



Risk in Perspective

Cellular Telephones and Brain Cancer

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Cellular telephones are rapidly gaining popularity. They have become one of the fastest selling consumer electronic products, with over 19 million Americans using cellular telephones in 1994. Industry forecasts estimate that, within a decade, cellular communications devices will be used by over 60 million Americans.

Over the last several years, questions have arisen regarding the safety of this technology. There have been several public claims of brain tumors associated with cellular telephone use. In response to these claims, the cellular communications industry has launched a multi-million dollar research program to explore the safety and potential health effects of cellular technology.

This issue of RISK IN PERSPECTIVE examines cellular telephone technology, including what is known and unknown about its safety, the new research program being developed in this area, and the role HCRA has undertaken in the research program.

Nature of the Technology

Cellular telephone technology encompasses several types of telephones, including 1) car telephones, where the telephone body is installed inside the car and the antenna is mounted on the outside of the vehicle; 2) portable telephones, with the antenna and telephone body carried in a case separate from the handset, and 3) self-contained portable telephones, in which the handset contains the power source and the antenna. It is the hand-held self-contained unit, where the antenna is attached to the handset and is in close proximity to the head when used, which is the focus of this discussion. Hand-held models currently encompass about one third of all cellular telephones in use and are rapidly growing in popularity.

Cellular telephones operate by sending and receiving radio signals. The telephones transmit voice messages with electronic signals sent over radio waves from the antenna on the handset. The radio waves are then relayed to the receiving telephone via cellular transmitter towers. These electronic signals — a form of radio-frequency (non-ionizing) radiation — are transmitted in radio wave frequencies between 824 and 894 megahertz (MHZ). (For comparison, common electrical household appliances operate in the range of 50-60 hertz (Hz); radio broadcasts

transmit in the range of 0.5-1.6 MHZ; microwave ovens operate at 2450 MHZ.)

Most current cellular telephones use a continuous analog system, transmitting voice messages by varying either the amplitude (height) or the frequency (number of wave crests) of the radio wave. Increasingly, cellular telephones will use a digital communication system, where messages are transmitted as a series of digits in rapid pulses. Pulse-modulated signals offer the advantage of increasing channel capacity and allowing several users to send messages over the same radio wave at the same time.

Sparse Science

While cellular communications technology has been rapidly advancing, there have been few scientific studies of the safety of this new technology. There is very limited information on whether the radiation emitted by cellular telephones poses a risk to human health. Many studies have examined low level electromagnetic fields (50-60 Hz) as well as the higher frequency used by microwave ovens (2450 MHZ), but there has been little research exploring the 824-894 MHZ range. There is also limited safety information on other technologies using tower transmissions systems, such as broadcast radio and television.

The initial health concern with radio-frequency radiation was its ability to heat body tissue and cause thermal effects such as burns. While it is known that cellular telephones operate at low enough power levels and in a frequency range that does not produce immediate thermal effects, epidemiologic and cell studies done on low-level electric and magnetic fields have raised questions about potential nonthermal effects of radio-frequency radiation. These studies on 50-60 Hz electromagnetic fields have bolstered concern about the potential for radiation at higher frequency levels, such as cellular telephone frequencies, to cause adverse effects on human health.

The limited scientific work that has been done using radio-frequency radiation has produced mixed results. In studies exploring effects in cells, for example, some scientists have found that exposure to low-level pulsed radio-frequency radiation may 1) temporarily diminish the effectiveness of certain immune system cells in fighting off tumor cells, and 2) enhance the transformation of cells treated with a tumor-

promoting chemical into tumor cells. Other researchers, however, have found no evidence that radio-frequency radiation alters the course of tumor development. Studies exploring the effects of radio-frequency radiation on the immune system and DNA of rodents and other animals have been equally inconclusive. To date, there have been no epidemiological studies completed which examine the risk of brain cancer from cellular technology. In a recent study at the National Cancer Institute, investigators explored the proposed hypothesis that radio-frequency radiation is an important risk factor for female breast cancer, with the results indicating little support for this hypothesis. Other studies have been launched to explore the relationship between exposure to radio-frequency radiation and brain cancer, but the results of these studies are several years away.

The paucity and inconclusiveness of these scientific data have led both the Food and Drug Administration — the primary federal agency responsible for evaluating the safety of cellular telephones — and the Environmental Protection Agency to conclude that the available research in this area is insufficient to warrant regulatory action.

