Exhibit 44
Compilation of 2009 State and Municipal Actions
on Electromagnetic Awareness
and Opposing FCC Siting Policy and RF Safety Standards

Honorary Proclamation

BILL RITTER, JR.
GOVERNOR

ELECTROMAGNETIC SENSITIVITY AWARENESS MONTH
May 2009

WHEREAS, people of all ages in Colorado and throughout the world have developed the illness of Electromagnetic Sensitivity (EMS) as a result of global electromagnetic pollution; and

WHEREAS, Electromagnetic Sensitivity is a painful chronic illness of hypersensitive reactions to electromagnetic radiations for which there is no known cure; and

WHEREAS, the symptoms of EMS include, dermal changes, acute numbness and tingling, dermatitis, flushing, headaches, arrhythmia, muscular weakness, tinnitus, malaise, gastric problems, nausea, visual disturbances, severe neurological, respiratory, speech problems, and numerous other physiological symptoms; and

WHEREAS, Electromagnetic Sensitivity is recognized by the Americans with Disabilities Act, the US Access Board and numerous commissions; and

WHEREAS, this illness may be preventable through the reduction or avoidance of electromagnetic radiations, in both indoor and outdoor environments and by conducting further scientific research;

Therefore, I, Bill Ritter, Jr., Governor of Colorado, do hereby proclaim May 2009

ELECTROMAGNETIC SENSITIVITY AWARENESS MONTH

in the State of Colorado.

GIVEN under my hand and the Executive Seal of the State of Colorado, this fifteenth day of May, 2009

Bill Ritter Jr.

Bill Ritter, Jr.
Governor

State of Connecticut

By Her Excellency M. Jodi Rell, Governor: an

Official Statement

WHEREAS, people of all ages in Connecticut and throughout the world have developed the illness of Electromagnetic Sensitivity (EMS) as a result of global electromagnetic pollution; and

WHEREAS, Electromagnetic Sensitivity (EMS) is a painful chronic illness of hypersensitive reactions to electromagnetic radiations for which there is no known cure; and

WHEREAS, the symptoms of EMS include dermal changes, acute numbness and tingling, dermatitis, flushing, headaches, arrhythmia, muscular weakness, tinnitus, malaise, gastric problems, nausea, visual disturbances, severe neurological respiratory, speech problems, and numerous other physiological symptoms; and

WHEREAS, Electromagnetic Sensitivity (EMS) is recognized by the Americans with Disabilities Act, the U.S. Access Board, and numerous commissions; and

WHEREAS, the health of the general population is at risk from electromagnetic exposures that can lead to this illness induced by electromagnetic radiations; and

WHEREAS, this illness may be preventable through the reduction or avoidance of electromagnetic radiations, in both indoor and outdoor environments and by conducting further scientific research; and

WHEREAS, people with EMS need the support of the medical establishment and understanding of family, friends, co-workers, and society as they struggle with their illness and have to adapt to new lifestyles; now

THEREFORE, I, M. Jodi Rell, Governor of the State of Connecticut, do hereby proclaim the month of May 2009, as

ELECTROMAGNETIC SENSITIVITY (EMS) AWARENESS MONTH

in the State of Connecticut.

STATE OF CONNECTICUT EXECUTIVE DEPARTMENT

M. Jodi Rell
Governor

Proclamation

REQUESTED BY
MAYOR STACY RITTER
BROWARD COUNTY

WHEREAS, as a result of global electromagnetic pollution, people of all ages in Broward County and throughout the world have developed an illness known as Electromagnetic Sensitivity (EMS); and

WHEREAS, Electromagnetic Sensitivity (EMS) is a painful chronic condition of hypersensitivity reactions to electromagnetic radiation in the environment for which there is currently no known cure; and

WHEREAS, the symptoms of EMS include dermal changes, dermatitis, acute tingling and numbness, muscular weakness, headaches, heart rate changes, nausea, gastric problems, loss of visual acuity, severe neurological, respiratory, speech problems, and numerous other physiological symptoms; and

WHEREAS, EMS is recognized by the Americans with Disabilities Act, and the U.S. Access Board; and

WHEREAS, the health of the general population is at risk from electromagnetic exposures that can lead to this illness induced by electromagnetic radiations; and

WHEREAS, this illness may be preventable through the reduction or avoidance of electromagnetic radiation, in both indoor and outdoor environments, and further scientific research to be conducted including genetics; and

WHEREAS, people with EMS need the support of the medical establishment, and the understanding of family, friends, co-workers, and society as they struggle with their illness and learn to adapt to new lifestyles; **NOW, THEREFORE,**

BE IT PROCLAIMED BY THE BOARD OF COUNTY COMMISSIONERS OF BROWARD COUNTY, FLORIDA:

That the Board hereby designates the month of May 2009 as **"ELECTROMAGNETIC SENSITIVITY (EMS) AWARENESS MONTH"** in Broward County, Florida.

May 1, 2009
Date

BROWARD COUNTY
FLORIDA

Mayor

MOTIONS/RESOLUTIONS PRESENTED TO THE LOS ANGELES CITY BOARD OF EDUCATION FOR CONSIDERATION

SUBJECT: Wireless Telecommunication Installations

DATE NOTICED: 5-12-09

PRESENTED FOR ACTION: 5-26-09

PRESENTED BY: Ms. Korenstein

MOVED/SECONDED BY: Ms. Korenstein
Ms. LaMotte

MOTION:

RESOLUTION: X

Whereas, The health and safety of our students and employees are fundamental concerns of the Los Angeles Unified School District;

Whereas, On June 27, 2000, the Governing Board of the Los Angeles Unified School District adopted a resolution opposing the siting of cellular facilities on or in close proximity to schools to ensure individuals, especially children, are protected from the potential health effects associated with exposures to extremely low frequency electromagnetic and radio-frequency radiation;

Whereas, The District has been successful in restricting the placement of wireless communication installations on its school facilities, it has had limited success in preventing wireless service facilities from siting near its schools due to apparent restrictions placed upon zoning authorities to consider the health and environmental effects of radio-frequency radiation;

Whereas, The desire of the wireless companies to market new wireless services has since led to a proliferation of cellular facilities targeting residential areas and areas near schools;

Whereas, Wireless infrastructure is being deployed at an unprecedented speed and cellular facilities have been approved without proper justification and proof that the placement is to serve existing demand or provide public safety benefits;

Whereas, Serious concerns exist regarding wireless permits approved near schools without proper notification to school officials and nearby property owners or proper review and oversight of the wireless applications;

Whereas, Cities, counties, and local municipalities have relied upon Section 704 of the Federal Telecommunications Act of 1996 to preempt local communities and school districts from opposing the placement, construction, and modification of personal wireless service facilities on the basis of environmental effects of radio-frequency emissions to the extent that the proposed facilities comply with the Federal Communications Commission regulations concerning such emissions;

Whereas, Cities, counties, and local municipalities have not had to demonstrate that these telecommunication facilities comply with the Federal Communications Commission regulations concerning radio-frequency emissions as they relate to multiple-transmitter sites and complex environments whereby all significant contributions to environmental exposures are cumulatively considered;

Whereas, Based upon new and emerging scientific evidence there continues to be considerable debate as to the adequacy of existing public exposure standards including those promulgated by the Federal Communications Commission;

SUBJECT: Wireless Telecommunication Installations

Whereas, The full Parliament of the European Union has raised concerns about the exposure of children and young people to electromagnetic fields and continuing uncertainties about possible health risks; and therefore, adopted on April 2, 2009 a resolution encouraging 1) the establishment of setback criteria for wireless antennas, mobile phone masts and other electromagnetic emitting devices to be set within a specific distance from schools and health institutions, 2) stricter regulations and protections for residents and consumers and 3) more reliable information be made available about the effects of exposure to electromagnetic fields to citizens in an effort to prevent a "proliferation of poorly positioned masts and transmitters;"

Whereas, The Federal Communications Commission is obliged to conduct periodic reviews of current research and analysis of the health implications associated with radio-frequency exposures in cooperation with industry, agency, and organizations responsible for community health and safety to ensure exposure guidelines are appropriate and scientifically valid; therefore, be it

Resolved, That the Governing Board of the Los Angeles Unified School District directs the Office of Environmental Health and Safety to request local jurisdictions to provide timely notification when new cellular permit applications are filed and provide comment on the health risks from the proposed facility as it relates to compliance with existing Federal Communications Commission regulations associated with cumulative exposures;

Resolved further, That the Board supports responsible deployment of fiber optic broadband technology, which is superior to wireless technology in speed, reliability, security, durability and protections it affords people and the environment from the potential hazards of exposure to radio-frequency radiation; and be it finally

Resolved, That the Board requests the County of Los Angeles, the Los Angeles City Council and all local jurisdictions that the District serves to join them in passing a resolution in favor of revising Section 704 of the Federal Telecommunications Act of 1996's preemption of consideration of the health and environmental effects of radio-frequency radiation at levels below current Federal Communication Commission standards in decisions involving the placement, construction and modification of wireless facilities, and in favor of amending the California Public Utilities Code to grant local governments authority to regulate wireless facilities in public rights of way pursuant to local planning and zoning ordinances, to be sent to Sacramento and Washington, D.C.

	AYES	**NOES**	**ABSTAIN**	**ABSENT**
Ms. Canter	**x**			
Ms. Korenstein	**x**			
Ms. LaMotte	**x**			
Dr. Vladovic	**x**			
Ms. Galatzan	**x**			
Ms. Flores Aguilar	**x**			
Ms. Garcia				**x**
TOTAL	**6**			**1**

ACTION: ADOPTED

2. Recommendation as submitted by Supervisor Ridley-Thomas: Waive the facility use fee in the amount of $200, and reduce the parking fee to $1 per vehicle, excluding the cost of liability insurance, at Mother's Beach for the California Highway Patrol's "Wellness Day" event, to be held June 2, 2009. (09-1208)

At the suggestion of Supervisor Ridley-Thomas, and on motion of Supervisor Yaroslavsky, seconded by Supervisor Antonovich, this item was approved.

Ayes: 4 - Supervisor Molina, Supervisor Yaroslavsky, Supervisor Antonovich and Supervisor Knabe

Absent: 1 - Supervisor Ridley-Thomas

Attachments: Motion by Supervisor Ridley-Thomas

3. Recommendation as submitted by Supervisors Yaroslavsky and Antonovich: Instruct the County's legislative advocates in Washington, D.C. to actively seek and support Federal legislation to repeal limitations on State and local authority imposed by the Telecommunications Act of 1996 that infringe upon the authority of local governments to regulate the placement, construction, and modification of telecommunications towers and other personal wireless services facilities on the basis of the health and environmental effects of these facilities, and to submit comments on the National Broadband Policy in furtherance of these policy goals prior to the June 8, 2009 comment deadline; and instruct the County's legislative advocates in Sacramento to actively seek and support State legislation that would give local governments greater flexibility to regulate the placement of cellular and other wireless facilities within the road right-of-way given the unique aesthetic and safety issues that these facilities raise.

Also consideration of Supervisor Ridley-Thomas' **revised** recommendation: Instruct the County's Legislative Advocates in Sacramento to actively seek and support ~~State~~ **Federal** legislation that would direct the Federal Communications Commission to pursue a comprehensive global analysis of best practices and scientific evidence in order to update their existing standards to adequately measure the health impacts of telecommunications towers. (09-1201)

Jody Donnelly, Jamie T. Hall, Sally Hampton, Elise E. Kalfayan, Elizabeth A. Kelley, Gene Krischer and Miriam Nakamura addressed the Board.

After discusssion, on motion of Supervisor Antonovich, seconded by Supervisor Knabe, this item was approved.

Ayes: 4 - Supervisor Molina, Supervisor Yaroslavsky, Supervisor Antonovich and Supervisor Knabe

Absent: 1 - Supervisor Ridley-Thomas

Attachments:
Joint Motion by Supervisors Yaroslavsky and Antonovich
Revised Joint Motion by Supervisors Yaroslavsky and Antonovich
Motion by Supervisor Ridley-Thomas
Revised Motion by Supervisor Ridley-Thomas
Video
Audio

4. Recommendation as submitted by Supervisor Yaroslavsky: Instruct the Acting County Counsel, in conjunction with the Directors of Parks and Recreation and Public Health, and the Chief Executive Officer, to develop a smoke-free parks ordinance in Los Angeles County for the Board's consideration in 90 days. The development of the ordinance should be guided by the findings and recommendations outlined in the Directors of Parks and Recreation and Public Health's report dated April 7, 2009. (09-1200)

Jonathan E. Freedman, Chief Deputy of Public Health, and John Wicker, Chief Deputy Director of Parks and Recreation, responded to questions posed by the Board.

Robert Berger, Ray A. Chavira, Janice Chow, Gloria J. Davis, Carey January, Denise Lamb, Wesley Reutimann, Janet A Roberts and David L. Ross addressed the Board.

