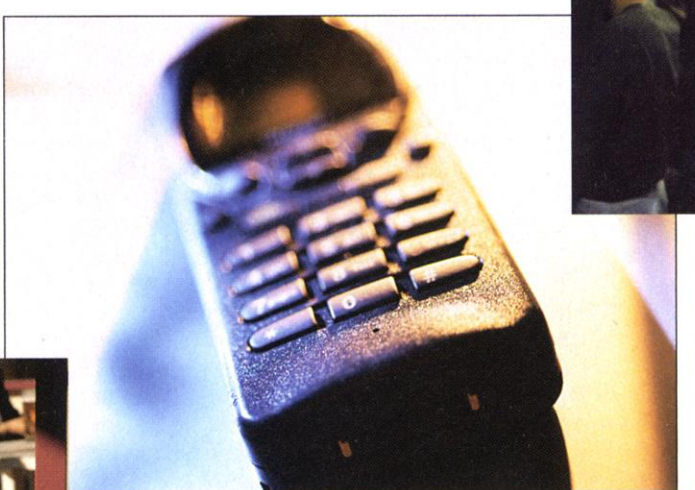
Evidence that radiation from cell phones increases the risk of brain cancer has not fared well in the court of scientific opinion; is it acceptable in the court of law?

# Cell Phone Lawsuits Face a Scientific Test

Christopher J. Newman, a 41-year-old Baltimore neurologist, began using a Motorola cell phone in 1992 to keep in touch with his patients. In 1998, he was diagnosed with a life-threatening brain tumor, which he concluded was caused by the phone. Two years later, he filed suit against Motorola and several other manufacturers and service providers seeking $720 million in compensation and punitive damages. Newman's tumor, the complaint reads, is "a direct and proximate result of the defective and unreasonably dangerous condition of the relevant products," which the manufacturers failed to prevent or warn him about.

Newman's case is not the first of its kind, but it represents an escalation in the battle over claims that public health is threatened by electromagnetic radiation from cell phones and other devices. It also marks the crest of a new wave of such lawsuits filed by plaintiff lawyers across the United States since last spring in Louisiana, Pennsylvania, New York, Maryland, and Georgia. And it could have broad implications for other cases, because it will use some new, science-based standards to determine whether these claims should be examined by the court.

The Newman case is being pursued by Baltimore superlawyer Peter Angelos, who is also behind some of the other lawsuits. Angelos, owner of the Baltimore Orioles, made a fortune in the 1980s suing asbestos companies on behalf of workers and headed Maryland's litigation against the tobacco industry. The Angelos team faces substantial challenges. In civil actions the burden of proof rests squarely on the plaintiff, and several complaints alleging phone-induced cancer have already been dismissed. Most of the human health studies completed so far have failed to find any harmful effects from cell phones, and most experts agree that the science remains uncertain. Newman's case, which is the closest to trial, will face a critical review on its scientific merits when it comes before a federal judge for a pretrial inquiry in Baltimore next January.



**Cause or coincidence?** Plaintiffs link cell phone use to a variety of cancers, although they can point to only scant epidemiological evidence.

Courts have been under increasing pressure to screen cases for merit and keep "junk science" from going before a jury, but they are moving at their own pace. Says David Faigman, a professor at the Hastings College of Law in San Francisco and author of *Legal Alchemy: The Use and Misuse of Science in the Law*, "We're very much in a transition period. The law has finally joined the scientific revolution, but it will be some time before the culture of science makes its way into the caverns of the law." All eyes will be on Baltimore to see whether the case will pass this crucial test.

### Judging the science

The opening salvo in the battle over cell phones took place during a TV show. On 21 January 1993, Florida businessman David Reynard announced on CNN's *Larry King Live* that he was suing the manufacturer of his wife's cell phone, along with the service carrier, because he believed that it had caused her fatal brain cancer. She had been using the phone for less than 1 year, but a magnetic resonance imaging scan showed her tumor to be, according to Reynard, "directly next to the antenna, and [it] seemed to be growing inward from that direction." Stocks of cellular phone companies dipped the following week, and the industry, in a gesture of concern, later agreed to put up $25 million for research on the health effects of cell phones.

