

San Francisco Medicine  
A Journal of the San Francisco Medical Society  
March 2001  
Prepared by Cindy Sage, Sage Associates  
1396 Danielson Road  
Santa Barbara, CA 93108  
Sage@silcom.com

**See <http://www.sfms.org/sfm/sfm301h.htm>**

## **MICROWAVE AND RADIOFREQUENCY RADIATION EXPOSURE: A GROWING ENVIRONMENTAL HEALTH CRISIS?**

Can radiofrequency radiation (RFR) adversely affect vital processes in the human body? The answer is clearly yes. Can this occur at environmental levels of exposure? The answer is clearly yes. Which processes? What levels? This short paper is an introduction to what we know (and do not know) about RFR.

Bioeffects that are reported to result from RF exposure include changes in cell membrane function, major changes in calcium metabolism and cellular signal communication, cell proliferation, activation of proto-oncogenes, activation of HSP heat shock proteins as if heating has occurred when it has not, and cell death. Resulting effects which are reported in the scientific literature include DNA breaks and chromosome aberrations, increased free radical production, cell stress and premature aging, changes in brain function including memory loss, learning impairment, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion, and cancer. The virtual revolution in science taking place now is based on a growing recognition that non-thermal or low intensity RF exposure can be detected in living tissues and result in well-defined bioeffects.

The most rapidly growing environmental pollutant in today's environment is probably electromagnetic fields (EMF) including radiofrequency radiation. Public exposure to electromagnetic radiation (radiofrequency and microwave) is growing exponentially worldwide with the introduction and use of cordless phones, cellular phones, pagers and antennas in communities designed to transmit their RF signals. Cell phone exposures can be intense enough to cause DNA damage and/or failure to repair DNA damage in the brain. It's not necessarily the heating that causes damage. It appears to be exposure to non-thermal levels of RFR that interferes with normal body processes in the brain, skull, ear, and nerves of the head, neck and face. Casual use (a few hours per month) has not yet been linked to increased brain tumors, but heavy users like some business travelers, realtors and physicians have not yet been studied as a group so

any reassurance given to cell phone users in recent media coverage of the Muscat study, for example, is false reassurance. The Muscat (JAMA, 2001) study compared infrequent users (less than one hour per month) to frequent users (greater than 10 hours per month) effectively blurring any effect for users who may bill 1000 or 2000 or even 2500 minutes per month. However, even this study did report a doubling of risk for neuroepithelial tumors. And a tripling of eye cancer (uveal melanoma) was recently reported in cell phone users. The first cancer related to cordless phone use was reported in Sweden where such use was linked to development of an angiosarcoma. Some oncologists and brain cancer surgeons report they have excised brain tumors positioned along the antenna alignment and on the side of the head as the cell phone has been used in heavy cell phone users. Although the US media has been relatively silent on reporting studies linking RFR to health effects, this is not true of western European countries, Australian, Israel, the former USSR and China.

Chronic long-term exposure to lower-level RFR from wireless antennas is also linked to some of these effects, particularly on the immune system, mental function, sleep interference and on DNA. These exposures are reported in the range of 0.1 to 10 or 20 microwatts per centimeter squared exposure (a measure of power density in the air). An alternate measure is SAR or specific absorption rate which tells how much energy deposition occurs inside the body (how much RFR is absorbed by different tissues). SARs as low as 0.0024 watts/kilogram whole body exposure at cell phone frequencies are reported to cause serious interference with body processes (in this case DNA damage and/or DNA repair processes).

Long-term and cumulative exposure to such massively increased RF has no precedent in history. These exposures simply did not exist 150 years ago. Life on earth evolved with vanishingly small RF exposures, most of that from natural lightning. We have increased the background nonionizing radiation by  $10^{12}$ . There is no conclusive scientific evidence on the safety or risk of such exposures, but a growing body of scientific evidence reports such bioeffects and adverse health effects are possible, if not probable. The weight of the evidence that bioeffects occur with RFR exposure is beyond argument and some of the evidence suggests that serious health effects may result, particularly from cumulative or chronic exposure. Scientific study on cumulative effects is very incomplete, and some studies report that low-intensity chronic exposure may produce permanent adverse health consequences.

