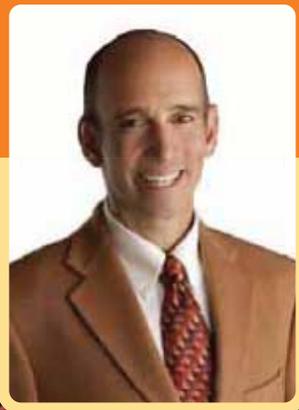


# Cell Phone Radiation Is the Danger All in Your Head?

DR. MERCOLA



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# Cell Phone Radiation — Is the Danger All in Your Head?

Can the radiation from your cell phone really damage your health?

That's the question scientists and researchers across the globe have tried to answer for the last two decades. Reports vary from definitive yes's to absolute no's, with most falling somewhere in-between, leaning toward—but not admitting to—potential health hazards.<sup>1</sup>



## Radiation 101

Radio Frequencies (RF), Electro Magnetic Fields (EMF) and X-rays are all produced by electromagnetic sources. The difference between them is the frequency of their source. Frequency is measured in hertz (Hz), which is the number of times a wave changes direction—by oscillating up and down—per second. 1 Hz, therefore, means one wave-cycle per second. 1 mega hertz (MHz) equals 1,000,000 Hz (wave-cycles) per second.

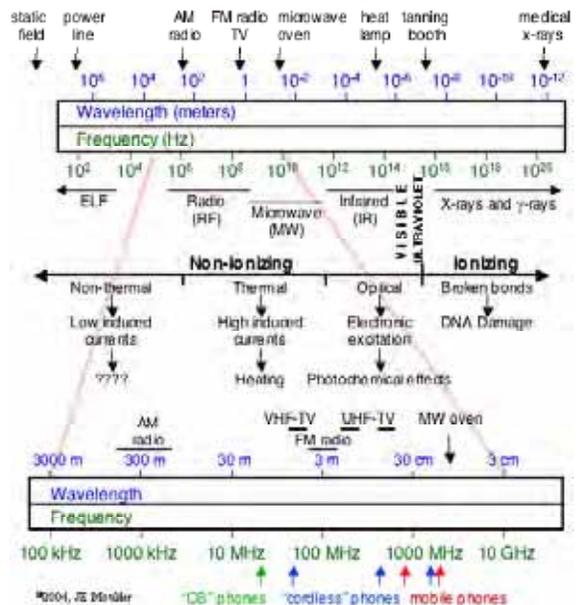
All electromagnetic energy falls somewhere on the electromagnetic spectrum<sup>2</sup>, ranging from extremely low frequency (ELF) radiation to microwaves, x-rays and gamma rays.

ELF fields include household appliances and overhead power lines. Scientists agree that **ELF fields are hazardous to human health. It's considered 'possibly carcinogenic', and has been linked to cases of childhood leukemia<sup>3</sup>.**

Common frequencies on the electromagnetic spectrum include:

- Electric Power 60 Hz
- AM radio 1 MHz
- FM radio 100 MHz
- Cellular phones 800-2200 MHz
- Microwave ovens 2450 MHz
- X-rays, more than 1,000,000 MHz

**It's also a proven fact that at extremely high frequencies, like that of x-rays, the electromagnetic**



**particles have enough power to break chemical bonds and cause serious damage to human tissue.** This is known as ionizing radiation.

Since X-rays have the power to damage the genetic material of cells, they can lead to cancer and birth defects—which is why you wear a lead vest during x-rays to protect the surrounding areas from unnecessary damage.

At lower frequencies, such as the microwave range used by mobile phones and base stations, the energy emitted is too low to break chemical bonds (non-ionizing radiation). This is the main staple argument by those who believe that cell phone radiation is completely harmless.

Perhaps the most interesting, and perplexing thing to note here is this: Although **extremely low frequencies** (ELF's emitted from appliances and power lines) **are known to be carcinogenic, and high levels of radio frequency energy are known to create heat that damages biological tissue**, the scientific community is extremely hesitant to attach any kind of danger to the in-between frequencies where cell phones operate.

## How Cell Phone Radiation Works



When you speak into a cell phone, the sound of your voice goes through a transmitter that encodes the sound into a sine wave. A sine wave is a continuously fluctuating wave that radiates out from the antenna, and is measured in hertz.

Once the encoded sound has been placed on the sine wave the transmitter sends the signal to the antenna, which then sends the signal out into space in all directions.

The transmitter in your phone operates on about 0.75 to 1 watt of power, with 2 W at peak usage. This electric current running through the transmitter circuit also creates an electromagnetic field around it. As the electric current moves back and forth, the fields continue to build and collapse, forming electromagnetic radiation.

