Cellular Phone Towers

From the American Cancer Society

What Are Cellular Phone Towers?

The widespread use of cellular phones has led to the placement of cellular phone towers in many communities. These towers, also called "base stations," consist of radios, computerized switching equipment, and antennas that receive and transmit radiofrequency (RF) signals.

When a person makes a cellular phone call, a signal is sent from the phone's antenna to the base station antenna. The base station responds to this signal by assigning it an available radiofrequency channel. Transmission and reception of these radio signals transfer the voice information to the base station. Next, the voice signals are sent to a switching center, which transfers the call to its destination. For additional information on the phones themselves, please see the American Cancer Society document, "Cellular Phones."

Cellular phone towers are usually mounted either on top or on the side of existing structures, such as trees, water tanks, or tall buildings. The antennas need to be located high enough so they can adequately cover the area. Base stations usually range in height from 150-270 feet.

Cellular phones operate at the radiofrequency (RF) part of the electromagnetic spectrum. This is non-ionizing radiation. Other examples of the non-ionizing part of the electromagnetic spectrum include AM and FM radio waves, microwaves, and infrared waves from heat lamps. Unlike x-

rays and gamma rays (which are examples of ionizing radiation), radio waves have too little energy to break the bonds that hold molecules (such as DNA) in cells together. Similarly, since RF of this frequency contains relatively low energy, it does not enter tissues. At very high levels of exposure, RF can cause warming of tissues, much as a heat lamp does. The wavelength of cell phone waves is about one foot and the frequency is approximately 800 to 900 MHz, although newer models may use higher frequencies up to 2,200 MHz.

How Are People Exposed to Radiofrequency Energy From Cellular Phone Towers?

As people use cellular phones to make phone calls, signals are transmitted back and forth to the base station. The radio waves produced at the base station are emitted into the environment, where people can be exposed.

The energy from a cellular phone antenna, like that of other telecommunication antennas, is directed toward the horizon (parallel to the ground), with some downward scatter. Base station antennas use higher power levels than other types of land-mobile antennas, but much lower levels than radio and television broadcast stations. The power density decreases with increasing distance from the antenna. As a result, the level of exposure to radio waves at ground level is very low compared to the level close to the antenna.

Public exposure to radio waves from cellular phone antennas is slight for several reasons. The power levels are relatively low, the antennas are mounted at high above ground level, and the signals are transmitted intermittently, rather than constantly.

Agencies such as the National Council on Radiation Protections and Measurements, the International Radiation Protection Association, the Institute of Electrical and Electronics Engineers, and the American National Standards Institute, have established guidelines for exposure to RF radiation originating from cellular communications base stations. These guidelines were designed to protect workers, as well as the public, from potentially harmful radio frequency. The recommended exposure limits are in the range of .41-.45 milliwatts per square centimeter (mW/cm2) for cellular radiofrequencies.

Exposures that exceed these recommended standards can sometimes be encountered on the rooftops of buildings where base stations are mounted. If this is the case, access to these areas should be limited. The power density inside buildings where a base station is mounted is typically 10 to 100 times lower than the level outside depending on the construction materials of the building. Wood or cement block reduces the exposure level of RF radiation by a factor of about ten. The power density behind an antenna is hundreds to thousands of times lower than in front. Therefore, if an antenna is mounted on the side of a building, the exposure level in the room directly behind the wall is typically well below the recommended exposure limits.

Do Cellular Phone Towers Cause Cancer?

Humans generate electromagnetic fields internally as well as externally. The simple collision between 2 molecules is an electrical event. Since there is electrical activity inside the human body, the question arises as to whether radio waves emitted by cellular phone towers can influence cell function, and in particular whether they can cause cancer.

However, several theoretical considerations suggest that cellular phone towers are unlikely to cause cancer.

First, the energy level of radio waves is relatively low. Electromagnetic energy comes in "packages" that are referred to as photons. Photon energy is measured in electron volts (eV), the energy gained by an electron after accelerating over 1 volt. The energy in the photons depends directly on the frequency, and decreases as one moves down the electromagnetic spectrum. X-rays have about 1,000 eV of energy, while the photon energy of radio waves from cellular phone towers is about one millionth of an eV, not enough to alter molecules in the body.

A second issue has to do with wavelength. Radio waves have a wavelength of approximately 1 foot in air, and about 2 inches in body tissue. As a result, RF radiation can only be concentrated to about an inch or two in size. This makes it unlikely that the energy from radio waves could be concentrated on a small bit of tissue, affecting individual cells.

A third issue has to do with the magnitude of exposure. Measurements taken around typical cellular phone towers show ground level power densities well below the recommended limits. Moreover, public exposure near cell phone towers is not significantly different than background levels of RF radiation in urban areas from other sources, such as radio and television broadcast stations.

For these reasons, cell phone antennas or towers are unlikely to cause cancer.

What Does the Epidemiologic Evidence Say?

