



Science and Public Health Implications of Electromagnetic Fields

The BioInitiative Working Group Report

Public Health Issues from Wireless Technologies: The Critical Need for Biologically-based Public Exposure Standards

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Important Highlights

- The BioInitiative Report was compiled by 14 international experts in 9 month project
- Documents over 2000 scientific studies
- We have definitive evidence for biological effects at low RF exposure.
- We have strongly suggestive evidence for harmful effects of RF exposure to humans at levels frequently found in our environment, including elevated risk of various cancers and neurodegenerative diseases.
- Inaction will likely result in large health impacts.

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Important Highlights

- It is the [information content](#)- not heating that causes these effects.
- That means existing FCC public safety limits are obsolete.
- May be no lower RF limit that is safe.
- We need new biologically-based limits
- Children are at most risk.

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Objective of the BioInitiative Report

To document key scientific studies and reviews that identify low-intensity effects for which new human exposure standards should provide safety limits. This affects limits for cell and cordless phones, WI-FI, WiMAX, and other wireless communication and data transmission - and power frequency fields (60-Hz).

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The BioInitiative Report Concludes

- The evidence indicates that everyday levels are associated with increased risk of cancer and neurological diseases in both adults and children.
- The existence of low-intensity effects is established.
- The existing public safety limits are obsolete.
- New public safety limits are warranted, based on biologically-relevant exposure levels.

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Risks to Health from Electromagnetic Fields and Radiofrequency Radiation (RF) (Wireless Technologies)

- We know that exposure to power line frequency EMFs results in associated with increase in risk of leukemia. IARC Classification - Group 2B (Possible Carcinogen)
- Currently there is a rapid expansion of RF exposures through use of cell phones, other communication devices and WiFi.
- This issue is different from other public health issues in that we are all exposed - without informed consent.

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Chronic Disease Burden

- Richard Carmona, MD, former Surgeon General
- *“Chronic disease accounts for 7 in 10 deaths and 75 cents of every dollar are spent on health care in the United States”.*
- Exposures to ELF and RF are likely contributors to many chronic inflammatory-based diseases (Alzheimer’s, ALS, cancer, auto-immune disorders)

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What does the Future Hold?

- Of particular concern is the possibility that we will see a RF-induced epidemic of brain cancer and acoustic neuroma, and perhaps Alzheimer’s Disease and ALS in the future, due to the long latency for these diseases following exposure.
- There is overwhelming evidence that in general children are more vulnerable than adults to environmental exposures. Unfortunately children are major users of cell phones in today’s culture.

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Biologically-Based Exposure Standards Are Needed to Protect Against

- Genotoxicity: DNA damage and cancer
- Malignant brain tumors and acoustic neuromas
- Electrohypersensitivity
- Adverse changes in immune function
- Childhood leukemia
- Male and female breast cancer
- Alzheimer's disease and ALS
- Miscarriage and loss of fertility
- Insomnia and sleep disorders
- Memory impairment (loss of cognitive function)

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Why Does it Matter?

- Wireless exposures reach 92% of the American people.
- Thus, it is a widespread problem for health.
- It is involuntary (in the airwaves) and cannot be avoided.
- 262 million Americans are wireless subscribers but do not have protection against the likely health effects from wireless technologies, nor are they advised about the possible health risks.
- There are 220,500 cell sites in the US, up from only 600 in 1985. Each affects community health. The wireless industry says it needs another 16,000 new sites. The rush to deploy is running far ahead of public health planning and public education about health risks. There is NO health oversight relevant to the RF exposure levels of concern.
- Chronic exposure to wireless technologies will likely DECREASE worker productivity and increase health costs due to illness, absenteeism, treatment costs and deaths.
- The wireless industry ignores health concerns and costs while promoting more saturation of the American population.
- The federal agencies that regulate wireless are not health-knowledgeable and have clear mission conflict (selling airwaves but enforcing regulations).

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Brain Tumors + Acoustic Neuromas

- Studies on brain tumors and use of cell phones for ≥ 10 years gave a consistent pattern of an increased risk for acoustic neuroma and brain tumors (gliomas). Same for cordless phones.
- The risk is most pronounced for high-grade glioma and for ipsilateral exposure.
- Adults = 180%-200% increased risk(meta-analysis); children's use is linked to a 500+% increased risk.
- Existing standards do not protect us.

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The Young are Most at Risk

- Number of children and adolescents who use cell phones = %
- Number of 65+ age group = %
- Like tobacco, hook the young.