But when pretrial maneuvering began in Reynard's case in 1995, the evidence proved insubstantial. Reynard had relied heavily on an expert witness named David Perlmutter, a neurologist who runs an alternative and complementary medicine clinic in Naples, Florida, and who had appeared with Reynard on talk shows. In a written statement, Perlmutter admitted that no studies had shown any adverse biological effects from cell phones, but he suggested that studies using animals and cell cultures "provide strong inferential data that use of this device represents a clear health hazard." The court dismissed the case, stating that Perlmutter's expert opinion "did not meet [the] *Daubert* standard for

CREDITS: (LEFT TO RIGHT) DAVID AND PETER TURNLEY/CORBIS; JOHN WILKES/CORBIS; WALTER HODGES/CORBIS

admissibility of scientific evidence."

This standard was established in the landmark 1993 U.S. Supreme Court ruling, *Daubert* v. *Merrell Dow Pharmaceuticals*. In that case, parents claimed that the use of a morning sickness drug had caused birth defects in their children, but their evidence was limited to a few animal studies and unpublished reanalyses of data from negative epidemiologic studies. The Supreme Court agreed to hear the case because the legal system had been grappling with the appropriate standards for admitting scientific testimony into the courtroom, particularly for "toxic tort" lawsuits. The *Daubert* decision, released just 5 months after Reynard appeared on the Larry King show, made judges responsible for ensuring that a scientific expert's testimony is based on evidence that is both reliable and relevant.

Legal reformers had been pushing for such changes for years, frustrated that any medical doctor could give an opinion in court about the causation of injury—even in the absence of evidence. In 1998, the Supreme Court raised the bar higher in the case of *General Electric Co.* v. *Joiner*, in which lung cancer was attributed to polychlorinated biphenyl exposure. The Supreme Court urged judges to analyze an expert's reasoning, conclusions, and the studies they are based on. It added that judges may exclude expert testimony when they "conclude that there is simply too great an analytical gap between the data and the opinion proffered."

Michael Green, an expert on product liability law and professor at Wake Forest University School of Law in Winston-Salem, North Carolina, affirms that "*Daubert* has made a sea change of difference." Last year, a study of expert testimony conducted by the Federal Judicial Center found that judges are holding more pretrial hearings on evidence and excluding more expert testimony than in the days before *Daubert*. In some cases, such as in the breast implant litigation, judges have even hired their own expert advisers (*Science*, 3 January 1997, p. 21).

**STUDIES TRACKING CAUSE OF DEATH IN CELL PHONE USERS**

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| Nancy A. Dreyer *et al.*, November 1999 | 285,561 U.S. cell phone subscribers | "The only category of cause of death for which there was an indication of increasing risk with increasing minutes of use was motor vehicle collisions." |
| Robert W. Morgan *et al.*, March 2000 | 195,775 Motorola employees | "We did not observe higher risk with increased exposure duration or latency." |
| Christoffer Johansen *et al.*, February 2001 | 420,095 Danish cell phone users linked to the Danish Cancer Registry | "No excesses were observed for cancers of the brain or nervous system." |

**STUDIES COMPARING CELL PHONE USE IN BRAIN CANCER PATIENTS AND CONTROLS**

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| Joshua Muscat *et al.*, December 2000 | 469 brain cancer patients and 422 controls | "No association with brain cancer was observed according to duration of use." |
| Peter D. Inskip *et al.*, January 2001 | 782 brain cancer patients and 799 controls | "There was no evidence that the risks were higher among persons who used cellular telephones 60 or more minutes per day or regularly for five or more years." |
| Lennart Hardell *et al.*, June 2001 (unpublished) | 1429 brain cancer patients and 1470 controls | "This study showed an increased risk for brain tumors among users of analog cellular telephones." |

### Gold standard

In the years since Reynard's lawsuit, results from several epidemiologic studies of cell phones and cancer have trickled in. Three studies released last winter amid much publicity failed to find any adverse effects. Two of them, one funded by the National Cancer Institute and one by the telecommunications industry, are based on interviews with several hundred brain cancer patients about their cell phone use and with controls who did not have cancer. The third, a massive Danish study, matched the names of 420,000 cell phone subscribers with the Danish Cancer Registry to determine whether they had an unusually high cancer rate; it also found no association. The *Journal of the National Cancer Institute* followed up with an editorial by physicist and junk-science warrior Robert L. Park of the University of Maryland, College Park, concluding that "we now have a convincing answer" to the question.