After discussion, on motion of Supervisor Yaroslavsky, seconded by Supervisor Antonovich, this item was duly carried by the following vote:

Ayes: 3 - Supervisor Molina, Supervisor Yaroslavsky and Supervisor Antonovich

Abstentions: 1 - Supervisor Knabe

Absent: 1 - Supervisor Ridley-Thomas

Attachments:
Motion by Supervisor Yaroslavsky
April 7, 2009 report
Video
Audio

AGN. NO. _____

MOTION BY SUPERVISORS ZEV YAROSLAVSKY AND
MICHAEL D. ANTONOVICH June 2, 2009

There is an ongoing debate within the scientific community and among governing bodies throughout the world regarding how thoroughly the long-term health effects of low-frequency electromagnetic and radio-frequency emissions are understood. In particular, questions have been raised regarding how well the existing regulations established by the Federal Communications Commission protect more vulnerable populations such as school-aged children, and how well they protect against the cumulative effect of radio-frequency emissions on people who live or work in close proximity to multiple cellular facilities.

Unfortunately, Section 704 of the Federal Telecommunications Act of 1996 prevents local governments, including the County of Los Angeles, from opposing the placement of personal wireless service facilities on the basis of the environmental or health effects of radio-frequency emissions to the extent that the proposed facilities comply with the Federal Communications Commission regulations concerning such emissions. In addition, the California Public Utilities Code unfairly limits the authority of local governments to regulate wireless facilities in public rights of way.

As long as questions exist as to the adequacy of these federal regulations, local

MOTION

MOLINA _____

RIDLEY-THOMAS _____

YAROSLAVSKY _____

ANTONOVICH _____

KNABE _____

governments should have the ability to include a consideration of the health and environmental effects of these facilities when deciding whether or not to approve the construction or modification of a cellular communications facility. The County should also have expanded discretion to decide how, when and where cellular facilities should be sited within the road right of way due to the unique aesthetic and safety issues that these facilities raise.

WE, THEREFORE, MOVE that the Board of Supervisors instruct the County's legislative advocates to actively seek and support federal legislation to repeal limitations on state and local authority imposed by the Telecommunications Act of 1996 that infringe upon the authority of local governments to regulate the placement, construction, and modification of telecommunications towers and other personal wireless services facilities on the basis of the health and environmental effects of these facilities, and to submit comments on the National Broadband Policy in furtherance of these policy goals prior to the June 8, 2009 comment deadline.

WE FURTHER MOVE that the Board of Supervisors instruct the County's legislative advocates to actively seek and support state legislation that would give local governments greater flexibility to regulate the placement of cellular facilities within the road right of way given the unique aesthetic and safety issues that these facilities raise.

BS S:/Motions/Cell Phone Leg

AGN. NO. 3

MOTION BY SUPERVISOR MARK RIDLEY-THOMAS JUNE 2, 2009

RELATED TO ITEM #3

While local planning agencies should have the authority to regulate the placement, construction, and modification of telecommunications towers and other personal wireless services facilities, such agencies should be positioned to do so based on the most protective standards and guidelines that address the health impacts of this infrastructure.

However, diverging guidelines have been promulgated for limiting human exposure to radio-frequency radiation worldwide, leading to a persistent and publicly expressed lack of confidence in radiofrequency-exposure standards. The rationales adopted by the International Commission on Non-Ionizing Radiation Protection and the Institute of Electrical and Electronic Engineers are divergent, and the Federal Communication Commission's adopted limits are substantially less protective than the standards of many of the individual nations within Europe, Asia and other regions of the world.

As our communities become increasingly more reliant on wireless technology, it is incumbent upon this Board to call for the continued analysis and critique of the health impacts of telecommunications towers.

I, THEREFORE, MOVE that the Board of Supervisors:
Instruct the County's legislative advocates to actively seek and support federal legislation that would direct the Federal Communications Commission to pursue a comprehensive global analysis of best practices and scientific evidence in order to update their existing standards and to adequately measure the health impacts of telecommunications towers.

# # #

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	MOTION
MOLINA	_____
RIDLEY-THOMAS	_____
YAROSLAVSKY	_____
ANTONOVICH	_____
KNABE	_____

RESOLUTION No.

Request the federal government to update studies on potential health effects of radio frequency wireless emissions in light of significant increases in wireless use.

WHEREAS, federal law preempts state and local governments, including the City of Portland, from considering health concerns in the regulation and placement of wireless facilities, so long as such facilities otherwise comply with applicable federal law; and

WHEREAS, the Federal Communications Commission (FCC) has jurisdiction over non-federal wireless facilities, authorizing and licensing all non-federal devices, transmitters and facilities that generate Radio Frequency (RF) radiation; and

WHEREAS, the FCC relies upon federal agencies with health and safety expertise, such as the Food and Drug Administration (FDA), the Environmental Protection Agency, the National Institute for Occupational Safety and Health, and the Occupational Safety and Health Administration which have assigned roles in federal law for monitoring and investigating issues related to RF exposure; and

WHEREAS, the Government Accounting Office in 2001 prepared a report of its investigation into safety concerns related to mobile phones, and concluded that further research into wireless technology is needed, recommending the FDA take the lead in monitoring research results; and

WHEREAS, the FCC in 2003 last updated guidelines for human exposure to RF electromagnetic fields from wireless facilities, based primarily on recommendations of other federal agencies after reviews of prior scientific literature related to RF biological effects, primarily from the 1990s; and

WHEREAS, a survey released in May 2009 from the Centers for Disease Control and Prevention concluded that for the first time the number of households in the U.S. with only a cell phone exceeds the number of households in the U.S. with only a landline phone;

NOW THEREFORE BE IT RESOLVED that the Portland City Council requests the FCC to work in cooperation with the FDA and other relevant federal agencies to revisit and update studies on potential health concerns arising from RF wireless emissions in light of the national proliferation of wireless use; and

BE IT FURTHER RESOLVED, that the Council Clerk shall cause a copy of this Resolution to be sent to all members of the FCC, to the FDA Commissioner, and to all members of the Oregon Congressional Delegation.

Adopted by the Council:
Commissioner Amanda Fritz
May 12, 2009

Gary Blackmer
Auditor of the City of Portland
By

Deputy

IDENTIFICATION OF RESEARCH NEEDS RELATING TO POTENTIAL BIOLOGICAL OR ADVERSE HEALTH EFFECTS OF WIRELESS COMMUNICATION DEVICES

Committee on Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices

Nuclear and Radiation Studies Board

Division on Earth and Life Studies

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

THE NATIONAL ACADEMIES PRESS
Washington, D.C.
www.nap.edu

EXHIBIT 45

Executive Summary

The U.S. Food and Drug Administration (FDA) of the Department of Health and Human Services asked the National Academies to organize a workshop of national and international experts to identify research needs and gaps in knowledge of biological effects and adverse health outcomes of exposure to radiofrequency (RF) energy from wireless communications devices. To accomplish this task, the National Academies appointed a seven member committee to plan the workshop.[1] Following the workshop, the committee was asked to issue a report based on the presentations and discussions at the workshop that identified research needs and current gaps in knowledge. The committee's task did not include the evaluation of health effects or the generation of recommendations relating to how the identified research needs should be met.

For the purposes of this report, the committee defines research needs as research that will increase our understanding of the potential adverse effects of RF energy on humans. Research gaps are defined as areas of research where the committee judges that scientific data that have potential value are presently lacking, but that closing of these gaps is either ongoing and results should be awaited before judgments are made on further research needs, or the gaps are not judged by the committee to be of as high a priority with respect to directly addressing health concerns at this time.

The research needs and gaps identified by the committee are presented in abbreviated form in the report Summary and in more detail in the text.

[1]Committee on Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices.

These needs and gaps are committee judgments derived from the workshop presentations and discussions, and the report does not necessarily reflect the views of the FDA, individual workshop speakers, or other workshop participants.

The committee judged that important research needs included, in order of appearance in the text, the following:

- Characterization of exposure to juveniles, children, pregnant women, and fetuses from personal wireless devices and RF fields from base station antennas.
- Characterization of radiated electromagnetic fields for typical multiple-element base station antennas and exposures to affected individuals.
- Characterization of the dosimetry of evolving antenna configurations for cell phones and text messaging devices.
- Prospective epidemiologic cohort studies of children and pregnant women.
- Epidemiologic case-control studies and childhood cancers, including brain cancer.
- Prospective epidemiologic cohort studies of adults in a general population and retrospective cohorts with medium to high occupational exposures.
- Human laboratory studies that focus on possible adverse effects on electroencephalography[2] activity and that include a sufficient number of subjects.
- Investigation of the effect of RF electromagnetic fields on neural networks.
- Evaluation of doses occurring on the microscopic level.
- Additional experimental research focused on the identification of potential biophysical and biochemical/molecular mechanisms of RF action.

[2] *Electroencephalography* is a neurological diagnostic procedure that records the changes in electrical potentials (brain waves) in various parts of the brain.

Summary

In recent years there has been a rapid increase in the use of wireless communications devices, and a great deal of research has been carried out to investigate possible biological or human health effects resulting from the use of these devices. In a more focused initiative, the U.S. Food and Drug Administration (FDA) of the Department of Health and Human Services asked the National Academies to organize a workshop of national and international experts to identify research needs and gaps in knowledge of biological effects and adverse health outcomes of exposure to radiofrequency (RF) energy from wireless communications devices (for full statement of task see Appendix A). To accomplish this task, the National Academies appointed a seven member committee to plan the workshop (Appendix B).[1] Following the workshop, the committee was asked to issue a report based on the presentations and discussions at the workshop that identifies, in the committee's judgment, research needs and current gaps in knowledge. The committee's task did not include the evaluation of health effects or the generation of recommendations relating to how identified research needs should be met.

The requested workshop was held on August 7-9, 2007 (Appendix C). It was organized into five sessions to identify research needs and gaps in the following areas:

- dosimetry and exposure,
- epidemiology,

[1]Committee on Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices.

- human laboratory studies,
- mechanisms, and
- animal and cell biology.

A sixth session, which was held on the morning of the third day of the workshop, introduced overarching issues and solicited research needs and gaps from workshop speakers and other interested parties.

The organizing committee invited experts from 9 countries (Appendix D) to speak on research needs and gaps relating to potential biological or adverse health effects of wireless communications devices. Written contributions relating to research needs and gaps were also solicited for consideration prior to and at the workshop (individuals who submitted written contributions are listed in Appendix E).

The report contains the committee's evaluation of the workshop presentation and discussion sessions followed by the committee's identification of research needs and gaps.

RESEARCH NEEDS AND GAPS

For the purposes of this report, the committee defines "research needs" as research that will increase our understanding of the potential adverse effects of RF energy on humans. "Research gaps" are defined as areas of research where the committee judges that scientific data that have potential value are presently lacking, but that closing of these gaps is ongoing, and results should be awaited before judgments are made on further research needs, or the gaps are not judged by the committee to be of as high a priority at this time.

To the extent possible, near-, mid-, and long-term research opportunities have been characterized as follows: the committee judged that "research needs" are near-term research opportunities. "Research gaps" that are currently being filled may result in mid-term research opportunities, depending on the outcome of the current research. "Research gaps" defined as being of lower priority with respect to directly addressing health concerns comprise possible long-term research opportunities.

Abbreviated versions of committee judgments on research needs and gaps are organized below in the Summary in order of the five sessions that comprised the first two days of the workshop. The reader is referred to the text of the report for details on research needs and gaps.

DOSIMETRY AND EXPOSURE

Research Needs

1. There is a need to characterize exposure of juveniles, children, pregnant women, and fetuses, both for personal wireless devices (e.g., cell phones, wireless personal computers [PCs]) and for RF fields from base station antennas including gradients and variability of exposures, the environment in which devices are used, and exposures from other sources, multilateral exposures, and multiple frequencies.

2. Wireless networks are being built very rapidly, and many more base station antennas are being installed. A crucial research need is to characterize radiated electromagnetic fields for typical multiple-element base station antennas and for the highest radiated power conditions with measurements conducted during peak hours of the day at locations close to the antennas as well as at ground level.

3. The use of evolving types of antennas for hand-held cell phones and text messaging devices need to be characterized for the Specific Absorption Rates (SARs) that they deliver to different parts of the body so that this data is available for use in future epidemiologic studies.

4. RF exposure of the operational personnel close to multi-element newer base station antennas is unknown and could be high. These exposures need to be characterized. Also needed are dosimetric absorbed power calculations using realistic anatomic models for both men and women of different heights.

Research Gaps

Research Ongoing

1. Although several dosimetric models are currently available for children and individuals of reduced stature, a research gap remains in the further development of models of several heights for men, women, and children of various ages for use in the characterization of SAR distributions for exposures characteristic of cell phones, wireless PCs, and base stations.

Judged to Be of Lower Priority

2. Presently, there is negligible or relatively little knowledge of local SAR concentration (and likely heating) in close proximity to metallic adornments and implanted medical devices for the human body.

3. There is a need for improved exposure systems for human laboratory studies including reliable and accurate exposure assessment for designs of next generation exposure systems for human laboratory studies. Furthermore, location-dependent field strength needs to be accounted for

in the characterization of exposures. A very important consideration is the validation of results by several independent investigators so that reliable and accurate exposure assessments are available for both comparisons between systems and between laboratories.

4. There is a need for an updated survey in a properly selected sample of the U.S. population to characterize and document rapidly changing exposures to electromagnetic field strengths that would improve our knowledge of the exposure levels for the population at large, taking into account the large number of new cell phones and base stations, radio and TV stations, and a wide array of other communications devices, including a survey of measured personal exposure with information on location and activity at the time of measurement including the difference between indoor and outdoor environments.

EPIDEMIOLOGY

The committee identified significant research needs for a number of epidemiologic studies, particularly of children.