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Children and Brain Tumors

- Brain cancer rates are increasing in children and adolescents (National Cancer Institute, NIH Pub. No. 06-5767. Bethesda, MD 2006. Chapter 6)
- Cell phone use is increasing rapidly by children and adolescents (US Congressional Testimony of Robert Hoover, National Cancer Institute, September 2008)
- Children who start using cell phones before the age of 20 have a 500%+ risk of glioma, a malignant brain tumor (Lennart Hardell, RRT Conference Presentation at the Royal Society of London, 2008)

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Neurological Effects

- Effects of radiofrequency and microwave radiation on neurophysiological and cognitive functions are well established. Brainwave activity is affected.
- Pulsed high-frequency electromagnetic fields can affect normal brain functioning and have effects on cognition, memory, learning, behavior and reaction time.
- Central nervous system effects occur at very low intensities (cell phone, base station, WI-FI levels). There is some evidence for effects on sleep, performance, judgment, reaction time, immune function, and behavior.
- There is good evidence for effects on learning and memory; synchronization of brainwave activity and cognition (electrical activity μ s at as low as 0.1 W/kg) where current safety limits are 1.6 W/kg (US) and 2 W/kg (Europe)
so existing limits do not protect against harm.
- There is substantial evidence that RF is a physiological stressor. Chronic stress can have serious effects on general health and wellbeing.

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Immune Function

- Both human and animal studies report large immunological changes with exposure to environmental levels of electromagnetic radiation (EMR). Some of these exposure levels are equivalent to those of e.g. wireless technologies in daily life.
- Measurable physiological changes that are bedrock indicators of allergic response and inflammatory conditions are stimulated by EMR exposures (mast cells increase, for example).
- Negative effects on pregnancy (uteroplacental circulatory disturbances and placental dysfunction with possible risks to pregnancy).

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Immune Function

- Over-reaction of immune system = inflammatory response
- Alterations of immune cells
- Profound increases in mast cells in the upper skin
- Increased degranulation of mast cells and larger size of mast cells in electrohypersensitive individuals
- Presence of biological markers for inflammation that are sensitive to EMF exposure at non-thermal levels
- Changes in lymphocyte viability/ decreased count of NK cells and T lymphocytes

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Electrical Hypersensitivity

Electrical hypersensitivity is reported by individuals in the United States, Sweden, Switzerland, Germany, Denmark and many other countries of the world.

Estimates range from 3% to perhaps 10% of populations, and appears to be a growing condition of ill-health leading to lost work and productivity.

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Stress Proteins

- Cells react to an EMR as potentially harmful
 - Direct interaction of ELF and RF with DNA has been documented and both activate the synthesis of stress proteins.
 - Biochemical pathway that is activated is the same pathway in both ELF and RF and it is non-thermal.
 - Existing limits do not protect us.

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ELF-EMF and RF are Genotoxic

- *There is substantial evidence that RFR may be considered genotoxic (cause DNA damage).* Of 28 total studies on radiofrequency radiation (RFR) and DNA damage, 14 studies reported effects (50%) and 14 reported no significant effect (50%). Of 29 total studies on radiofrequency radiation and micronucleation, 16 studies reported effects (55%) and 13 reported no significant effect (45%). Of 21 total studies on chromosome and genome damage from radiofrequency radiation, 13 studies (62%) reported effects and 8 studies (38%) reported no significant effects.
- *Extremely-low frequency (ELF-EMF) has also been shown to be genotoxic and cause DNA damage.* Of 41 relevant studies of genotoxicity and ELF-EMF exposure, 27 studies (66%) report DNA damage and 14 studies (44%) report no significant effect.
- Radiofrequency radiation exposure can induce genetic damages/changes in cells and organisms at non-thermal exposure levels. This can lead to change in cellular functions, cancer, and cell death.

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Childhood Leukemia

There is little doubt that exposure to ELF causes childhood leukemia.

- The WHO International Agency for Research on Cancer (IARC) as classified ELF-EMF as a Group 2B (Possible) Carcinogen.
- Children who have leukemia and are in recovery have poorer survival rates if their ELF exposure at home (or where they are recovering) is between 1mG and 2 mG in one study; over 3 mG in another study.
- A genetic basis for EMF effect on leukemia has been identified in 2008 - reducing DNA repair.