Courts and regulators generally consider epidemiologic studies such as these to be the gold standard for measuring human health risks. But they still drew criticism from some researchers. A major limitation in all of them, the authors admit, is that most of the subjects had been using their phones only for 1 to 3 years, whereas cancer takes 10 to 15 years to develop. Swedish epidemiologist Kjell Hansson Mild explains that in order to detect a modest increased cancer risk from cell phone use, "we need a long latency period and large numbers of people. A 10-year latency is what you should aim for."

CREDIT: (BOTTOM) JOSE GOITIA/AP

**Prime mover.** Baltimore attorney Peter Angelos has orchestrated a class action suit against cell phone–makers and service providers.

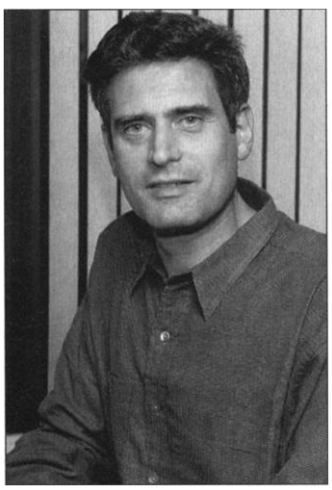
Critics have also questioned whether these studies measured exposure accurately. In the Danish study, all cell phone subscribers were categorized as "exposed," whether they used their phone only for emergencies or gabbed for hours at a time. Bruce Hocking, an Australian specialist in occupational medicine and former medical officer for an Australian telecommunications company, wrote in a letter to the *Journal of the National Cancer Institute* that some subscribers may also have used an earpiece or other device that kept the phone's antenna away from their head, leading to "appreciable imprecision" in the data.

One epidemiologic study, not yet published, has found an increased risk of benign brain tumors. In June, Mild and colleagues at Sweden's Örebro University announced at a conference in London that they had found a 35% increase in risk among 5-year subscribers, which rose to 77% among 10-year subscribers. The increase was seen only for analog phones, but, the researchers cautioned, the newer digital phones, which put out less radiation, might not have been around long enough for their effects to be seen. They also found an increase in malignant tumors, although it was not statistically significant.

Epidemiologic research would be much further along if it were not for another lawsuit that shut down a potentially

valuable study. With industry funding, epidemiologists Kenneth Rothman and Nancy Dreyer of the Epidemiology Research Institute (ERI) near Boston planned to cross-reference subscriber records of 300,000 cell phone users with the National Death Index. They hoped to compare the cause of death with the time the deceased had spent on the phone. But they were able to analyze only 1 year's worth of deaths, not enough to expect to see an effect, before a Chicago law firm claiming to represent 40 million cell phone users brought a class action lawsuit that halted their work in 1995.

The suit, which sought damages for alleged harm from cell phone use, claimed that the companies had conspired to thwart investigations into product safety. The suit also took aim at the ERI study, charging that industry and the researchers had invaded subscribers' privacy by accessing their phone records. Rothman and Dreyer's research remains on hold while the lawyers continue to fight over it. "The lawsuit is completely without any merit," says Rothman, "but it has been very effective in killing our study."



**Blocked.** Epidemiologist Kenneth Rothman's study of deaths among cell phone users was halted by a class action lawsuit.

Some researchers believe it will be at least a decade before consistent epidemiologic findings can settle the question either way. There are few shortcuts in epidemiology, and because cell phone technology changes (from analog to digital, for instance), the target itself may prove elusive. As Rothman wrote in *The Lancet* recently, "it is too soon for a verdict on the health risks from cellular telephones."