Adults

Research Needs

1. Prospective Cohort Studies. A prospective cohort study will allow for the evaluation of diverse outcomes, but a very large sample size and extended follow-up is required for rare outcomes or those that occur only with very long latencies.

2. Occupational Cohorts with Medium to High Exposure. None of the occupational studies to date have been based on an adequate exposure assessment. Much work is needed to identify occupations with potentially high RF exposures and to characterize them.

Research Gaps

Judged to Be of Lower Priority

1. Nested case-control studies of rare diseases.
2. Observational studies on subjective outcomes.

Children

Research Needs

1. Prospective Cohort Studies of Pregnancy and Childhood. Children are potentially exposed from conception through maternal wireless device use and then postnatally when they themselves become users of mobile phones.

2. Case-control Study of Children Mobile Phone Users and Brain Cancer. Owing to widespread use of mobile phones among children and adolescents and the possibility of relatively high exposures to the brain, investigation of the potential effects of RF fields in the development of childhood brain tumors is warranted.

Research Gaps

Research Ongoing

1. Case-control studies of childhood cancer with improved exposure assessment taking into account all major fixed point sources of RF exposure (base stations, AM, FM, TV antennas, and other sources).

HUMAN LABORATORY STUDIES

Research Needs

There are some significant research needs for human laboratory studies. Due to the paucity of data from identically replicated experiments,

1. There is a need for experiments focusing on possible adverse RF effects identified by changes in electroencephalogram activity as well as a need to include an increased number of subjects.

Research Gaps

Research Ongoing

1. Little or no information is available on possible neurophysiological effects developing during long-term exposure to RF fields.
2. Risks of exposure to RF fields in elderly volunteers are not well explored.
3. There is a continuing need for experiments focusing on possible adverse RF effects identified by changes in cognitive performance functions.

Judged to Be of Lower Priority

4. There is a need to conduct human volunteer studies to investigate potential **health implications arising from interaction of cell phones with** hearing aids and cochlear implants.

MECHANISMS

Research Needs

1. The effect of RF electromagnetic fields on neural networks is a topic needing further investigation. There are indications that neural networks are a sensitive biological target.

2. Evaluation of doses occurring on the microscopic level is a topic needing further investigation.

Research Gaps

Research Ongoing

1. Mechanisms that can be modeled theoretically with the use of software-based nonlinear cell models that describe field-induced molecular changes. **It is currently unclear if a nonlinear biological mechanism exists** that could lead to demodulation effects. There is some research with respect to this question underway.

Judged to Be of Lower Priority

2. It is unclear whether low-level RF exposure can trigger effects through stimulation of cellular thermo-receptors.

3. Knowledge is lacking concerning the effects of electromagnetic fields on ion and molecular transport through the cell membrane.

IN VIVO AND IN VITRO STUDIES IN EXPERIMENTAL MODEL SYSTEMS

Research Needs

1. Additional experimental research focused on the identification of potential biophysical and biochemical/molecular mechanisms of RF action is considered to be of the highest priority.

Research Gaps

Research Ongoing

1. Following completion of several large ongoing studies, a "weight-of-the-evidence" analysis can be conducted to synthesize and evaluate the entire data set. At that time, rational, informed decisions can be made concerning the value of conducting additional oncogenicity[2] studies in standard-bred laboratory animals.

2. The use of genetically engineered animals may increase the sensitivity of laboratory studies to detect weak effects, and may be particularly suitable to evaluate the possible interactions between RF fields and other agents in disease causation.

3. The overall database for RF fields and cancer would be strengthened by additional studies using multi-stage model systems for cancer in tissues (such as the brain) that have been hypothesized to be targets of RF action.

4. Although genetic toxicology studies have failed to identify potential RF health effects, additional genetic toxicology studies may be warranted should evidence of oncogenicity be identified in any of the ongoing chronic toxicity/oncogenicity bioassays of RF fields in laboratory animals, or in any future studies to be performed using genetically engineered animal models.

5. A number of potentially critical cancer-related endpoints have received only very limited study and are identified in the report text.

6. In addition to cancer-related endpoints, data gaps exist in a number of other areas of toxicology in which knowledge is needed to support a complete evaluation of the possible health effects of RF exposure; these gaps are identified in the body of the report.

[2] *Oncogenicity* is the capacity to cause tumors.

Introduction

The U.S. Food and Drug Administration (FDA) of the Department of Health and Human Services asked the National Academies to organize a workshop of national and international experts to discuss research needs and gaps in our knowledge of the biological effects and adverse health outcomes of exposure to radiofrequency (RF) energy from wireless communications devices. Although the sponsor's main interest centers on handheld devices such as cell phones or portable home phones, base stations and antennas were also considered by the committee based on discussions with the sponsors indicating that consideration of these components would not be discouraged.

The workshop was announced on the National Academies' Current Projects site, and attendance was available to anyone interested in attending the workshop. This workshop announcement included instructions for submitting written comments for consideration at the workshop. A workshop announcement was also provided to the FDA and the Bioelectromagnetics Society for distribution as deemed appropriate, as well as to individuals who expressed an interest in the workshop.

It was clear from the presentations and discussions at the workshop that a great deal of research has been accomplished to date, but sometimes with inconsistent results. This workshop, however, was not intended to evaluate health effects, and the report based on a workshop does not assess health effects or make recommendations as to how the identified research needs should be met. The National Academies was asked to issue a report following the workshop that exclusively draws on the workshop

presentations and discussions to identify current research needs and gaps in knowledge. The committee was also asked to provide its consensus findings on near-, mid-, and long-term research opportunities. The report is a committee product and does not necessarily reflect the views of the FDA, individual workshop speakers, or other workshop participants.

To organize the workshop and to identify experts to address research needs and gaps relating to potential biological or adverse health effects of wireless communications devices, the committee (Appendix B) held a workshop planning meeting on July 9-10, 2007. As a result of this planning meeting, international experts from 9 countries were invited to speak at the workshop. Written contributions on research needs and gaps for the committee's consideration were also solicited for submission prior to the workshop, which was held on August 7-9, 2007. A total of 16 written contributions were received from individuals listed in Appendix E. The speakers' presentations, panel discussions, comments from interested workshop attendees, and written contributions were considered by the committee as it developed this report.

The workshop itself was organized into six sessions (Appendix C). The first five sessions consisted of invited participants and panel discussions that identified research needs and gaps in the following areas:

- exposure and dosimetry,
- epidemiology,
- human laboratory studies,
- mechanisms, and
- animal and cell biology.

A sixth session, which was held on the morning of the third day, introduced overarching issues and solicited research needs from speakers and other interested participants. Overarching issues were determined by the committee at the workshop planning meeting held in July 2007. The purpose of the sixth session was to make sure that research needs that might reach across the disciplines were discussed and identified. The issues were thus designed to address current topics in RF research. A short introduction of each subject was made by a committee member and unrestricted input was then invited from interested parties attending the workshop. The overarching issues were as follows:

- Are there differences in health effects of short-term vs. long-term exposure?
- Are there differences between local vs. whole-body exposures?
- Can the knowledge of biological effects from current signal types and exposure patterns be extrapolated to emerging exposure scenarios?

- Are there any biological effects that are not caused by an increase in tissue temperature (nonthermal effects)?
- Does RF exposure alter (synergize, antagonize, or potentiate)[1] the biological effects of other chemical or physical agents?
- Are there differences in risk to children?
- Are there differences in risk to other subpopulations such as the elderly and individuals with underlying disease states?

These overarching issues and the general discussions that followed were factored into the committee's deliberations in developing the report. From the presentations and discussions that took place at the workshop sessions, the committee identified research needs and gaps; the selection of these research needs and gaps are committee judgments.

For the purposes of this report, the committee defines research needs as research that will increase our understanding of the potential adverse effects of RF energy on humans. Research gaps are defined as areas of research where the committee judges that scientific data that have potential value are presently lacking, but that closing of these gaps is ongoing, and results should be awaited before judgments are made on further research needs, or the gaps are not judged by the committee to be of as high a priority at this time.

To the extent possible, near-, mid-, and long-term research opportunities have been characterized as follows: the committee judged that research needs are near-term research opportunities. Gaps that are currently being filled may result in mid-term research opportunities, depending on the outcome of the current research. Gaps defined as being of lower priority with respect to directly addressing health concerns comprise possible long-term research opportunities.

[1] *Synergize:* two or more agents or forces interacting so that their combined effect is greater than the sum of their individual effects. *Antagonize:* two or more agents or forces interacting so that one agent counteracts the effect of another agent. *Potentiate:* one agent promotes or strengthens a biochemical or physiological action or effect of another agent.

Dosimetry and Exposure

This section reports on the workshop session on radiofrequency (RF) energy,[1] dosimetry,[2] and exposure.[3]

As discussed by Dr. van Deventer at the workshop (van Deventer 2007) there is a need to characterize exposure of juveniles, children, pregnant women, and fetuses both for personal wireless devices (e.g., cell phones, wireless personal computers [PCs]) and for RF fields from base station antennas. This characterization includes taking into account gradients and variability of exposures due to the actual use of the device, the environment in which it is used, and exposures from other sources, multilateral exposures, and multiple frequencies. The data thus generated would help to define exposure ranges for various groups of exposed populations.

There is a need for reliable and accurate exposure assessment for designs of the next generation of epidemiologic studies, such as development of an index that integrates service technology and location of use (both

[1] *RF energy* includes waves with frequencies ranging from about 3000 waves per second (3 kHz) to 300 billion waves per second (300 GHz). Microwaves are a subset of radio waves that have frequencies ranging from around 300 million waves per second (300 MHz) to 300 billion waves per second (300 GHz).

[2] *RF dosimetry* is the science pertaining to coupling of RF waves, e.g., from cell phones to the human body. Because of the human anatomy, RF dosimetry must take into account the shape as well as the heterogeneity of the tissues. The unit for absorbed dose (i.e., rate of energy absorption per unit mass) is Watts/kg.

[3] *RF exposure* is the quantification of the absorbed RF energy and its distribution for the various parts of the body. The absorbed energy and its distribution within the exposed body is a function of the incident electromagnetic fields described in units of Watts/meter-squared and the spatial variation of these fields.

geographic location and whether a phone is primarily used indoors or outdoors). Towards this end, we need tissue-characterized models of children of different ages and of pregnant women for dosimetric calculations. Specific Absorbtion Rates (SARs)[4] for children are likely to be higher than for adults, both for cell phones and for base station exposures, due to the fact that the exposure frequency is closer to the whole-body resonance frequency for shorter individuals such as children (ANSI 1982; Gandhi 1979; Wang et al. 2006; Hirata et al. 2007). Better characterization of SARs for children of various age groups is, therefore, needed. Furthermore, models are not presently adequate for men and women of various heights and for children of various ages.

BASE STATIONS

Wireless networks are being built very rapidly, and many more base station antennas are being installed. Maintenance personnel may be exposed to fairly high electromagnetic fields emanating from base station antennas[5] unless all of the typically four to six antennas mounted on the base station are turned off. For all of the base station antennas, the radiated power is on the order of several tens of watts, with higher powers being radiated at peak hours of the day. Though not as well characterized, particularly for multiple co-located base station antennas, the radiated RF fields for rooftops near base stations may also be fairly high. The quantification of SAR distributions from base stations is fairly minimal and those distributions are of concern for professionals involved in maintenance of base stations, building/roof maintenance personnel, and members of the public that live in close proximity to the antennas. There are also subpopulations among the employees, which might be exposed to greater amounts of RF energy than the average population. The characterization of these subpopulations is important.

Thus, the interest in base station exposures close to the antennas is driven by the potential health effects on antenna repair professionals and building/roof maintenance workers from relatively high, acute exposures, but the interest in exposures for members of the public that live in close proximity to the antennas or for the public at the ground level at larger distances is motivated by the need to address public concern about very low

[4]*Specific Absorption Rate* (SAR) is a measure of the rate at which radiofrequency (RF) energy is absorbed by the body when exposed to an RF electromagnetic field. The most common use is in relation to cellular telephones.

[5]Base station antennas mounted on rooftops, on poles, or other elevated positions are the important intermediaries for cell phone communications.

level, chronic exposures that are in fact similar to those from existing TV and radio antennas albeit at different frequencies.

Most of the reported studies to date have involved one base station antenna and have used mostly homogeneous models, often of simplified circular or rectangular cross sections of the exposed human. One study involving a heterogeneous, anatomically based model consisting of diverse constituents, but still assuming a single antenna rather than typical arrangements of four to six antennas, is given in Gandhi and Lam (2003). In other words, the studies to date do not pertain to the commonly used multiple-element base station radiators. Also, unlike highly localized cell phone RF energy deposition, the base station exposures involve much, if not all, of the body and would have slightly different radiator origins (for multi-element base stations) and may be multi-frequency as well, particularly if several different-frequency base station antennas are co-located. Furthermore, because of the whole-body resonance[6] phenomenon, the SAR is likely to be higher for shorter individuals due to the closeness of the frequency/frequencies of exposure to the whole-body resonance frequency. In addition to the rapid growth in the number of base stations since 1990, there has also been growth in other sources of RF radiation from cordless phones, wireless computer communications, and other communications systems. The last general survey of RF levels in U.S. cities was during the 1970s, and an updated survey of RF intensities would be useful background for future epidemiologic studies. There are many indoor wireless systems as well as cell phones, which are used both indoors and outdoors. Measurements of the differences in the exposures generated by the use of these devices in these environments will be of value in determining if there are any health effects resulting from exposures to low levels and intermittent sources of RF radiation.