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Alzheimer's Disease (AD)

- There is strong epidemiologic evidence that long-term exposure to extremely-low frequency (ELF) magnetic fields (MF) is a risk factor for AD.
- There is considerable in-vitro and animal evidence that melatonin protects against Alzheimer's.
- Human studies indicate that MF exposure can decrease melatonin production.
- New exposure limits are warranted, and preventative action is needed now.

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Breast Cancer

- Human studies have found that low melatonin production is a likely risk factor for breast cancer.
- Human studies indicate that ELF exposure can decrease melatonin production.
- ELF blocks the anti-cancer effects of both melatonin and tamoxifen (tamoxifen is given as chemotherapy to women with breast cancer).
- Laboratory studies of MCF-7 human breast cancer cells show more malignant cell proliferation with 6 - 12 mG ELF by blocking melatonin's protective action (also true for tamoxifen).
- Occupational studies indicate that high (10 mG and greater) ELF exposure increases the risk of breast cancer. The current exposure limit is 904 mG (US).

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Information Content of Signal

It appears it is the **INFORMATION conveyed by electromagnetic radiation (rather than heat) that causes biological changes - some of these biological changes may lead to loss of wellbeing, disease and even death. Current FCC exposure standards are only good for protecting against heating damage to tissues.**

Did not anticipate wireless technologies and do not protect against them.

Cancer and neurological diseases will result in far greater numbers from use of cell phones, cordless phones, PDAs, and other wireless.

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CTIA Wireless Industry Briefing

- Can only say they are ‘in compliance’ with FCCs outdated standards.
- Ignore the health risks from wireless technologies.
- Are **NO** relevant public safety limits for wireless given the science.
- Cannot say the exposures to wireless are safe, or make positive assertions of safety given the scientific evidence that already exists today.
- CTIA briefing demonstrates widespread exposures already exist without any health assessment.
- Global health impacts will be enormous if there is even a small risk to health (and the risks look to be large in comparison to other carcinogens)

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Precautionary Public Health Action

- The lessons from the histories of most well known hazards show that precautionary- based yet proportionate measures taken in response to robust early warnings can avoid the kinds of costs incurred by asbestos, smoking, PCBs, X rays etc.
- Such lessons are relevant to the EMF issue. Observing “Late Lessons from Early Warnings” can avoid risks and reduce health costs to society.

(David Gee, European Environmental Agency, 2007)

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Setting a Standard: What Level of Evidence?

- The standard for taking action should be precautionary.
- There is substantial public concern, but also widespread public ignorance of the hazard.
- There is inadequate warning to the public and there is no “informed consent”.
- No positive assertion of safety can be made.
- Conclusive scientific evidence (a causal link) between ELF-EMF and RF-EMF is not required to take reasonable, interim prudent public health action.
- There is a large difference between what constitutes causal evidence, what constitutes sufficient evidence for purposes of interim public health policy, and what constitutes "a more likely than not" case.

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Overall Conclusions

- Bioeffects are indisputable and chronic exposures may lead to harm.
- ICNIRP and FCC public safety limits are obsolete for wireless technologies.
- Biologically-based public exposure standards are warranted for ELF and RF.
- It is not in the public interest to wait.
- Biological effects may include both potential adverse health effects such as cancer, pregnancy loss, neurological disease and loss of homeostasis and well-being. Normal mental function is at risk.
- A biologically-based exposure limit needs to be protective against ELF and RF intensity and modulation factors, which, with chronic exposure, can reasonably be presumed to result in impacts to health and well-being.

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New Biologically-Based Limits

- Because of evidence for elevated risk of childhood cancer in children exposed to power line fields of 2 to 5 mG, we recommend an exposure standard of 1.0 mG where children have extended exposures, and 2 mG for all others.
- For RF - recommend a cautionary target level of $0.1 \mu\text{W}/\text{cm}^2$ for chronic exposure to combined AM, FM, TV and wireless frequencies. Even this may not be totally protective, however, and may need to be lowered.

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What We Need to Do to address the EMF and Wireless Technology Health Issue

- Commission an independent assessment - not by industry and ask “what is the evidence” - not “is there proof?”
- Read the science and public health studies yourselves.
- Direct the FCC to develop new standards that take into account non-thermal effects.
- Establish a stakeholders group to help develop and monitor new standards.
- Coordinate with legislative committees responsible for health issues.
- Urge industry to make mid-course corrections and support redesign for safer wireless technologies.
- Coordinate with the European Parliament and EEA on wireless regs

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