Citizens Go to Court

In early 1993, cellular telephones made national headlines when a Florida lawsuit was launched alleging that a woman's brain tumor was a result of her cellular telephone use. With little evidence other than the anecdotal history of the woman's cellular telephone usage, her husband filed suit against the industry claiming that cellular telephones were responsible for her cancer. While cellular telephones were rapidly gaining widespread use, this was the first major public questioning of their safety. Concern arose over the potential health risks from using a powerful energy source in such close proximity to the head.

Over the last two years, several other lawsuits have been filed against cellular telephone manufacturers, including a suit brought by an industry engineer involved in testing prototype cellular telephone antenna models. These suits similarly claim that radiation emitting from cellular telephone use is associated with brain cancer. Plaintiffs have charged that cellular telephones are dangerous and that they should be equipped with both a hazard warning and a shielding device against exposure to radio-frequency radiation.

Industry Response

In response to the initial Florida lawsuit and the ensuing public concern, the cellular industry manufacturers and carriers, under the coordination of the Cellular Telecommunications Industry Association, committed to a major research initiative to address the safety of portable cellular telephones. The industry has pledged \$15 to \$25 million over the next three to five years to the research initiative.

Independent WTR Program

The Wireless Technology Research LLC (WTR) was set up as an independent research entity designed to implement the research program

developed pursuant to the commitment of funds by the cellular telecommunications industry. The program will investigate the potential health effects of both the current and the rapidly evolving future technology of cellular communications.

The research program calls for laboratory studies in animal, cell, and genetic research, as well as large scale epidemiologic studies. The issue of critical concern is radio-frequency radiation exposure to the head and brain from the antenna of the cellular telephone. The primary health risk under investigation is brain cancer, but other health endpoints may be explored as well. The studies will employ exposure frequencies both in the range used by current cellular telephones and in higher ranges projected for the next wave of cellular technology. Initial research relevant to the program has included such diverse tasks as developing artificial human head models to measure the amount of radio-frequency radiation absorbed from cellular telephone use and investigating the effects of radio-frequency radiation exposure on breaks in the DNA of rat brain cells. A major epidemiologic cohort study of cellular telephone users has also been launched to examine the patterns of telephone usage, such as frequency and length of cellular telephone calls, as well as brain cancer mortality within the cohort.

Peer Review Board

In conjunction with the industry research initiative, the Harvard Center for Risk Analysis was asked to coordinate an independent peer review process for the program. HCRA's Peer Review Board will provide independent review of many facets of the research initiative. The first phase of the program was the development of the research agenda document to guide the scientific research. The next phase of the program will involve the Board's review of prospective scientific study protocols and results, as well as other critical scientific questions that arise as the program progresses. The Board consists of a panel of distinguished scientists from a range of disciplines relevant to cellular telephone technology.

Initial members of the Peer Review Board include: **Dr. Larry Anderson**, Battelle Pacific Northwest Laboratories; **Dr. Patricia Buffler**, Dean, School of Public Health, University of California at Berkeley; **Sir Richard Doll**, Professor Emeritus, Nuffield Department of Clinical Medicine, University of Oxford; **Dr. Carl Durney**, Professor of Electrical Engineering, University of Utah; **Dr. Joe Elder**, Health Effects Research Laboratory, U.S. EPA; **Dr. Saxon Graham**, Professor Emeritus, State University of New York at Buffalo; **Dr. Don Justesen**, VA Medical Center, Kansas City; **Dr. Richard Monson**, Professor of Epidemiology, Harvard School of Public Health; **Dr. Asher Sheppard**, Consultant on Environmental Science; **Dr. Dimitrios Trichopoulos**, Professor and Chair, Department of Epidemiology, Harvard School of Public Health; **Dr. Peter Valberg**, Principal, Gradient Corporation; and **Dr. Gary Williams**, Chief, Division of Pathology and Toxicology and Director of Medical Sciences, American Health Foundation.

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FURTHER READING:

United States General Accounting Office, "Telecommunications: Status of Research on the Safety of Cellular Telephones," United States General Accounting Office Report GAO/RCED-95-32, November, 1994.

Scientific Advisory Group on Cellular Telephone Research, "Potential Public Health Risks from Wireless Technology: Research Agenda for the Development of Data for Science-based Decision-making," Washington, DC: Scientific Advisory Group on Cellular Telephone Research, August, 1994.

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