MOBILE PHONES

The use of evolving types of antennas for cell phones and text messaging devices needs to be characterized for the SARs that they deliver to different parts of the body so that this data is available for use in future epidemiologic studies. A great deal of research has been done by many laboratories worldwide to understand coupling of RF energy irradiation from cell phone antennas to the human head. For most of these studies, the

[6] *Whole-body resonance*: It has been shown that each individual absorbs maximum energy from incident RF fields at frequencies that are higher for shorter individuals. Furthermore the SAR at this resonance frequency is increasingly higher for shorter individuals (Gandhi 1979). As the absorbed energy diminishes inversely with frequency in the post-resonance region, it is still quite high for the shorter individuals at base station frequencies because of the relative proximity of these frequencies to the resonance frequencies.

researchers have assumed that cell phones are held against one of the ears, and studies have used a variety of anatomically based models. Cell phones were assumed to have pull-out linear rod antennas with dimensions on the order of several centimeters. However, most of the recent telephones use built-in antennas of various shapes for which additional published information is needed.

The published results on pull-out linear rod antennas are generally in agreement in that the RF energy coupled to the human head is the highest for the ear and for a limited volume (approximately 3 × 3 × 3 cm) of the brain proximal to the cell phone (IEEE 1996). As expected, the penetration of the coupled electromagnetic fields[7] into the brain is shallow (approximately 2 cm) at higher frequencies (i.e., 1800-1900 MHz). For cell phones held against the ear, the SAR drops off rapidly for the regions of the brain away from the antenna and is negligible for the rest of the human body except for the hand.

Wireless technology is leading to devices such as wireless PCs, handheld devices used for video calls, and other handheld devices for text messaging. In their typical usage, the antennas are closer to the hand or other parts of the body. SAR distributions for these newer devices have been obtained using homogeneous liquid-filled flat phantom models. Though these models are reasonably accurate to get the 1 or 10 Watts/kg average SAR needed for safety compliance testing, they are incapable of providing detailed SAR distributions because of lack of detailed anatomical features, e.g., for the hand or the human lap or parts of the body close to the devices. Additionally, such models cannot resolve the detailed RF field distribution at the cellular and subcellular levels. Given a set of anatomical data, the RF field distributions can be modeled and estimates can be made of the effects of various wave forms and carrier frequencies. An important research gap is the lack of models of several heights for men, women, and children of various ages for use in the characterization of SAR distributions for exposures characteristic of cell phones, wireless PCs, and base stations.

Presently, there is negligible or relatively little knowledge of local SAR concentration (and likely heating) in close proximity to metallic adornments and implanted medical devices for the human body. Examples include metal rim glasses, earrings, and various prostheses (e.g., hearing aids, cochlear implants, cardiac pacemakers). Research is therefore lacking to quantify the enhanced SARs close to metallic implants and external metallic adornments.

[7]If either the electric or magnetic field has a time dependence, then both fields must be considered together as a coupled electromagnetic field using Maxwell's equations.

LABORATORY EXPOSURE SYSTEMS

There is a need for improved exposure systems for human laboratory studies. Furthermore, location-dependent field strength needs to be accounted for in the characterization of exposures. Most of the present-day exposure systems used in laboratory studies focus on the exposure of the head. Though exposures to the head are relevant for most cell phone exposures, whole-body exposures due to base stations are a research need. The laboratory exposure systems also need to include ELF[8] and pertinent modulation protocols.[9]

There is a need for reliable and accurate exposure assessment for designing the next generation of epidemiologic studies, such as development of an index that integrates service technology and location of use (both geographic location and whether a phone is primarily used indoors or outdoors). For human laboratory studies there has been considerable effort to quantify the uncertainties of the different methods used in dosimetry. However, there is little information about the overall accuracy of the dosimetric approaches with respect to reality and variability. The accuracy of dosimetric approaches is particularly important as well as the validation of results by several independent investigators to establish SAR variability.

The committee's evaluation of presentations and discussions at the workshop has resulted in the identification of the following research needs and gaps.

Research Needs

1. There is a need to characterize exposure of juveniles, children, pregnant women, and fetuses both for personal wireless devices (e.g., cell phones, wireless PCs) and for RF fields from base station antennas including gradients and variability of exposures, the environment in which devices are used, and exposures from other sources, multilateral exposures, and multiple frequencies. The data thus generated would help to define exposure ranges for various groups of exposed populations.

2. Wireless networks are being built very rapidly, and many more base station antennas are being installed. A crucial research need is to characterize radiated electromagnetic fields for typical multiple-element (four to six elements) base station antennas for the highest radiated power conditions and with measurements conducted during peak hours of the day at locations close to the antennas as well as at ground level. A study of the wire-

[8] *ELF:* Extremely low frequency fields, such as the 50 and 60 Hz power frequency fields used in Europe and the United States, respectively.

[9] Some commonly used modulation protocols are TDMA (time division multiple access) and CDMA (code division multiple access).

Nominations from FDA's Center from Device and Radiological Health

Radio Frequency Radiation Emissions of Wireless Communication Devices (CDRH)

Executive Summary

Over 80 million Americans currently use wireless communications devices (e.g., cellular phones) with about 25 thousand new users daily. This translates into a potentially significant public health problem should the use of these devices even slightly increase the risk of adverse health effects. Currently cellular phones and other wireless communication devices are required to meet the radio frequency radiation (RFR) exposure guidelines of the Federal Communications Commission (FCC), which were most recently revised in August 1996. The existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure, and may not be protective against any non-thermal effects of chronic exposures. Animal exposure research reported in the literature suggests that low level exposures may increase the risk of cancer by mechanisms yet to be elucidated, but the data is conflicting and most of this research was not conducted with actual cellular phone radiation. In one study transgenic mice exposed to a digital phone signal developed more than twice as many non-lymphoblastic lymphomas as the unexposed control group, a statistically significant increase. These results suggest a potential carcinogenic effect from the digital phone signal using this animal model. There is wide agreement within the international scientific community regarding the types of research needed to assess whether RFR from wireless communications poses a health risk to users. Research needs have been articulated by a number of groups, including the European Commission and the World Health Organization International EMF Project. Animal experiments are crucial because meaningful data will not be available from epidemiological studies for many years due to the long latency period between exposure to a carcinogen and the diagnosis of a tumor. Studies must also be performed in animals that are genetically predisposed to cancer and endpoints other than cancer, such as ocular damage and neurological effects, must also be examined. High priority must be given to replication of prior studies that indicate adverse effects, such as the transgenic mice model mentioned above. There is currently insufficient scientific basis for concluding either that wireless communication technologies are safe or that they pose a risk to millions of users. A significant research effort, involving large well-planned animal experiments is needed to provide the basis to assess the risk to human health of wireless communications devices.

A. Summary of Biological Effects - Wireless Telephone Radiation

As noted above, the use of wireless communications devices (e.g., cellular phones) is increasing rapidly. FDA concluded over five years ago that little was known about the possible health effects of repeated or long-term exposure to low levels of RFR of the types emitted by such devices. However, some scientific articles suggest a potential cancer risk may exist. While some other studies did not find evidence of carcinogenicity for RFR, data from long-term animal studies with a multi-dose exposure paradigm are unavailable. Properly conducted scientific research is needed to address these issues and

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fill in the gaps in our understanding of the biological effects of exposure to RFR.

B. Physical Properties of Wireless Telephone Radiation

Personal (cellular) telecommunications is a rapidly evolving technology that uses microwave radiation to communicate between a fixed base station and a mobile user. Presently, most systems employ analog technology, where the low frequency speech signals are directly modulated on to a high frequency carrier in a manner similar to a frequency-modulated (FM) radio. The power level is effectively constant during the modulation, although some power control may occur. However, the recently introduced second-generation systems in Europe, USA and Japan employ digital technology, where the low frequency speech is digitally coded prior to modulation. There is a strong trend towards hand-held cellular telephones, which means that the radiating antenna is close to the head of the user. In the relatively near future the use of digital systems will predominate.

The electric and magnetic fields surrounding a cellular telephone handset near a person's head are complicated functions of the design and operating characteristics of the handset and its antenna and the electric and magnetic fields vary considerably from point to point.

Microwave radiation absorption occurs at the molecular, cellular, tissue and whole-body levels. The dominant factor for net energy absorption by an entire organism is related to the dielectric properties of bulk water, which ultimately causes transduction of electromagnetic energy into heat. For laboratory experiments, exposure conditions can be classified as thermal or non-thermal. There are no strict boundaries for these different exposure regimens because a number of factors may influence the characteristics of exposure. Thermal effects are well established and form the biological basis for restricting exposure to RF fields. In contrast, non-thermal effects are not well established and, currently, do not form a scientifically acceptable basis for restricting human exposure to microwave radiation at those frequencies used by hand-held cellular telephones. A large number of biological effects have been reported in cell cultures and in animals, often in response to exposure to relatively low-level fields, which are not well established but which may have health implications and are, hence, the subject of on-going research. It is not scientifically possible to guarantee those non-thermal levels of microwave radiation, which do not cause deleterious effects for relatively short exposures, will not cause long-term adverse health effects.

C. Human Exposure

For the purpose of radiation protection, dosimetric quantities are needed to estimate the absorbed energy and its distribution inside the body. A dosimetric quantity that is widely adopted for microwaves is the Specific Absorption Rate (SAR). SAR is defined as the time derivative of the incremental energy, absorbed by or dissipated in an incremental mass contained in a volume element of a given density. SAR is expressed in the unit watt per kilogram ($W\ kg^{-1}$). Numerical calculations, based upon coupling from handsets to an anatomically realistic numerical phantom of the head have been performed. Such

calculations have shown that, during normal operation, a radiated power of 1 W gives rise to a maximum SAR of 2.1 W kg^{-1} at 900 MHz and 3.0 W kg^{-1} at 1.8 GHz averaged over any 10 g of tissue. Typical handset powers are 0.6 W. To enable communication with locations not easily reachable with land networks, satellite communication systems have been recently designed and implemented. New systems will involve small portable units and hand-held sets similar to current cellular telephones. In these special cases, higher power classes can be envisioned.

Digital cellular telephones transmit information in bursts of power. The power is turned on and off, and the equipment transmits for a fraction of the time only and then is silent for the remaining part of the burst period. The basic repetition frequency is 217 Hz for GSM and DCS 1800 systems and 100 Hz for DECT; however, the spectrum also contains a number of higher harmonics due to the narrow pulse, so there are also frequencies in the kilohertz region. Owing to the complexity of these communications systems, there are also 2 and 8 Hz components in the signal, apart from multiples of 100 and 217 Hz.

D. Regulatory Status

As described previously, when tissues are exposed to microwave fields strong enough to raise the temperature, the resulting biological effects are said to be thermal. There is currently a general consensus in the scientific and standards community that the most significant parameter, in terms of biologically relevant effects of human exposure to RF electromagnetic fields, is the SAR in tissue. SAR values are of key importance when validating possible health hazards and in setting standards.

Possible thermal effects in the eye are also important. The latter is regarded as potentially sensitive to heating because of the limited cooling ability of the lens caused by the lack of a blood supply and the tendency to accumulate damage and cellular debris. Effects of electromagnetic radiation on the three major eye components essential for vision, the cornea, lens and retina, have been investigated, the largest number of studies being concerned with cataracts. It has been established that lens opacities can form after exposure to microwave radiation above 800 MHz; however, below about 10 GHz cataract induction requires long exposures at an incident power density exceeding 10^3 Wm^{-2}. SARs in the lens large enough to produce temperatures in the lens greater than 41 ^{o} C are required. Effects on the retina have been associated with levels of microwave radiation above 500 Wm^{-2}. All these data suggest that thermal effects will probably only occur in people subjected to whole body or localized heating sufficient to increase tissue temperatures by more than 1 ^{o}C. These various effects are well-established and form the biological basis for restricting exposure to RF fields. In contrast, non-thermal effects are not well-established and, currently, do not form a scientifically acceptable basis for restricting human exposure to microwave radiation at those frequencies used by handheld cellular telephones and base stations.

The setting of safety limits for human exposure to RF electromagnetic fields is currently performed in two steps. First, basic limits (or restrictions) for SARs inside the body are specified from biological considerations in terms of whole-body SAR and SAR averaged

over a small mass of tissue. Then relationships between SAR values and unperturbed field strengths are used to set derived limits (or reference or investigation levels) for field strengths and power density to be used in assessing compliance with the adopted standard. Studies to relate core temperature rise with whole-body averaged SARs (Elder and Cahill, 1984) suggested that the 1-4 W Kg^{-1} range is the threshold at which significant core temperature rise occurs. Another approach to identify thresholds of whole body thermal effects is based on the change in animal behavior exposed to RF fields. A review of animal data indicates a threshold for behavioral responses in the same 1-4 W kg^{-1} range. Another review of animal data also concluded that the threshold of RF exposure in terms of the whole body SAR is 4 W kg^{-1} (IEEE, 1991). Based on the estimated threshold and a safety factor of 10, the whole body averaged SAR of 0.4 W kg^{-1} has been widely accepted as the basic restriction for occupational exposures under controlled environmental conditions (IEEE, 1991). For the general public under uncontrolled environmental conditions, a five times smaller value of 0.08 W kg^{-1} has often been adopted as the basic restriction. In order to avoid excessive local exposures, maximum local SARs are limited as one of the basic restrictions in safety guidelines.