Public policies to address the issue of decision making in the face of this scientific uncertainty are evolving but are far behind the growth curve of wireless communications. The global infrastructure will be in place before we know what the health risks will be. The precautionary principle (erring on the side of conservatism) is frequently promoted by public health advocates given the massive public health risk that is possible if such exposure is carcinogenic or has other adverse bioeffects. Even if the risk to an individual is slight (which is at present suspected but not conclusively proven), the sheer number of people around the globe who may be at risk makes this policy choice of utmost importance. At present, no US agency

systematically monitors health effects from radiofrequency/microwave radiation. The wireless industry was recently required to provide mobile phone buyers with the SAR (specific absorption rate or a measure of energy absorbed into the brain from mobile phones). The industry has stated it will not post SARs on the box, but place it hidden inside to prevent comparison shopping. The FDA is allowing this as compliance with its recommendation to provide meaningful information to the public.

The United States has a de facto policy of "post-sales surveillance" with respect to mobile phones. That means mobile phones can be sold to the public, and only after years of use might there be studies to characterize what health consequences, if any, have arisen as a result. In shorter terms, "we are the experiment" for health effects. "Post-sales surveillance" is inadequate to protect existing users. And given that the US has no research funding for RF exposure, there will be no systematic look at what mobile phone use does to people.

### **WEIGHT OF THE SCIENTIFIC EVIDENCE FOR NONTHERMAL RADIOFREQUENCY/MICROWAVE RADIATION HEALTH EFFECTS**

While the scientific community continues to study and understand the physical (and quantum mechanic) basis for electromagnetic effects on living systems, there is little to protect or inform the public about consequences of unlimited reliance on these new technologies. For all the potential good which such inventions bring to us, including the immeasurable benefit of the telecommunications/internet revolution, we must be vigilant about what consequences may come uninvited.

The evidence for an association between RFR and bioeffects in living systems spans the entire range from effects on individual atoms (calcium) and molecules (DNA or the genetic code in each living cell) to humans and other mammalian species. In the past 50 years, experimentation across the electromagnetic spectrum of frequencies has found replicable bioeffects on everything from mice to humans. The cascade of biological, chemical and physical events that occur in living systems in response to RFR is better understood as the multi-disciplinary scientific community and its science matures. Disease is not the only endpoint of this research. The potential medicinal applications of RFR treatment may also offer an unparalleled opportunities for healing and wellness as we gain understanding of how the body receives, processes and responds to this subtle information contained in radiofrequency/microwave energy.

### **SYMPTOMS OF ELECTROSENSITIVITY/ELECTROSTRESS**

The environmental illness is sometimes termed electrostress or technostress, electrosensitivity or electric allergy. Patients may comment on minor, annoying symptoms or they may be severely debilitated.

EMF/RFR exposures can interfere with sleep, work and normal life. What kinds of symptoms might a physician hear from a patient? The most common complaints are;

- headaches, dizziness and nausea
- failing memory, confusion and spatial disorientation
- pain and burning feeling in the eyes
- parched, thirsty or dry feeling that is not quenched with drinking
- ringing in the ears (tinnitus or similar chronic ear-noise)
- irregular heartbeat and palpitations (shaky stressed feeling)
- fatigue or exhaustion
- insomnia and sleep difficulties
- skin rashes and sunburn-like redness and swelling of face and neck
- burning or tingling of face and extremities
- light sensitivity

Symptoms quickly improve when away from EMF/RFR sources, particularly when the patient moves away from computers, interior fluorescent lighting, transformers, wireless antenna exposures, cell phones and cordless phones, appliances and out of proximity to freeways, electrical substations and powerlines, airports, military bases and doppler or other radar installations. All these are potential sources of higher than normal EMF/RFR exposure. Symptoms return very quickly on returning to the original environment. Over time, it appears that sensitivity is increased to smaller and smaller EMF/RFR exposures. Chemical sensitivities (to paints, pesticides, heavy metals, etc) may precede electrostress symptoms and patients are often both chemically and electrically sensitive. Around the world and particularly in the Scandinavian countries, there are growing populations of electrosensitive people who have abandoned normal urban/suburban lifestyles because of incapacitating symptoms. In Sweden it is estimated that several thousand people live in remote areas without electricity and away from wireless antenna RFR in order to avoid these symptoms.