No human studies have focused specifically on cellular phone

towers or even on radio waves more generally. Several studies have looked at the effects of radio waves and microwaves combined; these have generally not shown any increase in cancer, except for a US Air Force study that suggested an increase in brain tumors in association with radiofrequency/microwave exposure.

What Does the Animal Evidence Say?

A number of animal studies have been conducted, generally showing no carcinogenic (cancer-causing) effect of radio waves. Several experiments have used exposure levels that cause a rise in tissue temperature, and even in these studies, there was no increase in DNA mutations or in cancer. A recent review concluded that: "The scientific evidence indicates that exposure to radiofrequency radiation fields is not mutagenic and is therefore unlikely to act as an initiator of carcinogenesis."

What Do the Expert Agencies Say?

The expert agencies that usually provide findings on carcinogenicity (whether something can cause cancer) – the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), and the US Environmental Protection Agency (EPA) – have not issued findings on cellular phone towers.

The World Health Organization stated in 1993 that "the epidemiologic and comparative clinical studies do not provide clear evidence of detrimental health effects in humans from exposure to RF fields. Occupational exposure to RF will be at higher levels than that encountered by the general population, and, thus, there is less likelihood of health effects in the

general population as a whole."

The US Food and Drug Administration (FDA) offers the following information to individuals concerned about the safety of cellular phone towers (also known as wireless telephone base stations):

The electromagnetic RF signals transmitted from base station antennas stations travel toward the horizon in relatively narrow paths. For example, the radiation pattern for an antenna array mounted on a tower can be likened to a thin pancake centered around the antenna system. The individual pattern for a single array of sector antennas is wedge-shaped, like a piece of pie. As with all forms of electromagnetic energy, the power decreases rapidly as one moves away from the antenna. Therefore, RF exposure on the ground is much less than exposure very close to the antenna and in the path of the transmitted radio signal. In fact, ground-level exposure from such antennas is typically thousands of times less than the exposure levels recommended as safe by expert organizations. So exposure to nearby residents would be well within safety margins.

Cellular and PCS (Personal Communications Service) base stations in the United States are required to comply with limits for exposure recommended by expert organizations and endorsed by government agencies responsible for health and safety. Measurements made near cellular and PCS base station antennas mounted on towers have confirmed that ground-level exposures are typically thousands of times less than the exposure limits adopted by the FCC (Federal Communications Commission). In fact, in order to be exposed to levels at or near the FCC limits for cellular or PCS frequencies an individual would essentially have to remain in the main transmitted radio signal (at the height of the

antenna) and within a few feet from the antenna. This is, of course, very unlikely to occur.

When cellular and PCS antennas are mounted on rooftops, RF levels on that roof or on others near by would probably be greater than those typically encountered on the ground. However, exposure levels approaching or exceeding safety guidelines should be encountered only very close to or directly in front of the antennas. In addition, for sector-type antennas, typically used for such rooftop base stations, RF levels to the side and in back of these antennas are insignificant. General guidelines on antenna installations and circumstances that might give rise to a concern about a facility's conformance with FCC regulations can be found in A Local Government Official's Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance. This Guide can be accessed on the Internet at: www.fcc.gov/oet/rfsafety.

Do Cellular Phone Towers Cause Any Other Health Problems?

While high levels of radiofrequency waves can cause a warming of tissues, cellular phone towers do not yield exposure at levels sufficient to cause this effect. There is no evidence in published scientific reports that cell phone towers cause any other health problems.

What Do I Do If I’ve Been Exposed to Cellular Phone Towers?

As noted above, cell phone towers pose little risk under ordinary conditions. There is no test to measure whether you have been exposed to RF radiation from cellular phone towers. However, if there is a cellular phone tower mounted

near your home or office, you can ask a government agency or private firm to measure the radiofrequency field strength near the tower to ensure that it is within the acceptable range. If you have additional health concerns, please consult your doctor.

The Bottom Line...

Cellular phone towers, like cellular phones themselves, are a relatively new technology, and we do not yet have full information on health effects. In particular, not enough time has elapsed to permit epidemiologic studies. There are some theoretical reasons why cellular phone towers would not be expected to increase cancer risk, and animal studies of RF have not suggested a risk of cancer. People who are concerned can ask for measurements of RF near cellular phone towers to be sure exposures do not exceed recommended limits.

Additional Resources

National Organizations and Web Sites

The following organizations can provide additional information and resources.*

Federal Communications Commission RF Safety Program, Office of Engineering and Technology, 2006 Internet Address: www.fcc.gov/oet/rfsafety/

Food and Drug Administration Cell Phone Facts: Consumer Information on Wireless Phones, 2005 Internet Address: www.fda.gov/cellphones/

National Institute of Environmental Health Sciences Internet

Address: www.niehs.nih.gov/external/faq/cellular.htm

World Health Organization Electromagnetic fields and public health: extremely low frequency fields and cancer. 2001. Internet Address: www.who.int/mediacentre/factsheets/fs263/en/

** Inclusion on this list does not imply endorsement by the American Cancer Society*

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