Basic restrictions for partial body exposure are given in terms of maximum local SARS. Local SAR values change spatially within the body depending on the depth of penetration, shape of the body part, and tissue homogeneity. It is therefore important to define the mass of tissue taken to evaluate average local body SARS. The limit values of local SARs have not been unified between various standards or guidelines. However, a local SAR limit of 8 W kg^{-1} averaged over a mass of 1g has also been adopted (IEEE, 1991).

Currently cellular phones and other wireless communication devices are required to meet the RFR exposure guidelines of the Federal Communications Commission (FCC), which were most recently revised in August 1996. Since the FCC is not a health agency, it sought and received guidance from the federal health agencies including the Environmental Protection Agency, the National Institute of Occupational Health and Safety, the Occupational Safety and Health Administration, and the FDA. These exposure guidelines incorporated the most recent exposure standards of the National Commission for Radiation Protection and the American National Standards Institute, and are subject to continuing review and revision as new scientific information which could define a better basis for such exposure guidelines becomes available. As noted above, the existing exposure guidelines are based entirely on protection from acute injury from thermal effects of RF exposure, and may not be protective against any non-thermal effects of chronic exposures.

E. Toxicological Data

The evidence for a clastogenic (chromosome breaking) or genetic effect of microwave radiation exposure is contradictory and, overall, it may be concluded that RF/microwave radiation is not genotoxic. Therefore, it may also be concluded that RF/microwave radiation is not a tumor initiator and that, if it is somehow related to carcinogenicity, this has to be by some other mechanism (e.g., by influencing tumor promotion). Tumor

promotion may be influenced by increases in cell proliferation rate via effects mediated through changes in proliferative signaling pathways, leading to enhanced transcription and DNA synthesis.

According to a series of papers, low level, low frequency, amplitude-modulated microwave radiation may affect intracellular activities of enzymes involved in neoplastic promotion without measurable influence on overall DNA synthesis. For example, a number of investigations showed some evidence of an effect on intracellular levels of ornithine decarboxylase (ODC) an enzyme implicated in tumor promotion. Tumor promoters increase ODC synthesis. Where such effects have been observed with microwave exposure, they have been much weaker and have occurred only for certain modulations of the carrier wave.

Assays of cell transformation were performed in order to detect changes consistent with carcinogenesis. For example, Balcer-Kubiczek and Harrison (1991) exposed cells to 120 Hz modulated microwave radiation followed by treatment with a phorbol ester tumor promoter. Cell transformation was induced in a dose-dependent way (increase with increasing SAR value). Overall, these results are in agreement with those from earlier studies, although there are also some inconsistencies. To date, the significance of these results is not clear in terms of *in vivo* carcinogenesis.

Along with investigations carried out *in vitro,* a number of *in vivo* investigations have also been performed. Of particular interest is, for example, the study conducted by Szmigielski et al (1983), who observed faster development of benzo(a)pyrene-induced skin tumors in mice that were exposed for some months to sub-thermal 2450 MHz microwave radiation.

Also of interest is a study where 100 rats were exposed from 2 to 27 months of age to pulsed microwave radiation (0.4 W kg^{-1}) (Guy et al, 1985). The exposed group had a significant increase in primary malignant lesions compared with the control group when lesions were pooled regardless of their location in the body, but no single type of malignant tumor was enhanced. Overall the incidence of primary malignancies was similar to that reported elsewhere in rats of this type. If the incidence of primary malignant lesions was pooled without regard to site or cause of death, however, the exposed group had a significantly higher incidence compared with the control group. Also, primary malignancies occurred early in the exposed group compared with the sham exposed group. While interesting, these data do not provide clear evidence of an increase in tumor incidence as result of microwave exposure. The incidence of benign tumors did not appear enhanced in the exposed group compared with the controls, nor was any particular type of neoplasm in the exposed group significantly elevated compared with the values reported in stock rats of this strain. Yet, overall, there was no clear evidence of an increase in tumor incidence as a result of exposure to microwave radiation.

In another study, the effects of exposure to electromagnetic fields were investigated in a rat brain glioma model. The exposure consisted of 915 MHz microwave radiation, both as continuous wave and ELF-modulated radiation (Salford, *et al*, 1993). The extensive

daily exposure did not cause tumor promotion. However, the experimental model has sometimes been questioned as the experimental animals had a high rate of spontaneous tumors. In another investigation in which cancer cells (B 16 melanoma) were injected into animals, a lack of effect of exposure to continuous wave and pulsed RFR on tumor progression was observed (Santini et al, 1988). Overall, evidence for a co-carcinogenic effect of microwave radiation on tumor progression is not substantiated. The few positive results which do exist are, however, sufficiently indicative to merit further investigation.

Repacholi et al (Repacholi, et al 1997) using Pim-l transgenic mice that are moderately predisposed to develop lymphoma spontaneously, conducted a more recent study of the co-carcinogenic potential of RFR. One hundred mice were exposed for two thirty-minute periods per day for up to 18 months to 900 MHz RFR with modulation characteristics and SAR similar to those of some wireless telephones. The mice exposed to RFR developed over twice as many lymphomas as the sham-exposed group of mice. A study of 50 Hz magnetic fields in these same transgenic mice conducted by the same investigators (Repacholi et al, 1998) did not result in greater numbers of lymphomas in the exposed mice, suggesting that the earlier positive result in RFR exposed mice is unlikely to be artifactual.

There is wide agreement within the international scientific community regarding the types of research needed to assess whether RFR from wireless communications poses a health risk to users. Research needs have been articulated by a number of groups, including the European Commission and the World Health Organization International EMF Project. Animal experiments are crucial because meaningful data will not be available from epidemiological studies for many years due to the long latency period between exposure to a carcinogen and the diagnosis of a tumor. Studies must also be performed in animals that are genetically predisposed to cancer and endpoints other than cancer, such as ocular damage and neurological effects, must also be examined. High priority must be given to replication of prior studies that indicate adverse effects, such as the transgenic mice model mentioned above. These research needs are similar to those identified by the *VVEO* EMF Project.

There is currently insufficient scientific basis for concluding either that wireless communication technologies are safe or that they pose a risk to millions of users. A significant research effort, including well-planned animal experiments, is needed to provide the basis to assess the risk to human health of wireless communications devices.

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NATIONAL TOXICOLOGY PROGRAM
FACT SHEET

Headquartered at the National Institute of Environmental Health Sciences • NIH • DHHS

STUDIES ON RADIOFREQUENCY RADIATION EMITTED BY CELLULAR PHONES

Year 2005

Personal (cellular) telecommunications is a rapidly evolving technology that uses microwave radiation to communicate between a fixed base station and a mobile user. Until recently, most systems employed analog technology where low frequency speech signals are directly modulated onto a high frequency carrier in a manner similar to a frequency-modulated (FM) radio. These second-generation systems, widely used in Europe, USA and Japan, employ digital technology where the low frequency speech is digitally coded prior to modulation. Most systems employ hand-held cellular telephones where the radiating antenna is close to the head of the user.

Over 100 million Americans currently use wireless communication devices with over 50 thousand new users daily. This translates into a potentially significant public health problem should the use of these devices even slightly increase the risk of adverse health effects. Cellular phones and other wireless communication devices are required to meet the *radiofrequency radiation* (RFR) exposure guidelines of the Federal Communications Commission (FCC, August 1996)[1]. The existing exposure guidelines are based on protection from acute injury from thermal effects of RFR exposure. Current data are insufficient to draw definitive conclusions concerning the adequacy of these guidelines to be protective against any non-thermal effects of chronic exposures.

Studies in laboratory animals are considered crucial for understanding whether exposure to RFR is adverse to human health because meaningful data from epidemiological studies (human population studies) of cellular phone use will not be available for many years. This is due to the long latency period between exposure to a carcinogenic agent and the diagnosis of a tumor. Most scientific organizations that have reviewed the results from laboratory studies conducted to-date, however, have concluded that they are not sufficient to estimate potential human cancer risks from low-level RFR exposures and long-term, multi-dose, animal studies are needed.

Currently there is an international effort underway to develop and conduct long-term toxicology studies on the potential health effects associated with cellular phone RFR emissions. This effort includes studies by a consortium of European investigators and cellular phone manufacturers under the auspices of the European Union (PERFORM-A), and by investigators at the Cancer Research Center of the European Ramazzini Foundation of Oncology and Environmental Sciences Commission in Bologna, Italy.

What is the NTP Doing?

The Food and Drug Administration (FDA) nominated RFR emissions of wireless communication devices to the National Toxicology Program (NTP) for toxicology and carcinogenicity testing. The NTP has carefully evaluated the efforts already underway and concluded that while they have an excellent probability of producing high quality research results, additional studies may be warranted to more clearly define any potential health hazard to the U.S. population.

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[1] FCC, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, 61FR41006 available at http://www.fcc.gov/oet/dockets/et93-62/

ADDRESS P.O. Box 12233, Maildrop A3-01, Research Triangle Park, NC 27709-2233 *WEB SITE* http://ntp-server.niehs.nih.gov/
NTP LIAISON & SCIENTIFIC REVIEW OFFICE 919-541-0530 *E-MAIL* liaison@starbase.niehs.nih.gov

Because of the technical complexity of such studies, NTP staff is working with RFR experts from the National Institute of Standards and Technology (NIST). With support from the National Institute of Environmental Health Sciences of the National Institutes of Health, scientists at NIST have been testing the suitability of various RFR exposure systems for use in these studies. The studies at NIST have demonstrated the feasibility of using specially designed reverberation chambers as the exposure system to evaluate potential long-term health effects, including carcinogenicity, of cellular phone RFR in unrestrained laboratory animals. Based on the findings from NIST, the NTP designed studies to evaluate the potential toxicity and carcinogenicity of cell phone RFR in rats and mice exposed in reverberation chambers at the two frequencies (~900 and 1900 MHz) that are at the centers of the primary cellular bands used in the United States. In addition, these exposures will include the most common coding strategies for carrying information by cellular telephone communication technology in the United States: the Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA) signal modulations. These studies will be conducted at multiple power levels and will include special emphasis on potential adverse effects in the brain. In addition to histopathological evaluations for toxic or neoplastic lesions, special studies will examine effects on the blood brain barrier, neonatal cell migration patterns in the brain, and DNA strand breaks in brain cells.

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Setting Prudent Public Health Policy for Electromagnetic Field Exposures

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Abstract: Electromagnetic fields (EMF) permeate our environment, coming both from such natural sources as the sun and from manmade sources like electricity, communication technologies and medical devices. Although life on earth would not be possible without sunlight, increasing evidence indicates that exposures to the magnetic fields associated with electricity and to communication frequencies associated with radio, television, WiFi technology, and mobile cellular phones pose significant hazards to human health. The evidence is strongest for leukemia from electricity-frequency fields and for brain tumors from communication-frequency fields, yet evidence is emerging for an association with other diseases as well, including neurodegenerative diseases. Some uncertainty remains as to the mechanism(s) responsible for these biological effects, and as to which components of the fields are of greatest importance. Nevertheless, regardless of whether 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. Inaction is not compatible with the Precautionary Principle, as enunciated by the Rio Declaration. Because of ubiquitous exposure, the rapidly expanding development of new EMF technologies and the long latency for the development of such serious diseases as brain cancers, the failure to take immediate action risks epidemics of potentially fatal diseases in the future.

Keywords: leukemia, brain cancer, electricity, radiofrequency, cell phones, neurodegenerative diseases

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The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer

Horst Eger, Klaus Uwe Hagen, Birgitt Lucas, Peter Vogel, Helmut Voit

Published in *Umwelt·Medizin·Gesellschaft* 17,4 2004, as:
'Einfluss der räumlichen Nähe von Mobilfunksendeanlagen auf die Krebsinzidenz'

Summary

Following the call by Wolfram König, President of the Bundesamt für Strahlenschutz (Federal Agency for radiation protection), to all doctors of medicine to collaborate actively in the assessment of the risk posed by cellular radiation, the aim of our study was to examine whether people living close to cellular transmitter antennas were exposed to a heightened risk of taking ill with malignant tumors.

The basis of the data used for the survey were PC files of the case histories of patients between the years 1994 and 2004. While adhering to data protection, the personal data of almost 1,000 patients were evaluated for this study, which was completed without any external financial support. It is intended to continue the project in the form of a register.

The result of the study shows that the proportion of newly developing cancer cases was significantly higher among those patients who had lived during the past ten years at a distance of up to 400 metres from the cellular transmitter site, which has been in operation since 1993, compared to those patients living further away, and that the patients fell ill on average 8 years earlier.

In the years 1999-2004, *ie* after five years' operation of the transmitting installation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the installation compared to the inhabitants of Naila outside the area.

Key words: cellular radiation, cellular transmitter antennas, malignant tumours

The rapid increase in the use of mobile telephony in the last few years has led to an increasing number of cell phone transmission masts being positioned in or near to residential areas. With this in mind, the president of the German governmental department for protection against electromagnetic radiation (Bundesamtes für Strahlenschutz) Wolfram König, has challenged all doctors to actively help in the work to estimate the risks from such cell phone masts. The goal of this investigation was therefore to prove whether on not people living near to cell phone masts have a higher risk of developing cancerous tumours.

