magnetic vision*".

### **Mobile telecommunications generate similar fields.**

Microwaves that are modulated to carry digital information generate a similar broad spectrum of frequencies in this range. These frequencies occur in most mobile telecommunications, including cell phones, DECT cordless phones and Wifi. These too may blot out "*magnetic vision*". In real life, even lower field strengths are likely to disturb magnetic navigation, since radiation that is too weak to blot out *magnetic vision* may still be strong enough to distort the bird's perception of the Earth's field so that it flies in the wrong direction.

### **Their sheer numbers may also be a problem.**

What may be even more important is the sheer multiplicity of modern-day wireless devices; most western households have several. They may suddenly burst into life and/or be mobile; so as to give the birds continually conflicting navigational data. Many may find this disturbing. It's like being constantly bombarded from all directions by the flashing lights of a disco. We should not be too surprised to find that these birds may choose to leave the area.

### **Bees may not like the radiation either.**

Like the birds, bees may also find electromagnetic fields disturbing, and choose to leave the area. Scientists who put DECT cordless phone base stations (cheap sources of modulated microwaves) next to their beehives found that they made the bees behave abnormally and were less likely to return to the hive (<http://tinyurl.com/rans84>). Based on this observation, beekeepers would be well advised to switch off their cell phones when visiting their hives. Even when not in use, cell phones periodically emit bursts of radiation at full power so that the phone company can keep track of where you are.

### **Cryptochrome and solar navigation**

Many animals, including birds and bees, can also navigate by using the position of the sun. But in order to do this, they must have an internal clock to compensate for its changing position throughout the day. The mechanism of this clock has been extensively studied in mutants of the fruit fly *Drosophila*. It uses cryptochrome to sense the light-dark transitions at dawn and dusk to reset its clock and also to keep it running at the correct speed. Unfortunately, the use of cryptochrome also makes the clock sensitive to magnetic fields. Yoshii *et al.* found that a 300 microtesla steady field could alter the speed of the clock or even stop it altogether. (Yoshii *et al.* <http://tinyurl.com/cx7xaa>) They didn't test weak alternating fields, but given the findings of Ritz *et al.* and the fact the sensing of light and magnetic fields by cryptochrome uses the same basic mechanism, it is likely that these too would disrupt the clock's normal functions. The consequence of this would be that electromagnetic fields of this sort would render the animal unable to compensate accurately for the changing position of the sun. This means that both solar and magnetic navigation would fail together and, if there were no landmarks to guide it, the animal would be completely lost. This could explain colony collapse disorder when bees do not return to the hive, why it is so prevalent in the featureless almond plantations of the USA and why there are increasing losses of animals that have the option to use both.

### **Circadian rhythms are affected too**

Circadian rhythms are natural metabolic rhythms that occur in virtually all higher organisms. They too are driven by the biological clock so that the organism can *anticipate* the coming of dawn and dusk and modify its metabolism to be ready for the new conditions. Many metabolic functions are controlled in this way. These include the

rhythmic production of melatonin (a sleep hormone) and the diversion of metabolic resources from physical activity during the day, to repair and the immune system at night.

### **Consequences of losing the circadian rhythm**

If the rhythm were to be lost or become weaker due to a failure of the clock as a result of electromagnetic exposure, it would have serious consequences. In humans it would result in tiredness during the day, poor sleep at night, and a reduced nightly production of the sleep hormone melatonin. All of these effects have been reported in people exposed to the radiation from cell towers and other sources of continuous weak electromagnetic radiation such DECT phone base stations and Wifi routers. Also, any weakening of the amplitude of these rhythms means that **at no time will any process controlled by them ever function at maximum power.** In particular, the immune system may never be able to summon up the overwhelming power that is sometimes needed to overcome pathogens or to destroy developing cancer cells before they get out of control. This could in part explain the increased risk of cancer often found in epidemiological studies of people living near mobile phone base stations. It may also be an important factor in the continuing reduction in the health of our bee population and its apparently reduced ability to resist pathogens.

*Andrew Goldsworthy BSc PhD*

*May 2009*



information is available on the Technical Page. Electrical pollution is a very potent form of exposure to high frequencies. Exposure to all forms of high frequencies, including electrical pollution, must be included in standards regulating exposure of the general public to protect the public health during continuous exposure.

10. Because of the serious effects exposure to high frequencies has on our health, we do not own a cellphone, cordless phones, wireless router, baby monitors, or subscribe to wireless internet.