Thus, cell phone radiation is generated in the transmitter, and is emitted through the antenna in the form of radio waves. In the case of cell phones, the frequencies of these radio waves fall in the low frequency microwave range.

## New Technology Triples the Danger

One of the main concerns associated with cell phone use is that the phone is pressed to the head. Since electromagnetic radiation shoots out—at the speed of light—in all directions, this radiation can penetrate up to two inches into your brain.

Making matters worse, modern Digital Service and PCS<sup>6,7</sup> cell phones—as opposed to analog cell phones—have two additional low frequency magnetic fields associated with them. “Time division multiple access” (TDMA), is the system currently used to increase the number of people who can communicate simultaneously with a base station.



The process of TDMA results in a continuous low frequency pulsing at 8 to 34 Hz. Some phones also have the energy-saving discontinuous transmission mode (DTX), which emits yet a third, even lower frequency that pulses at 2 Hz when the user is listening and not speaking.

Since extremely low frequency radiation (ELF) has been shown to cause cancer—like leukemia—these additional ELF's raise new questions. Many warn that our current technology is in fact far more dangerous in this respect than previous analog models.

## Into the Looking Glass—A Sterile Future?

When high frequency microwave radiation penetrates the body, exposed molecules start to move about and collide with each other. These collisions create friction and, thus, heat. This is known as “thermal effect,” which can cause serious, irreversible damage to human tissue.

Microwave radiation is especially damaging to your eyes and genital organs because these areas contain few blood vessels. The less blood you have circulating through an area, the less heat dissipates, leading to a quicker rise in heat and faster damage. Cataracts have occurred in both humans and animals because of microwave radiation.



The Communications Workers of America (CWA)<sup>8</sup> warns their workers about potential reproductive problems from high frequency microwave exposure. Partial or permanent sterility in both men

and women can occur. They also point out the potential for birth defects, such as mongolism (Down's syndrome) and central nervous system damage.

But what about lower frequency radiation like that from cell phones? Can it cause similar damage as higher frequency radiation?

According to a recent scientific study published in *Fertility and Sterility*, the answer is **YES**!

Published in May 2007, this study investigated the effect of cell phone use on semen quality. 361 men were divided into four groups according to their active cell phone use, ranging from 'no use', up to 'more than 4 hours' per day.

They found statistically significant changes in sperm count and health of the sperm, based on cell phone use. Their conclusion?

**“Use of cell phones decreases the semen quality in men by decreasing the sperm count, motility, viability and normal morphology. The decrease in sperm parameters was dependent on the duration of daily exposure to cell phones, and independent of the initial semen quality.”**

## The Head-In-The-Sand Approach to Dangers

As cell phone use skyrockets, spreading from industrialized nations out into more and more remote locations, the concern over potential health risks rise as well.

Scientists, lawmakers, manufacturers and governments are well aware of the dire ramifications, should proof emerge that cell phones are dangerous to your health. No doubt, this should be entered into the equation when deciphering the truth...

Dr. George Carlo<sup>10 11</sup>, an epidemiologist and pathologist who headed a research program funded by the cellular phone industry, criticized the mostly reassuring headlines appearing in national magazines.<sup>12</sup>

In an article penned for *USA Today* in 2001, Carlo claims the media reports missed some vital points. “If journalists had paused to consider what the new studies were really saying—and not saying—we’d have a more realistic but less reassuring picture,” he wrote.

Carlo pointed out that two U.S. studies looking at a period between the early and mid-1990's,



only included people who spent an average of 2.5 hours or less per month on their cell phones. They'd also used their cell phones for less than 3 years.

He claimed the studies were very small and looked at the wrong type of brain tumors. "Tumors in almost all patients were located in interior regions of the skull that couldn't be reached by cell phone radiation, which penetrates only two inches inside adult skulls," Carlo noted.



Perhaps even more disturbing is his critique of a study that, according to Carlo, failed to emphasize its most chilling finding—that the cancer risk doubled for a certain subgroup that had neuroepithelial tumors near the side of the head, close to the location of cell phone antennas.

Other findings link cell phones to cancer by showing that human blood cells exposed to cell phone radiation suffered the kind of genetic damage experts consider "high risk" markers for developing tumors. And yet, these findings were merely glossed over in the final analysis. People should "...read the fine print of any new studies that come in," Carlo warned.

## Blowing the Whistle on "Phony Dangers"

An interesting aspect of Dr. George Carlo's rare outspokenness about wireless dangers is that Carlo was known as a relentless advocate for the industry he later came to speak out against.