The basic data was taken from the medical records held by the local medical authority (Krankenkasse) for the years 1994 to 2004. This material is stored on computer. In this voluntary study the records of roughly 1,000 patients from Naila (Oberfranken) were used, respecting the associated data protection laws. The results from this study show a significantly increased likelihood of developing cancer for the patients that have lived within 400 metres of the cell phone transmission mast (active since 1993) over the last ten years, in comparison to those patients that live further away. In addition, the patients that live within 400 metres tend to develop the cancers at a younger age. For the years 1999 to 2004 (*ie* after five or more years of living with the cell phone transmission mast), the risk of developing cancer for those living within 400 metres of the mast in comparison to those living outside this area, was three times as high.

Introduction

A series of studies available before this investigation provided strong evidence of health risks and increased cancer risk associated with physical proximity to radio transmission masts. Haider *et al.* reported in 1993 in the Moosbrunn study frequent psychovegetive symptoms below the current safety limit for electromagnetic waves (1). In 1995, Abelin *et al.* in the Swiss- Schwarzenburg study found dose dependent sleep problems (5:1) and depression (4:1) at a shortwave transmitter station that has been in operation since 1939 (2).

In many studies an increased risk of developing leukaemia has been found; in children near transmitter antennas for Radio and Television in Hawaii (3); increased cancer cases and general mortality in the area of Radio and Television transmitter antennas in Australia (4); and in England, 9 times more leukaemia cases were diagnosed in people who live in a nearby

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area to the Sutton Coldfield transmitter antennas (5). In a second study, concentrating on 20 transmitter antennas in England, a significant increased leukaemia risk was found (6). The Cherry study (7) indicates an association between an increase in cancer and living in proximity to a transmitter station. According to a study of the transmitter station of Radio Vatican, there were 2.2 times more leukaemia cases in children within a radius of 6 km, and adult mortality from leukaemia also increased (8).

In 1997 Goldsmith published the Lilienfeld-study that indicated 4 times more cancer cases in the staff of the American Embassy in Moscow following microwave radiation during the cold war. The dose was low and below the German limit (9).

The three studies of symptoms indicated a significant correlation between illness and physical proximity to radio transmission masts. A study by Santini *et al.* in France resulted in an association between irritability, depression, dizziness (within 100m) and tiredness within 300m of a cell phone transmitter station (10).

In Austria there was an association between field strength and cardiovascular symptoms (11) and in Spain a study indicates an association between radiation, headache, nausea, loss of appetite, unwellness, sleep disturbance, depression, lack of concentration and dizziness (12).

The human body physically absorbs microwaves. This leads to rotation of dipole molecules and to inversion transitions (13), causing a warming effect. The fact that the human body transmits microwave radiation at a very low intensity means that since every transmitter represents a receiver and transmitter at the same time, we know the human body also acts as a receiver.

In Germany, the maximum safe limit for high frequency microwave radiation is based on purely thermal effects. These limits are one thousand billion times higher than the natural radiation in these frequencies that reaches us from the sun.

The following study examines whether there is also an increased cancer risk close to cellular transmitter antennas in the frequency range 900 to 1800 MHz. Prior to this study there were no published results for long-term exposure (10 years) for this frequency range and its associated effects to be revealed. So far, no follow-up monitoring of the state of health of such a residential population has been systematically undertaken.

Materials and Methods

Study area

In June 1993, cellular transmitter antennas were permitted by the Federal Postal Administration in the Southern German city of Naila and became operational in September 1993.

The GSM transmitter antenna has a power of 15 dbW per channel in the 935MHz frequency range. The total transmission time for the study period is ca. 90,000 hours. In December 1997 there followed an additional installation from another company. The details are found in an unpublished report, appendix page 1-3 (14).

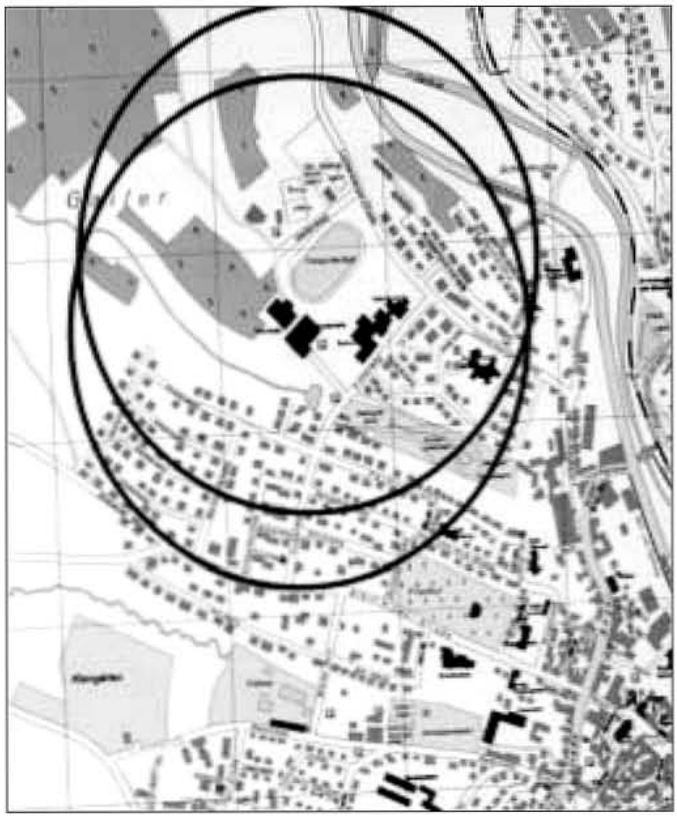

Fig. 1: Schematic plan of the antenna sites

To compare results an 'inner' and 'outer' area were defined. The inner area covered the land that was within a distance of 400 metres from the cellular transmitter site. The outer area covered the land beyond 400 metres. The average distance of roads surveyed in the inner area (nearer than 400m) was 266m and in the outer area (further than 400m) 1,026m. Fig. 1 shows the position of the cellular transmitter sites I and 2, surrounded by circle of radius 400 metres. The geographical situation shows the transmitter sites (560m) are the highest point of the landscape, which falls away to 525m at a distance of 450m. From the height and tilt angle of the transmitter it is possible to calculate the distance where the transmitter's beam of greatest intensity strikes the ground (see Fig. 2).

The highest radiation values are in areas of the main

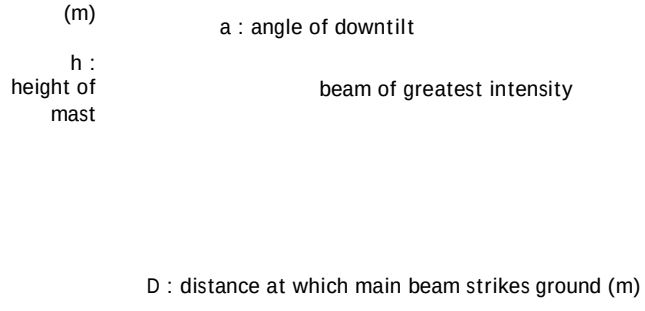

Fig. 2: From the mast height h and the downtilt angle a, the distance D at which the main beam reaches ground is given by D = tan(90-a) × h

beam where it hits the ground and from the expected associated local reflection; from this point the intensity of radiation falls off with the square of the distance from the transmitter.

In Naila the main beam hits the ground at 350m with a beam angle of 6 degrees (15). In the inner area, additional emissions are caused by the secondary lobes of the transmitter; this means in comparison that from purely mathematical calculations the outer area has significantly reduced radiation intensity.

The calculations from computer simulations and the measurements from the Bavaria agency for the environmental protection, both found that the intensity of radiation was a factor of 100 higher in the inner area as compared to the outer area. The measurements of all transmitter stations show that the intensity of radiation from the cell phone transmitter station in Naila in the inner area was higher than the other measurement shown in the previous studies of electromagnetic fields from radio, television or radar (14).

The study StSch 4314 from the ECOLOG Institute indicates an association between a vertical and horizontal distance from the transmitter station and expected radiation intensity on the local people (16). The reason for setting a distance of 400m for the differentiation point is partly due to physical considerations, and partly due to the study of Santini *et al.* who chose 300m (10).

Data Gathering

Similar residential streets in the inner area and outer areas were selected at random. The large old people's home in the inner area was excluded from the study because of the age of the inhabitants. Data gathering covered nearly 90% of the local residents, because all four GPs in Naila took part in this study over 10 years. Every team researched the names of the patients from the selected streets that had been ill with tumours since 1994. The condition was that all patients had been living during the entire observation time of 10 years at the same address.

The data from patients was handled according to data protection in an anonymous way. The data was evaluated for gender, age, tumour type and start of illness. All cases in the study were based on concrete results from tissue analysis. The selection of patents for the study was always done in exactly the same way. Self-selection was not allowed. Also the subjective opinion of patients that the radio mast detrimentally affected their health has not affected this study. Since patients with cancer do not keep this secret from GPs, it was possible to gain a complete data set.

Population study

In the areas where data was collected 1,045 residents were registered in 31.12.2003. The registration statistics for Naila at the beginning of the study (1.1.1994) show the number of old people in the inner and outer areas, as shown in Table 1. The average age at the beginning of the study (1.1.1994) in both the inner and outer areas was 40.2 years. In the study period between 1994-2004, 34 new cases of cancer where documented out of 967 patients (Table 3). The study covered nearly 90% of local residents.

	female	male	total
Inner area	41.48	38.70	40.21
Outer area	41.93	38.12	40.20
Naila total	43.55	39.13	41.45

Table 1 : Overview of average ages at the beginning of the study in 1994

1994	inner 22.4%	outer 2.8%	Naila total 24.8%
2004	inner 26.3%	outer 26.7%	

Table 2 : Proportion of patients aged over 60

The average age of the residents in Naila is one year more than that of the study due to the effects of the old people's home. From the 9,472 residents who are registered in Naila, 4,979 (52.6%) are women and 4,493 (47.4%) are men. According to the register office, in 1.1.1994 in the outer area, the percentage was 45.4% male and 54.5% female, and in the inner area 45.3% male and 54.6% female. The number of people who are over 60 years old is shown in Table 2.

The social differences in Naila are small. Big social differences like in the USA do not exist here. There is also no ethnic diversity. In 1994 in Naila the percentage of foreigners was 4%. Naila has no heavy industry, and in the inner area there are neither high voltage cable nor electric trains.

Results

Results are first shown for the entire 10 year period from 1994 until 2004. Secondly, the last five-year period 1999 to 2004 is considered separately.

Period 1994 to 2004

As a null hypothesis it was checked to see if the physical distance from the mobile transmission mast had no effect on the number cancer cases in the selected population, *ie* that for both the group nearer than 400 metres and the group further than 400 metres the chance of developing cancer was the same. The relative frequencies of cancer in the form of a matrix are shown in Table 3. The statistical test method used on this data was the chi-squared test with Yates's correction. Using this method we obtained the value of 6.27, which is over the critical value of 3.84 for a

Period 1994-2004	**Inner area**	**Outer area**	**total**
new cases of cancers	18	16	34
with no new cancer	302	631	933
total	320	647	967

Table 3 : numbers of patients with and without cancers, 1994-2004

statistical significance of 0.05).

This means the null hypothesis that both groups within the 400-metre radius of the mast and beyond the 400 metre radius, have the same chance of developing cancer, can be rejected with a 95% level of confidence. With a statistical significance of 0.05, an even more significant difference was observed in the rate of new cancer cases between the two groups.

Calculating over the entire study period of 1994 until 2004, based on the incidence matrix (Table 3) we arrive at a relative risk factor of 2.27 (quotient of proportion for each group, *eg* 18/320 in the strongly exposed inner area, against 16/647 in the lower exposed comparison group). If expressed as an odds ratio, the relationship of the chance of getting cancer between strongly exposed and the less exposed is 2.35.

The following results show clearly that inhabitants who live close to transmitter antennas compared to inhabitants who live outside the 400m zone, double their risk of developing cancer. In addition, the average age of developing cancer was 64.1 years in the inner area whereas in the outer area the average age was 72.6 years, a difference of 8.5 years. That means during the 10 year study that in the inner area (within 400 metres of the radio mast) tumours appear at a younger age.

In Germany the average age of developing cancer is approximately 66.5 years, among men it is approximately 66 and among women, 67 (18).

Over the years of the study the time trend for new cancer cases shows a high annual constant value (Table 4). It should be noted that the number of people in the inner area is only half that of the outer area, and therefore the absolute numbers of cases is smaller.

Table 7 shows the types of tumour that have developed in the cases of the inner area.

Period 1994 to 1999

No. of cases of tumours per year of study	inner area: of the 320 people		outer area: of the 647 people	
	total cases	per 1,000	total cases	per 1,000
1994	—	—	I	1.5
1995	—	—	—	—
1996	II	6.3	I	1.5
1997	I	3.1	III	4.6
1998	II	6.3	III	4.6
1999	II	6.3	I	1.5
2000	IIIII	15.6	I	1.5
2001	II	6.3	II	3.1
2002	II	6.3	II	3.1
2003-3/2004	II	6.3	II	3.1

Table 4 : Summary of the total tumours occurring per year (no. and per thousand)

Period 1994-1999	Inner area	Outer area	total
new cases of cancers	5	8	13
with no new cancer	315	639	954
total	320	647	967

Table 5 : numbers of patients with and without cancers, 1994-1999

For the first five years of the radio transmission mast operation (1994-1998) there was no significant increased risk of getting cancer within the inner area as compared to the outer area (Table 5).