Treatment is not well established, but “radiofrequency illness” is recognized to be a true medical syndrome in many countries around the world. Patients report that eliminating exposures to EMF/RFR is the primary way they deal with their symptoms. Occupational exposures that result in chronic symptoms generally cannot be treated without a change in work environment. Some researchers find anti-oxidants can retard or eliminate RFR effects in cellular studies (probably by reducing free-radical damage or cellular stress known to occur with RFR exposure).

## **WHAT EFFECTS HAVE BEEN REPORTED WITH USE OF MOBILE PHONES AND OTHER NONTHERMAL EXPOSURES TO RADIOFREQUENCY/MICROWAVE RADIATION?**

- Sleeplessness/impaired sleep patterns/decrease in REM sleep
- Memory loss (short-term memory deficit)
- Slowed motor skills and reaction time
- A 4-fold increase in motor vehicle accidents
- A 9-fold increase in deaths from motor vehicle accidents (highest fatality rate under 20 years age)
- Spatial disorientation
- Headaches, facial and tooth pain
- Blood brain barrier changes (pathological leakage in BBB)
- Loss of concentration and 'fuzzy thinking'
- Suppression of the lymphocyte effectiveness (immune function)
- Increase in serum cortisol (stress hormone)
- Increased heart rate
- Increased blood pressure
- Change in the brain's electrical activity
- DNA damage
- Cell proliferation
- Neuroepithelial tumors
- Acoustic neuromas
- Angiosarcoma of the scalp (with cordless phone)
- Salivary tumors
- Uveal melanomas (rare cancer of the eye)
- Lymphoma (doubling of risk with chronic exposure)
- Increased HSP gene activity (heat shock protein response)
- Decrease in melatonin production
- Decrease in testosterone and insulin
- Calcium efflux in cells (calcium is a critical

component to cellular communication and proper growth regulation of cells).

### **AND NOW FOR SOME PRACTICAL ADVICE**

#### **WHAT ABOUT CORDLESS PHONES IN YOUR HOME (AS OPPOSED TO MOBILE OR MOBILE PHONES)?**

Cordless phones that you use around the house have far lower levels of RFR, but they still produce RFR that a land line does not. In preference, use a land line, then a cordless, then a mobile phone for continual use, particularly for children.

- A land line produces no RFR
- A cordless phone produces about 10 microwatts/cm<sup>2</sup>
- A mobile phone produces about 150 microwatts/cm<sup>2</sup>

#### **WHAT DOES THIS SAY FOR DRIVING AND USING A CELL PHONE AT THE SAME TIME?**

Cell phone use by a driver of a car increases the risk of accident by 4 X (a four hundred percent risk) which is equivalent to driving under the influence of alcohol. This may be due both to the distraction and to physical effects of cell phone RFR on the brain, eye and body of the cell phone user.

#### **ARE CHILDREN AT ANY GREATER RISK?**

Probably yes, since children are growing, and their cells are turning over faster than adults. Many of the studies linking power lines and cancer show that children are particularly sensitive to low EMF levels from chronic exposure, and develop leukemias in response. The use of “kiddy mobile phones” with a button for mom and a button for dad are terrible ideas at this point.

#### **SECOND HAND RADIATION**

If you are sitting or standing near a person using a mobile phone, be aware that you are within their radiation pattern for a few feet in all directions.

If you are using a mobile phone in the car, your passenger and very possibly your kids in the back seat are within the radiation pattern of the mobile phone.

Involuntary exposure to RFR may ultimately be viewed as unacceptable as to “second-hand smoke”.

In other countries like Japan, there are mobile phone jammers that can be used to kill mobile phone transmissions. They are popular in restaurants, theaters and on the subway. They cover a large room area.

### **HOW DO YOU RESPOND TO THE TELECOM ADS THAT PROMOTE THE USE OF MOBILE PHONES IN EMERGENCIES?**

A mobile phone may be fine for infrequent or emergency calls, like an insurance policy in case of trouble. But to focus exclusively on the benefits of wireless communication, while denying any potential health effects is disingenuous.

### **WHAT ABOUT THE CELL TOWERS IN NEIGHBORHOODS?**

It is worrisome, however, that the installation of antennas go up in neighborhood locations, near schools, churches and homes. These wireless antennas expose people to involuntary, chronic RFR.

Low levels of RFR, which have been shown to be bioactive and are associated with changes in cell proliferation and DNA damage.