11. I have read widely on the research into the health effects of exposure to high frequencies. I believe that the increased exposure to high frequencies from radiowave and microwave transmitters and from electrical pollution are behind the public health crisis that has dramatically increased utilization of our medical system for chronic conditions. The recent article by Halberg and Johansson in *Pathophysiology*<sup>1</sup> supports this contention. The comprehensive review by Dr. Cherry, which documents health effects and explores mechanisms, besides thermal mechanisms, through which microwave and radiowave radiation can impact health, also supports my contention that exposure to microwave and radiowave radiation is a public health threat which is probably contributing to significant public illness. Papers by Dr. Milham<sup>3</sup>, Dr. Havas<sup>4,5,6</sup> and Dr. Wertheimer<sup>7</sup> also show that exposure to electrical pollution constitutes a public health threat, as does a report by Char Sbraggia regarding health improvements experienced by teachers and students when the electrical pollution in their school was cleaned up (Exhibit A). These are just a few of the papers I have read. However, they provide a picture which should illustrate the need for precautionary action to halt the expansion of public exposure to high frequencies until safety standards can be established to prevent health problems in the general population during continuous exposures to high frequencies, taking into account all sources of exposure.

1. Ö. Hallberg, O. Johansson, Apparent decreases in Swedish public health indicators after 1997—Are they due to improved diagnostics or to environmental factors? *Pathophysiology*(2009)
2. Cherry, N. 2000 Criticism of the Health Assessment in the ICNIRP Guidelines for Radiofrequency and Microwave Radiation (100 kHz- 300 GHz)
3. Milham S, Morgan L. 2008 A New Electromagnetic Exposure Metric: High Frequency Voltage Transients Associated With Increased Cancer Incidence in Teachers in a California School. *American Journal of Industrial Medicine*.
4. Havas M, Olstad A. 2008. Power quality affects teacher wellbeing and student behavior in three Minnesota Schools, *Science of the Total Environment*, July.
5. Havas M. 2006. Electromagnetic hypersensitivity: biological effects of dirty electricity with emphasis on diabetes and multiple sclerosis. *Electromagnetic Biology Medicine* 25(4):259-68.
6. Havas M. 2008. Dirty Electricity Elevates Blood Sugar Among Electrically Sensitive Diabetics and May Explain Brittle Diabetes. *Electromagnetic Biology and Medicine*, 27:135-146.
7. Wertheimer N, Savitz DA, Leeper E. 1995 Childhood Cancer in Relation to Indicators of Magnetic Fields from Ground Current Sources *Bioelectromagnetics* 16: 86-96.

12. I am very concerned that a continued increase in levels of transmitted radiowave and microwave radiation will be very detrimental to my health and that of my family and will further impair our ability to live a normal life.

13. Because of the number of cell service carriers and wireless internet providers operating in our area, we have many overlapping signals from them and the associated cellphones and wireless internet routers and we are concerned that there are insufficient safety standards to manage the exposure of our family to these signals.

14. As a result, we are concerned about the long-term and short-term health effects of continuous exposure to all these signals.

15. We do not want to be guinea pigs for the government-sanctioned rollout of new technologies with insufficient safety standards. We do not want to continue to be part of the experiment being involuntarily carried out on the American people verifying the results of decades old research showing that the long-term health effects of these wireless signals can be profound and dangerous.

16. Without conservative safety standards designed to protect the public health of our entire population during continuous exposures from all detrimental health effects and the rigorous enforcement of such standards, we fear the hazards to our family's health of this low level radiation over time.

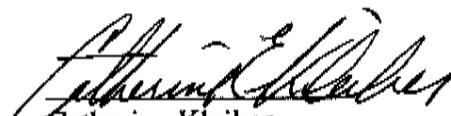
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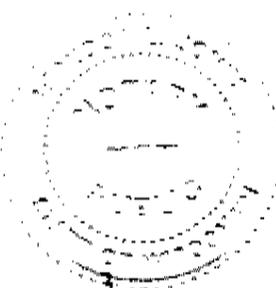
Sworn to before me

  
Catherine Kleiber

This 5 day of June, 2009

  
Notary Public EXP: 5-13-12

County of Jefferson  
State of Wisconsin



**Exhibit A**

---

**Melrose-Mindoro****N181 State Rd. 108 • Melrose, WI 54642**

Ron Perry, Superintendent  
Del Deberg, High School Principal  
Tracy Dalton, K-8 Principal

High School – (608) 488-2201 or (608) 857-3417  
Fax – (608) 488-2805  
Melrose Elementary – (608) 488-2311  
Mindoro Elementary – (608) 857-3410

**CHANGES NOTED SINCE FILTERS INSTALLED**

In the years previous to the filters being installed, several children required inhalation treatments for their asthma in the spring and in the fall. Many of them required nebulizer treatments once or twice a day while at school. I have not had to administer one nebulizer treatment this past year and of the 37 students with inhalers, only three of them use the inhaler for their exercise-induced asthma before Phy Ed.

Teachers are stating they are less fatigued and tired.

The sense of smell has come back for me. I lost it for three years and the doctors said it was my allergies.

The students seem to have more energy and appear and seem less tired.

Several staff who doctored regularly for allergies have not had to take medication or see their doctor because they are having less problems.

Students whom have been diagnosed with migraine headaches have had their headaches reduced no headaches at all.

I feel that our faculty and students have had improved health overall since the filters have been installed.

Char Sbraggia R.N.  
District Nurse