Period 1999 to 2004

Under the biologically plausible assumption that cancer caused by detrimental external factors will require a time of several years before it will be diagnosed, we now concentrate on the last five years of the study between 1999 and 2004. At the start of this period the transmitter had been in operation for 5 years. The results for this period are shown in Table 6. The chi-squared test result for this data (with Yates's correction) is 6.77 and is over the critical value of 6.67 (statistical significance 0.01). This means, with 99% level of confidence, that there is a statistically proven difference between development of cancer between the inner group and outer group. The relative risk of 3.29 revealed that there was 3 times more risk of developing cancer in the inner area than the outer area during this time period.

Period 1999-2004	Inner area	Outer area	total
new cases of cancers	13	8	31
with no new cancer	307	639	946
total	320	647	967

Table 6 : numbers of patients with and without cancers, 1999-2004

The odds-ratio 3.38 (VI 95% 1.39-8.25, 99% 1.05-10.91) allows us with 99% confidence to say that the difference observed here is not due to some random statistical effect.

Discussion

Exactly the same system was used to gather data in the inner area and outer areas. The medical chip card, which has been in use for 10 years, enables the data to be processed easily. The four participating GPs examined the illness of 90% of Naila's inhabitants over the last 10 years. The basic data for this study were based on direct examination results of patients extracted from the medical chip cards, which record also the diagnosis and treatment. The study population is (in regards to age, sex and cancer risk) comparable, and therefore statistically neutral. The study deals only with people who have been living permanently at the same address for the entire study period and therefore

Type of tumour (organ)	no. of tumours found	total expected	incidence per 100,000	ratio inner: outer
breast	8	5.6	112	5:3
ovary	1	1.1	23	0:1
prostate	5	4.6	101	2:3
pancreas	m 3 f 2	0.6 0.9	14 18	2:1 1:1
bowel	m 4 f 0	3.7 4.0	81 81	2:2 0:0
skin melanoma	m 1 f 0	0.6 0.7	13 14	1:0 0:0
lung	m 3 f 0	3.6 1.2	79 24	2:1 0:0
kidney	m 2 f 1	1.0 0.7	22 15	1:1 1:0
stomach	m 1 f 1	1.2 1.1	27 23	0:1 0:1
bladder	m 1 f 0	2.0 0.8	44 16	0:1 0:0
blood	m 0 f 1	0.6 0.7	14 15	0:0 1:0

Table 7 : Summary of tumours occurring in Naila, compared with incidence expected from the Saarland cancer register

have the same duration of exposure regardless of whether they are in the inner area or outer area.

The result of the study shows that the proportion of newly developing cancer cases was significantly higher ($p<0.05$) among those patients who had lived during the past ten years within a distance of 400 metres from the cellular transmitter site, which has been in operation since 1993, in comparison to people who live further away. Compared to those patients living further away, the patients developed cancer on average 8.5 years earlier. This means the doubled risk of cancer in the inner area cannot be explained by an average age difference between the two groups. That the transmitter has the effect that speeds up the clinical manifestations of the illness and general development of the cancer cannot be ruled out.

In the years 1999-2004, *ie* after five years and more of transmitter operation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the mast compared to the inhabitants of Naila in the outer area ($p>0.01$). The division into inner area and outer area groups was clearly defined at the beginning of the study by the distance to the cell phone transmission mast. According to physical considerations people living close to cellular transmitter antennas were exposed to heightened transmitted radiation intensity.

Both calculated and empirical measurements revealed that the intensity of radiation is 100 times higher in the inner area compared to the outer area. According to the research StSch 4314 the horizontal and vertical position in regards to the transmitter antenna is the most important criterion in defining the radiation intensity area on inhabitants (16).

The layered epidemiological assessment method used in this study is also used in assessment of possible chemical environmental effects. In this case the layering is performed in regards to the distance from the cell phone transmitter station. Using this method it has been shown that there is a significant difference in probability of developing new cancers depending on the exposure intensity.

The number of patients examined was high enough according to statistical rules that the effects of other factors (such as use of DECT phones) should be normalised across the inner area and outer area groups. From experience the disruption caused by a statistical confounding factor is in the range between 20% and 30%. Such a factor could therefore in no way explain the 300% increase in new cancer cases. If structural factors such as smoking or excessive alcohol consumption are unevenly distributed between the different groups this should be visible from the specific type of cancers to have developed (*ie* lung, pharyngeal or oesophageal). In the study inner area there were two lung cancers (one smoker, one non-smoker), and one in the outer area (a smoker), but no oesophageal cancers. This rate of lung cancer is twice what is statistically to be expected and cannot be explained by a confounding factor alone. None of the patients who developed cancer was from a family with such a genetic propensity.

Through the many years experience of the GPs involved in this study, the social structures in Naila are well known. Through this experience we can say there was no significant social difference in the examined groups that might explain the increased risk of cancer.

The type and number of the diagnosed cancers are shown in Table 7. In the inner area the number of cancers associated with blood formation and tumour-controlling endocrine systems (pancreas), were more frequent than in the outer area (77% inner area and 69% outer area).

From Table 7, the relative risk of getting breast cancer is significantly increased to 3.4. The average age of patients that developed breast cancer in the inner area was 50.8 years. In comparison, in the outer area the average age was 69.9 years, approximately 20 years less. In Germany the average age for developing breast cancer is about 63 years. The incidence of breast cancer has increased from 80 per 100,000 in the year 1970 to 112 per 100,000 in the year 2000. A possible question for future research is whether breast cancer can be used as a 'marker cancer' for areas where there is high contamination from electromagnetic radiation. The report of Tynes *et al.* described an increased risk of breast cancer in Norwegian female radio and telegraph operators (20).

To further validate the results the data gathered were compared with the Saarland cancer register (21). In this register all newly developed cancers cases since 1970 are recorded for each Bundesland. These data are accessible via the Internet. Patents that suffer two separate tumours were registered twice, which increases the overall incidence up to 10%. In this

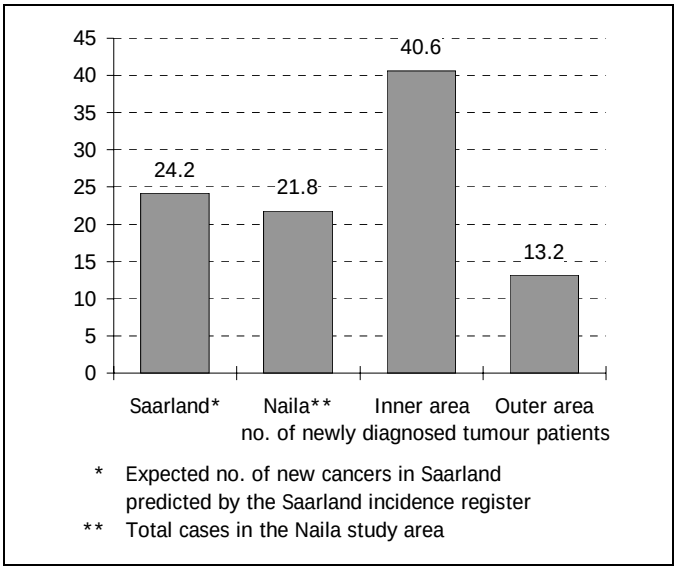

Fig. 3 : Number of new cancer cases 1999 to 2004, adjusted for age and gender, calculated for the 5,000 patient years

register there is no location-specific information, for instance proximity to cell phone transmission masts. The data in the cancer register therefore reflect no real control group but rather the effect of the average radiation on the total population.

From the Saarland cancer register for the year 2000 the incidence of new cancer cases was 498 per 100,000 for men and 462 per 100,000 for women. When adjusted for age and sex one would expect a rate of between 480 and 500 per 100,000 in Naila. For the years 1999 to 2004 there were 21 new cases of cancer among 967 patients. The expected number was 24 cases per 1,000 patients.

The results of the study are shown graphically in Fig. 3. The bars of the chart represent the number of new cancer cases per 1,000 patients in the separate areas, over the five years (bars 2 to 4). The first bar represents the expected number from the Saarland cancer register.

In spite of a possible underestimation, the number of newly developed cancer cases in the inner area is more than the expected number taken from the cancer register, which represents the total population being irradiated. The group who had lived during the past five years within a distance of 400 m from the cellular transmitter have a two times higher risk of developing cancer than that of the average population. The relative risk of getting cancer in the inner area compared with the Saarland cancer register is 1.7 (see to Table 7).

Conclusion

The result of this retrospective study in Naila shows that the risk of newly developing cancer was three times higher among those patients who had lived during past ten years (1994-2004), within a distance of 400m from the cellular transmitter, in comparison to those who had lived further away.

Cross-sectional studies can be used to provide the decisive empirical information to identify real problems. In the 1960s just three observations of birth deformities were enough to uncover what is today an academically indisputable Thalidomide problem.

This study, which was completed without any external financial support is a pilot project. Measurements of individual exposure as well as the focused search for further side effects would provide a useful extension to this work, however such research would need the appropriate financial support.

The concept of this study is simple and can be used everywhere, where there it a long-term electromagnetic radiation from a transmitting station.

The results presented are a first concrete epidemiological sign of a temporal and spatial connection between exposure to GSM base station radiation and cancer disease.

These results are, according to the literature relating to high frequency electromagnetic fields, not only plausible and possible, but also likely.

From both an ethical and legal standpoint it is necessary to immediately start to monitor the health of the residents living in areas of high radio frequency emissions from mobile telephone base stations with epidemiological studies. This is necessary because this study has shown that it is no longer safely possible to assume that there is no causal link between radio frequency transmissions and increased cancer rates.

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Exhibit 52

Research and Statements on RF Radiation Safety and Children

A. Web page - Healthy Schools Network *amicus curiae* brief in support of appeal to the U.S. Supreme Court in 06-175 *In Re Maria Gonzalez* found at: www.emrpolicy.org/litigation/case_law/docs/5sep06_amicus_hsn.pdf

B. P. 1 - "Electromagnetic Fields and the Public: EMF Standards and Estimation of Risk." Presented at the November 2007 Royal Society scientific conference in London by Prof. Yuri Grigoriev, Chairman of the Russian National Committee on Non-Ionizing Radiation Protection, Federal Medical Biophysical Centre, Moscow, Russia.

C. P. 8 - Open Letters to Parents, Teachers, School Boards. Regarding WiFi Networks in Schools. Statement in response to a request for information about Wi-Fi systems in schools. Dr. Magda Havas, B.Sc. Ph.D., Associate Professor of Environmental & Resource Studies, Trent University, Peterborough, Ontario, Canada.

Electromagnetic Fields and the Public: EMF Standards and Estimation of Risk

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Electromagnetic conditions in the environment have changed greatly within the past 15 years. This is in part due to the introduction of mobile telecommunication systems, which have essentially changed the degree of electromagnetic exposure members of the general public are exposed regularly to.

Completely new electromagnetic exposure regime for the population

Mobile communication is a completely new and additional source of electromagnetic exposure for the population. Standard daily mobile phone use is known to increase RF-EMF (radiofrequency electromagnetic field) exposure to the brains of users of all ages, whilst base stations can regularly increase the exposures of large numbers of the population to RF-EMF radiation in everyday life. The need to determine appropriate standards stipulating the maximum acceptable short-term and long-term RF-EMF levels encountered by the public, *and* set such levels as general guidelines are of great importance in order to help preserve the general public's health and that of the next generation. We do not have the right to make mistakes on such a major issue through complacency.

The Russian RF-EMF standards

First of all, it is necessary to provide background information to the reader on the Russian National Committee on Non-Ionizing Radiation Protection (RNCNIRP). The RNCNIRP was created 11-years ago (1997) at the Russian Academy of Medical Science (RAMS) within the framework of the Russian Scientific Commission on Radiation Protection (RSCRP). RSCRP acts as the overseer of the RNCNIRP.

The RNCNIRP employs 40 specialists, of whom 38 are qualified scientists, and 2 members are representatives of the Ministry of Health. The RNCNIRP is an independent scientific organization which does not accept financial sponsorship. The decisions of RNCNIRP are considered as recommendations, and are considered by the Ministry of Health of the Russian Federation when it is setting standards.

Mandatory compliance is required with regard to the Sanitary Provisions and Ecological Norms (SanPiN) guidelines set by the Ministry of Health of the Russian Federation. The latest RF-EMF SanPiN 2.1.8/2.2.4.1190-03 (safety standard) on mobile

Exhibit 52-B

communications was issued by the Ministry of Health of the Russian Federation in 2003. This decreed that the maximum permissible exposure level for RF-EMF over the frequency range of 300 MHz – 300 GHz in the Russian Federation is 10 μW/cm^2 (0.1 W/m^2). This SanPiN also recommended that: "Use of mobile telecommunication devices should be restricted for those under 18 or pregnant".

Characteristic conceptions on Russian and foreign standards

For the development of appropriate standards that take health and wellbeing into account; it appears necessary to formulate the hygiene hypothesis as follows, "The hygienic standards are for the protection of the population, taking into account factors potentially harmful to health, and with the obligation of taking into account typical prevalence of these factors in the general population".