In 1993, Dr. Carlo was hired by the Cellular Telephone Industry Association (CTIA) to re-search—and hopefully forever silence—claims that cell phones cause cancer. His company, the now disbanded Wireless Technology Research (WTR), was paid \$25 million over five years to carry out the task. No one expected the industry mouthpiece to come to the opposite conclusion.

In October of 1999, he sent an open letter to 30 chief executives of telecommunications companies, urging them to launch a public awareness campaign to warn about the potential dangers of wireless telephone technology.

This would be especially relevant and true for children, who will be exposed to a lifetime of potentially DNA-altering or life-threatening radiation.



According to an article in *The Australian*, published on October 26, 1999,<sup>13</sup> Carlo said that when his results first emerged, CTIA members verbally agreed to publicize the results, but never took action. What were those discarded results?

- **The risk of benign tumors of the auditory nerve is 50 percent higher in mobile users of six years or more.**
- **The risk of rare neuroepithelial tumors on the outside of the brain is more than doubled among mobile phone users.**
- **A correlation between radiation from the cell phone antenna and functional genetic damage was found.**
- **Mice subjected to 18 months of GSM-style microwaves had 2.4 times the tumor rate of unexposed mice.**
- **In 1995 and 1996, Lai and Singh found that microwaves radically increased DNA damage in rat brains after only two hours of exposure.**

In November of 2000, Dr. Carlo published a book, *Cell Phones—Invisible Hazards in the Wireless Age*,<sup>14</sup> in an effort to expose the industry cover-up.

## The Danger Nobody Wants to Face

Numerous studies claim there is no biological impact of RF radiation within the cell phone range. Still, researchers in different countries, in different laboratories, are finding disturbing results that point to far greater health implications than anyone is ready for.



Some illnesses and ailments linked to cell phone radiation include:

- Cancer
- Brain tumors
- Alzheimer's
- Parkinson's
- Fatigue
- Headaches
- Sleep disruptions
- Altered memory function

- Poor concentration and spatial awareness
- Pacemaker disruptions<sup>15</sup>

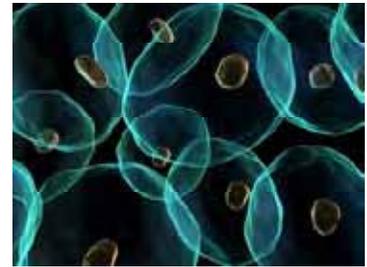
Although cell phone radiation is of low intensity, the oscillatory similarity between this pulsed microwave radiation and certain electrochemical activities within the living human being raises serious concerns, according to the study *Physics and biology of mobile telephony*,<sup>16</sup> published in *The Lancet*.

Your body is essentially a very sensitive electromagnetic instrument, controlled by highly complex and orderly oscillatory electrical processes. Each one of these electro-biological processes vibrate at a specific frequency—some of which happen to be close to those used in modern GSM cell phone technology.

The pulsating, low-intensity microwaves from mobile phones can exert subtle, non-thermal influences on the human biology because microwaves are waves. As such, they have properties other than just intensity (which is the part regulated by safety guidelines).

Therefore, much in the same way as a radio can receive interference; your biological processes can be interfered with by the oscillatory aspect of the incoming radiation.

**Highly organized electrical processes at the cellular level are especially vulnerable to interference from cell phone radiation, because their frequency happens to fall within the microwave range.**



Many of these biological activities are influenced by your metabolism, meaning the effect of the radiation will be different from one person to another.

The effect could also depend on the type of cell phone used, as different cell phones emit radiation at different frequencies.

Ultra-low intensity microwaves can affect processes as fundamental as cell division, and the TDMA frequencies of 8-34 Hz, and the DTX pulse frequency at 2 Hz, correspond to the frequencies of alpha and delta brain waves.

Therefore, it's quite possible that living organisms have a two-fold sensitivity to cellular phone signals:

1. The microwave radiation itself, plus
2. The lower frequency oscillations of the TDMA and DTX signals.

One good example of how someone may be vulnerable to the non-thermal electromagnetic influence is the ability of a flashing light (at about 15 Hz) to induce seizures in people with photosensitive epilepsy.

It's not the energy absorption itself that causes the seizure. Rather it's because the brain recognizes the information being transmitted via the pulsating light, since it's delivered at a frequency the brain uses.

## Generation 'Lab-Rats'

According to the study *Physics and Biology of mobile telephony*, radiation from cellular GSM technology does have a non-thermal effect on a variety of brain functions, including the neuroendocrine system. Anecdotal evidence also refers mainly to neurological problems, such as headaches, disturbed sleep, trouble concentrating and poor memory.