### Proof by other means?

The lack of positive epidemiological data has not put a brake on cell phone litigation. The Angelos team charges that cell phone firms have misrepresented data and "continue to manipulate science to the detriment of consumers by failing to reveal all relevant findings and by selectively withholding important public health information from the public." The group cites the work of Henry Lai and Narendra Singh of the University of Washington, Seattle, who have found DNA strand breaks in the brain cells of rats exposed to low-intensity electromagnetic radiation at 2450 megahertz, like that emitted by a mobile phone's antenna. However, the legal complaint fails to note that another group led by Robert S. Malyapa of Washington University in St. Louis, Missouri, has tried and failed to replicate that experiment.

For the Newman case, lawyers at Angelos's firm plan to call on Lai and seven other scientific experts. The group includes researchers who have appeared in previous scientific and legal disputes over health effects linked to power lines, microwaves, and cell phones. For example, Andrew Marino, a professor at Louisiana State University Health Sciences Center in Shreveport, who holds a Ph.D. in biophysics and a law degree, testified against the siting of power lines in New York state in the 1970s, arguing that they posed a human health hazard. And climatologist Neil Cherry of Lincoln University in Canterbury, New Zealand, has reanalyzed data from negative human studies of radar technicians to claim that increased cancer rates can be detected.

Given the negative epidemiologic findings, the debate will likely focus on laboratory studies of cell cultures and animals, such as the Lai and Singh work. The Angelos team also claims that research during the 1960s established that radio-frequency radiation —the portion of the electromagnetic spectrum that includes radiation from microwave ovens, radar, cell phones, and radio and television broadcasts— was "capable of producing biological injury." Physicist Allan Frey, a consultant to the Angelos team, helped pioneer this area of research through his studies of the effects of microwaves on the blood-brain barrier in animals. Because electromagnetic radiation is employed by many biological processes, he says, "it would be unbelievable to think that there would not be some effects. It is so fundamental to biology."

But other scientists are skeptical. "No physicist will say anything is impossible. But this is somewhere between implausible and impossible," says John Moulder, a professor of radiation oncology at the Medical College of Wisconsin in Milwaukee. Moulder has also been a consultant to parties in the ongoing lawsuits, although he would not say to whom. David Savitz, a professor and chair of epidemiology at the University of North Carolina School of Public Health in Chapel Hill, points out that earlier epidemiologic studies of radar workers have failed to find any human health effects from radio-frequency radiation. He says cautiously, "There is empirical evidence within certain bounds that there is not an adverse effect."

Even if a convincing case can be made that cell phones leave a biological imprint, some of Angelos's own experts admit that the link to brain cancer remains speculative. Epidemiologist Eli Richter of the Hadassah-Hebrew University Medical School in Jerusalem, who will testify for Newman, says of the animal studies, "None of these things prove causation. They just look at mechanisms of possible biological effects. It will be the epidemiology that will determine causation." Even Lai admits that the human health implications of short-term animal studies are uncertain. "The question is: Will cumulative exposures cause effects? We don't have an answer to that; there are not enough studies."

### Class actions

Perhaps acknowledging the difficulty of proving causation, a new wave of class action lawsuits filed this year, unlike the Newman case, does not claim that anyone actually developed cancer from a cell phone. Instead, the lawsuits allege a pattern of "fraudulent and conspiratorial conduct" and "deceitful and misleading statements." In particular, they claim that the cell phone industry failed to adequately test its products before putting them on the market and failed to warn consumers about possible health risks. These lawsuits demand that the industry provide all users with earpieces so that they can talk without holding the phones next to their heads.

However, plaintiffs in the class action lawsuits will still face the challenge of proving that cell phones pose a hazard. Most of these cases, including the Newman case, were initially filed in state courts. Because some states have not yet adopted *Daubert*, plaintiff lawyers may be hoping to benefit from a less rigorous review of their scientific claims. Many of the early skirmishes have been over where the cases will be heard, and some have already been moved to federal courts, where the *Daubert* standard is more likely to come into play.

Next January, if all goes according to schedule, lawyers in the Newman case will debate the science in a pretrial hearing before a Baltimore federal judge. If she finds that Newman's arguments pass the *Daubert* test, the case may get on track for a full-scale trial. If not, the case could effectively come to an end without ever reaching a jury. The hearing will be a critical challenge of Newman's claims, but more importantly, it will test the courts' new standard for vetting science. **–MARK PARASCANDOLA**

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