If you are within the first 500 feet of a cell site, you are most probably exposed to RFR above the Salzburg limit of  $0.1 \mu\text{W}/\text{cm}^2$ . For a macrocell (2000-2800 watts effective radiated power), these fields can be elevated above  $0.1 \mu\text{W}/\text{cm}^2$  for several thousand feet at equal elevation. Therefore, siting must take into account where people live, work and go to school.

### **WHAT'S WRONG WITH THE CURRENT SITING PROCEDURE FOR WIRELESS ANTENNAS?**

- local agencies are prevented from considering RFR health and safety issues in siting/zoning
- the FCC is in charge of RFR, but they do not recognize athermal or nonthermal RFR health effects
- the current FCC standard is  $1000 \mu\text{W}/\text{cm}^2$
- some scientific studies show adverse health effects reported in the  $0.01$  to  $100 \mu\text{W}/\text{cm}^2$  range (far lower)
- cell antennas can be hidden (stealth installations) like fake trees, bell towers etc.
- the consumer should be able to know where they are located in order to avoid them (buying a home, for example)
- Antenna farms on rooftops are big business

- some cities and counties are turning their collective heads away from RFR health concerns, while collecting fat fees for leasing out their properties for cell towers. There is a disincentive to protect the public.
- Other countries limit public exposure to  $0.1 \mu\text{W}/\text{cm}^2$  in recognition of bioeffects and potential adverse health effects of nonthermal RFR exposure (Salzburg)

## **WHAT ARE SCIENTISTS AND PUBLIC POLICY RESEARCHERS SAYING ABOUT RFR?**

The Vienna Resolution (October 1998) provided a consensus statement signed by sixteen of the world's leading bioelectromagnetics researchers. It says there is scientific agreement that biological effects from low intensity RF exposures are scientifically established. It also says that existing scientific knowledge is inadequate to set reliable exposure standards. That means, no safe exposure can be established. It also urges that there be public participation in making decisions about setting limits, and advises that technical information be made available for comparison of EMF exposure in communication devices so that users can make informed decisions for prudent avoidance of EMF.

The Salzburg Resolution (June 2000) was adopted at the International Conference on Cell Tower Siting and would prohibit any cell site from emanating more than  $0.1 \mu\text{W}/\text{cm}^2$  in all places. This would reduce public exposure below  $0.1 \mu\text{W}/\text{cm}^2$  in all places. It is a limit that takes into account nonthermal RF bioeffects and reported health effects.

## **AT WHAT POINT DO WE ADOPT STRATEGIES THAT ARE PROTECTIVE OF PUBLIC HEALTH? HOW MUCH SCIENTIFIC EVIDENCE DO WE NEED TO DO SO? WHO SHOULD BEAR THE BURDEN OF PROOF? IF CHRONIC EXPOSURE STUDIES ARE NEVER DONE, OR THEY DO NOT REFLECT "REAL LIFE" EXPOSURES, HOW CAN WE EVER KNOW?**

Scientific certainty about the potential for health effects from low intensity RF/MW radiation is not necessary for wise public health decision-making, as long as research continues to identify what, if any, specific exposure conditions may contribute to disease.

The basis for decision-making about a relationship between electromagnetic fields radiofrequency and microwave radiation and adverse health effects at low intensity exposures rests on two key areas. The first is the "weight of the scientific evidence" pointing to a relationship between RF/MW and illness. The scientific evidence needs to be reported to decision-makers in a format that is concise, understandable and accurate.

The second is definition of the basis on which the evidence is judged to be sufficient to take interim or permanent public health steps to reduce risk. Conclusive scientific

evidence should not be implicitly or explicitly set as the goal required before any action can be taken to limit public exposure to RF/MW from wireless communications. Given the potential for a very large world-wide public health impact if even a small health risk is present, interim public health actions should be proportionately triggered to the weight of scientific evidence as it grows in support of adverse health effects at low-intensity exposure levels.

Industry has been very active in setting the research agenda, funding RF studies, choosing the researchers, interpreting the results, and providing the media spin on findings.

Further Information: Contact Sage Associates at [sage@silcom.com](mailto:sage@silcom.com) and visit [www.sageassociates.net](http://www.sageassociates.net) on the web (particularly Radiofrequency)

A technical manuscript on Radiofrequency Radiation Health Studies  
Is available at a nominal charge for copy and shipping (ask for  
Testimony to the UK and Scottish Parliaments by Sage Associates.