Headaches are consistent with findings that show RF radiation can affect the dopamine-opiate system of the brain and permeate the blood-brain barrier. Reports of sleep disruptions can be related to the adverse effect it has on melatonin levels and on rapid-eye-movement (REM) sleep.



A study performed by the University of Helsinki in Finland, found that **EMF from mobile phones at 902 MHz has an adverse effect on children's memory and recognition**, when measured by EEG.<sup>17</sup>

Preadolescent children are particularly vulnerable because absorption of GSM microwaves is greatest in an object about the size of a child's head, due to the "head resonance" effect. Radiation can also penetrate the thinner skull of an infant much easier.

Additionally, the repetition frequencies of the TDMA and the DTX lie in the range of the alpha and delta brainwaves respectively. In a child, the alpha waves don't replace delta waves as a stable activity until they're about 12 years old.

Children's immune systems are also degraded by this kind of radiation, making them more susceptible to illnesses of all kinds.

## Victims Are Calling It in Court

Joanne Suder, a Baltimore attorney, raised both eyebrows and defenses when she filed an \$800 million lawsuit against the cell phone industry, back in 2002. The evidence she brought to court included dozens of cellular industry patents to create radiation-shielding technology, despite the industry's official proclamations of absolute safety.

One Nokia patent stated, "It has been suggested that radio frequency irradiation may stimulate extra growth among supportive cells in the nerve system, which in the worst case it has been suggested could lead to a development of a malignant tumor.

Although the consequences described above have not been scientifically verified, the uncertainty has some effects by reducing the speed of growth of the market of radiophones."<sup>18</sup>



Motorola, Ericsson and other cell phone manufacturers hold similar patents, according to Suder, and by doing so have something to hide. Why create protection from something that is completely harmless?

## The REFLEX Report

In 2004, the European Union released a 259-page document called the REFLEX report, summarizing multiple projects from a dozen different research groups, on the genotoxic potential of RF radiation.<sup>19</sup>

Agents that can damage cell DNA are called genotoxins, and are presumed to have carcinogenic potential. The REFLEX report received a lot of attention because of the genotoxicity reported.

Some of the findings include:

- Intermittent (but not continuous) ELF-EMF exposure damages DNA in human cells.
- Genotoxic effects are dependent on the frequency, but higher frequency does not necessarily correlate with more damage.
- The frequencies causing DNA damage were ranked, from High to Low damage, as follows: 50 Hz, 16 2/3 Hz, 3 Hz, 300 Hz, 550 Hz and 30 Hz.
- DNA strand breaks after ELF-EMF exposure is dependent on the person's age, with older

individuals showing a higher rate of DNA damage.

- DNA damage through ELF-EMF radiation is cell type specific. For example, human melanocytes (deep layer epidermal cells that synthesize melanin) reacted, whereas skeletal muscle cells did not.
- ELF-EMF radiation generated several types of chromosomal abnormalities in human cells.

## Safety Guidelines Tell Only Half the Story

The FCC established safety guidelines and exposure limits for cell phone radiation in 1996. Every mobile phone sold in the U.S. has to be tested and meet these standards before they can be sold.

One of the problems, however, as pointed out in the GAO report, *Research and Regulatory Efforts on Mobile Phone Health Issues*,<sup>20</sup> testing is primarily done by the manufacturers themselves, leaving plenty of room for uncertainty about their compliance.

Radiation levels are tested based on the *specific absorption rate (SAR)*. SAR is a way of measuring how much radio frequency energy is absorbed by the human body.<sup>21</sup> The maximum legal SAR level is 1.6 watts per kilogram (W/Kg).

As of 2000, all cell phone manufacturers must place labels on their phones disclosing their radiation level. To find the specific radiation level of the phone you're using, you can also visit the [FCC web site](#)<sup>22</sup> and look it up by brand.

One thing to keep in mind is that the SAR level only refers to the **intensity** of the radiation (watts emitted). It does not measure, nor are there any safety guidelines for the pulsating, **oscillatory action** of the waves. Meaning, there's no safety guideline forbidding frequencies between 45-55 Hz, for example.

Some researchers have shown, that it is this oscillatory action—the wave frequency—that can cause severe damage, simply because some of the vibrations are so similar to that of the brain itself.

## Getting Closer to Solving the Riddle

In 2004, a Swedish physicist named Bo Sernelius, stumbled across a surprising finding that suggests non-thermal mobile phone radiation can cause a massive increase in the forces that living cells exert on each other.<sup>23</sup> He discovered that electromagnetic forces might act on cells by affecting the attractive forces between them, without thermal heating.