International standards

Let us consider existing international standards and how these standards conform to this postulate. Presently international standards are determined by ICNIRP, IEEE, CENELEC and other national and international commissions. The first three organisations mentioned determined the basis for their standards some years ago, and continue to propose RF-EMF guidelines that only take into account thermal, acute and pathological effects (ICNIRP Guidelines 1998, IEEE Standard C95.1-2005, CENELEC EN 50166-2.2000). Unfortunately, these RF-EMF standards do little to provide protection for the general population.

Let's consider international standards and likely exposures. The population is not typically exposed to thermal levels in the workplace or in everyday life. The establishment of a proposed threshold level for pathological effects makes the assumption that compensative or adaptive reactions will occur in an organism. However we strongly disagree with this assumption. Whilst people very rarely receive acute exposures in everyday life, all populations in the world are chronically exposed on a daily basis to low levels of RF-EMF and standards have to be set accordingly.

There are no publications that present ways of extrapolating from the various existing standards recommendations to properly assess real environmental conditions for the population. There are currently no proposals on how to estimate danger by using existing international standards recommendations: from acute influences to chronic exposure, and from thermal levels to non-thermal levels.

Methodology used to create standards in Russia (and the USSR - former Soviet Union)

In Russia the principles are based on additional factors found during actual EMF exposure of the population:

- Non-thermal levels
- Chronic exposure
- An establishment of "working level", instead of threshold level. Consideration of the presence of adaptation processes in a chronic exposure instead of a direct pathological effect.

Database for standardisation: results of the research undertaken in industrial settings (1950 onwards – *almost 60 years of data*) and chronic exposure experiments, etc. The necessity of developing standards for children, as new risk group, is also recognised.

The potential health risk for children is very high and creates a completely new problem we need to address. "*Children are different from adults. Children have a unique vulnerability. As they grow and develop, there are "windows of susceptibility": periods when their organs and systems maybe particularly sensitive to the effect of certain environmental threats*" (WHO, 2003).

Modern children will use mobile phones for a longer overall period than adults of the present generation because they have started to use mobile phones at an earlier age and will continue to use them when they become adults. It is impossible to use data obtained on adults as an accurate predictor for effects on children. It is therefore necessary to develop standards which take into consideration localised head/brain exposures and undertake corresponding research. There are presently no studies investigating the effects of chronic RF-EMF exposure to the head/brain area, which takes into account investigation of the possible effects of such exposures in the developing brain.

Thermal and non-thermal effects.

There is denial by many western scientists into the possibility of detrimental non-thermal RF-EMF effects, which has resulted in consequence in an underestimation of the dangers that can exist to the health of the population through different degrees of exposure. However there is a very large number of publications on the biological effects of low level RF-EMF.

For example:

- *BioInitiative Report* (Blackman et al. 2007) – authored by 14 respected scientists from five countries (Austria, China, Denmark, Sweden, USA).
- The Stewart Report, UK (2000) and of other national committees and scientific forums.
- Numerous publications by Russian scientists (earlier - USSR).
- Bordeaux-Moscow project: - results of confirmation studies of the Russian data on immunological effects of microwaves.

The general conclusions of confirmation studies on Russian data on the immunological effects of microwaves undertaken in the Bordeaux-Moscow project are as follows:

1. The study was conducted using the methodology of the original experiments conducted in the USSR (Vinogradov & Dumansky 1974, 1975, Shandala & Vinogradov 1982) and the agreed Protocol of the Bordeaux-Moscow Project on “Confirmation studies of the Russian data on immunological effects of microwaves” (Statement of work, 2006). Autoimmunity was evaluated using the original methodology, developed in the USSR (Vinogradov & Dumansky 1974, 1975, Shandala & Vinogradov 1982). This original

methodology was a complement fixation test (CFT), however, our study was expanded to include modern ELISA test, and was conducted additionally in accordance with WHO recommendations on EMF biological research.

2. The results of our immunology study [full reference required] using the CFT and ELISA tests generally confirmed the results of Soviet research groups on the possible induction of autoimmune responses (formation of antibodies in brain tissues) and stress-reactions from long-term *non-thermal* levels of RF exposure (30-day exposures for 7 hours daily for 5 days per week at a power density of 5 W/m^2).

3. The results of our teratology study (*study investigating possible causes and biological processes that may lead to birth defects and abnormal development, and possible mitigative measures to prevent such occurrences*) [full reference required] testing the blood serum of RF-EMF exposed rats (30-day exposures for 7 hours daily for 5 days per week at a power density of 5 W/m^2), suggest possible adverse effects on pregnancy, foetal and postnatal development in agreement with the earlier results of Shandala & Vinogradov (1982).

Unsolved problems in estimating RF-EMF danger
new conditions - new problems:

- Problem of accumulation of effect. Remote somatic effects and cancer.
- Problem of adaptation.
- Estimation of the influence of simultaneous exposure to various frequencies.
- Estimation of the role of signal modulation.
- Coordination of the criterion to establish a threshold or appropriate “working level”.
- Changing reactivity and appearance of electromagnetic hypersensitivity.
- Modulation and bioeffects

The analysis of 28 biological experiments conducted *in vitro*, *in situ*, and *in vivo* by the present author from 1975 onwards in the former Soviet Union and later in Russia using modulated RF-EMF allows the following basic conclusions to be made:

- Exposure of bio-systems to EMF with higher or lower composite regimens of modulation can lead to the possible development of both physiological and unfavorable bio-effects, which are distinct from the bio-effects induced by non-modulated EMF;
- acute exposure to low intensities of modulated EMF (at non-thermal levels) can result in development of pathological effects;
- there is a dependence of development of a reciprocal biological response on the intensity and directness of the concrete regimen of EMF modulation; this dependence was fixed at all levels of biological systems — *in vitro, in situ* and *in vivo*;
- as a rule, modulated EMF invoked more recognisable bioeffects than continuous EMF regimes.

Guaranteeing good health for the population - Our conclusion

1. The present scientific thinking and basis used in many instances for developing suitable RF-EMF standards does not correspond realistically to modern conditions of RF-EMF exposure as experienced by members of the public (both through generalised exposures and through direct use of mobile communication systems).

2. From what we now know existing safety standards (both foreign and Russian) have become outdated. Modern accumulative RF-EMF exposures have also increased considerably from that found in the past, thereby increasing likely risk.

3. The existing standards cannot guarantee the safe, healthy development of the next generation.

The viewpoint of the Mobile Manufacturers Forum (MMF) - an international association of radio communications equipment manufacturers – differs from that of ourselves and is as follows "*the MMF believes that there is a strong scientific basis for all consumers to have confidence in the safety of mobile phones and base stations. In addition, we fully support parents deciding for themselves whether they want their children to use a mobile phone or not.*" (MMF 2008). We make no comment on this large variation in viewpoint from that of our own researchers and ask you to come to your own conclusions!

It is necessary:

1. To accumulate suitable knowledge for preparing proper precautionary standards based on the best available scientific evidence. To carry out appropriate research, for example, to study the possible effects of repeated RF-EMF exposures from mobile phone use over periods of several years on the brains of child, teenage and adult users from the age of seven onwards.

2. To develop and undertake new long-term standardization measures, including measures related directly to suitable exposure levels for children. To put forward more rigid requirements for industries using technologies operating over such frequency ranges.

3. To actively introduce the precautionary principle. The thesis held by some that the present forms of mobile communication are absolutely safe is both premature and potentially dangerous. It is necessary to educate scientists, politicians, industries and the general public, including parents and children, that mobile communication devices are not toys, and should be used carefully in a responsible manner.

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May 13, 2009.

Open Letter to Parents, Teachers, School Boards. Regarding Wi-Fi Networks in Schools

I am a scientist who does research on the health effects of electromagnetic radiation and I am becoming increasingly concerned that a growing number of schools are installing WiFi networks and are making their school grounds available for cell phone antennas.

You will be told by both the federal government (Federal Communication Commission in the US; Health Canada and Industry Canada in Canada) as well as by the Wi-Fi provider that this technology is **safe** provided that exposures to radio frequency radiation remain below federal guidelines.

This information is **outdated** and **incorrect** based on the growing number of scientific publications that are reporting adverse health and biological effects below our "short-term, thermal-based" guidelines (see www.bioiniative.org) and the growing number of scientific and medical organizations that are asking for stricter guidelines to be enforced.

For these reasons it is irresponsible to introduce Wi-Fi microwave radiation into a school environment where young children spend hours each day.

FACT:

1. **GUIDELINES: Guidelines for microwave radiation (which is what is used in Wi-Fi) range 5 orders of magnitude in countries around the world.** The lowest guidelines are in Salzburg Austria and now in Liechtenstein. The guideline in these countries is 0.1 microW/cm^2. See short video (http://videos.next-up.org/SfTv/Liechtenstein/AdoptsTheStandardOf06VmBioInitiative/09112008.html). In Switzerland the guideline is 1 and in both Canada and the US it is 1000 microW/cm^2!

   Why do Canada and the US have guidelines that are so much higher than other countries? Our guidelines are based on a short-term (6-minute in Canada and 30-minute in US) heating effect. It is assumed that if this radiation does not heat your tissue it is "safe". This is NOT correct. Effects are documented at intensities well below those that are able to heat body tissue. See attached report: *Analysis of Health and Environmental Effects of Proposed San Francisco Earthlink Wi-Fi Network* (2007). These biological effects include increased permeability of the blood brain barrier, increased calcium flux, increase in cancer and DNA breaks, induced stress proteins, and nerve damage. Exposure to this energy is associated with altered white blood cells in school children; childhood leukemia; impaired motor function, reaction time, and memory; headaches, dizziness, fatigue, weakness, and insomnia.

2. **ELECTRO-HYPER-SENSITIVITY:** A growing population is adversely affected by these electromagnetic frequencies. The illness is referred to as "electro-hyper-sensitivity" (EHS) and is recognized as a disability in Sweden. The World Health Organization defines EHS as:

   ". . . a phenomenon where individuals experience adverse health effects while using or being in the vicinity of devices emanating electric, magnetic, or electromagnetic fields (EMFs). . . EHS is a real and sometimes a debilitating problem for the affected persons, while the level of EMF in their neighborhood is no greater than is encountered in normal living environments. Their exposures are generally several orders of magnitude under the limits in internationally accepted standards. "

   Health Canada acknowledges in their Safety Code 6 guideline that some people are more sensitive to this form of

EXHIBIT 52-C

energy but they have yet to address this by revising their guidelines.

Symptoms of EHS include sleep disturbance, fatigue, pain, nausea, skin disorders, problems with eyes and ears (tinnitus), dizziness, etc. It is estimated that 3% of the population are severely affected and another 35% have moderate symptoms. Prolonged exposure may be related to sensitivity and for this reason it is imperative that children's exposure to microwave radiation (Wi-Fi and mobile phones) be minimized as much as possible.

3. **CHILDREN'S SENSITIVITY:** Children are more sensitive to environmental contaminants and that includes microwave radiation. The Stewart Report (2000) recommended that children not use cell phones except for emergencies. The cell phone exposes your head to microwave radiation. A wireless computer (Wi-Fi) exposes your entire upper body and if you have the computer on your lap it exposes your reproductive organs as well. Certainly this is not desirable, especially for younger children and teenagers. For this reason we need to discourage the use of wireless technology by children, especially in elementary schools. That does not mean that students cannot go on the Internet. It simply means that access to the Internet needs to be through wires rather than through the air (wireless, Wi-Fi).

4. **REMOVAL OF WI-FI:** Most people do not want to live near either cell phone antennas or Wi-Fi antennas because of health concerns. Yet when Wi-Fi (wireless routers) are used inside buildings it is similar to the antenna being inside the building rather than outside and is potentially much worse with respect to exposure since you are closer to the source of emission.

   Libraries in France are removing Wi-Fi because of concern from both the scientific community and their employees and patrons.

   The Vancouver School Board (VSB) passed a resolution in January 2005 that prohibits construction of cellular antennas within 1000 feet (305 m) from school property.

   Palm Beach, Florida, Los Angeles, California, and New Zealand have all prohibited cell phone base stations and antennas near schools due to safety concerns. The decision not to place cell antennas near schools is based on the likelihood that children are more susceptible to this form of radiation. **Clearly if we do not want antennas "near" schools", we certainly do not want antennas "inside" schools!** The safest route is to have wired internet access rather than wireless. While this is the more costly alternative in the short-term it is the least costly alternative in the long run if we factor in the cost of ill health of both teachers and students.

5. **ADVISORIES:** Advisories to limit cell phone use have been issued by the various countries and organizations including the UK (2000), Germany (2007), France, Russia, India, Belgium (2008) as well as the Toronto Board of Health (July 2008) and the Pittsburgh Cancer Institute (July 2008). While these advisories relate to cell phone use, they apply to Wi-Fi exposure as well since both use microwave radiation. If anything, Wi-Fi computers expose more of the body to this radiation than do cell phones.

6. **PRECAUTIONARY PRINCIPLE**: Even those who do not "accept" the science showing adverse biological effects of microwave exposure should recognize the need to be careful with the health of children. For this reason we have the Precautionary Principle, which states:

   In order to protect the environment, the precautionary approach shall be widely applied by States according to their capability. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.

   In this case "States" refers to the School Board and those who make decisions about the health of children.

The two most important environments in a child's life are the home (especially the bedroom) and the school. For this reason it is imperative that these environments remain as safe as possible. **If we are to err, please let us err on the side of caution.**

Respectfully submitted,
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