Water molecules have poles of positive and negative electrical charge that create attractive forces between cells, known as van der Waals forces.<sup>24</sup>

Van der Waals forces are much weaker than chemical bonds. And, whereas chemical bonds need high frequency ionizing radiation in order to break, van der Waals forces are disrupted by much smaller thermal fluctuations.

These intermolecular forces may be weak, but without them, life as we know it would be impossible.

Sernelius found that the water molecules inside cells will try to align their positive and negative poles with the alternating field produced by cell phone radiation. The result? They all end up pointing in the same direction, and this strengthens the van der Waals forces.

In the fields of 850 MHz (around the frequency used by mobile phones), the van der Waals forces leap—from a billionth-billionth of a Newton, to micro Newton strength—a massive jump of around 11 orders of magnitude.

Although it's still only theoretical, **this may be the missing link when trying to explain tissue damage from non-ionizing, non-thermal radiation.** Stronger attractive forces between cells can also make them clump together, and cause blood vessels to contract.

Back in 2002, a two-year study performed by the Radiation and Nuclear Safety Authority in Finland, found that human cells exposed to one hour of cell phone radiation (900 MHz GSM) triggered a response that normally only occurs when cells are being damaged. This led the cells that make up blood vessel walls to shrink, allowing tiny molecules to pass through the blood brain barrier.<sup>25</sup>

The summary states, **“We postulate that these events, when occurring repeatedly over a long period of time, might become a health hazard because of the possible accumulation of brain tissue damage.** Furthermore, our hypothesis suggests that other brain damaging factors may co-participate in mobile phone radiation-induced effects.”

Who knows, perhaps these “other, co-participating factors” in tissue and brain damage include the increased van der Waals forces, as discovered two years later?



Professor Darius Leszczynski has said he can confirm that radiation from mobile phones does affect the delicate make-up of human cells.

“We have shown there are biochemical changes in human cells,” he said in one interview. “Other studies in animals have shown this can lead to a leakage in the blood brain barrier... I believe we will find these leaks occur in humans too. What we do not know is the extent of these leaks, and whether they have an effect on our health. Our bodies may be able to cope with it, so there will be no risk. But it could be found that, over time, the effects on health could be much more significant.”<sup>26</sup>

## Safety Tips to Protect You and Your Family

For some time, the standard recommendation was to use a headset. It was thought that since radiation decreases exponentially over the distance between you and the phone, this would solve the problem.

But, newer investigations, and the emergence of wireless earpieces (like Bluetooth) turns this idea upside-down. These headsets may actually intensify your exposure to harmful radiation because the headset itself acts as an antenna, which is now inserted directly into the ear canal.

To date, there are few alternatives to ensure complete safety, but there are some common sense recommendations:

- Limit the amount of time you spend on the phone.
- Use the speakerphone instead of putting the phone to your ear this is probably one of the single most important steps you can take other than not using your cell phone.
- Use a non-Bluetooth (wired) headset to limit your exposure to the cell phone. Better yet would be use an air tube headset which conducts sound but prevents any radiation from travelling up the wire to your brain.
- Attach a ferrite bead to your headset to decrease RF interference
- Limit calls inside buildings.
- Use the phone in open spaces as often as possible.
- Limit use by children and preadolescents.

Ferrite is a semi-magnetic substance created from iron oxide (rust) alloyed with other materials. It is commonly used on computer cables, to reduce or eliminate the radio frequency inter-

ference emitted by these cables.<sup>27 28</sup>

A computer cable is essentially a really long antenna for the radio signals they carry, which can produce interference with radios and TV's. Likewise, a headset to your cell phone is one long antenna, directing RF waves into your ear.

The idea behind using ferrite beads on your headset<sup>29</sup> is fairly simple. Since radio waves can cause interference with the cellular functions in your brain—just like a computer cable can create static noise on your radio—the ferrite beads reduce the radio frequency interference broadcast by your phone through the headset, to your brain.

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<sup>3</sup>European Commission, Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), "Possible effects of electromagnetic fields (EMF) on human health", March 21, 2007, [http://ec.europa.eu/health/ph\\_risk/committees/04\\_scenihr/docs/scenihr\\_o\\_007.pdf](http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_007.pdf) (Accessed June 27, 2007)

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<sup>11</sup>The Boston Globe, Patricia Wen, October 4, 1999, p. C01, "Mixed Signals—The evidence indicates that cell phones don't cause cancer, but George Carlo is not so sure", [http://www.wave-guide.org/archives/emf-l/Oct1999/Two-parts-to-George-Carlo-article-\(Jonsson\)---.html](http://www.wave-guide.org/archives/emf-l/Oct1999/Two-parts-to-George-Carlo-article-(Jonsson)---.html) (Accessed June 28, 2007)

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