United States Government Accountability Office

GAO

Report to Congressional Requesters

July 2012

TELECOMMUNICATIONS

Exposure and Testing Requirements for Mobile Phones Should Be Reassessed

This Report Is Temporarily Restricted Pending Official Public Release.

G A O

Accountability * Integrity * Reliability

GAO-12-771

GAO
Accountability * Integrity * Reliability

Highlights

Highlights of GAO-12-771, a report to congressional requesters

July 2012

TELECOMMUNICATIONS

Exposure and Testing Requirements for Mobile Phones Should Be Reassessed

Why GAO Did This Study

The rapid adoption of mobile phones has occurred amidst controversy over whether the technology poses a risk to human health as a result of long-term exposure to RF energy from mobile phone use. FCC and FDA share regulatory responsibilities for mobile phones. GAO was asked to examine several issues related to mobile phone health effects and regulation. Specifically, this report addresses (1) what is known about the health effects of RF energy from mobile phones and what are current research activities, (2) how FCC set the RF energy exposure limit for mobile phones, and (3) federal agency and industry actions to inform the public about health issues related to mobile phones, among other things. GAO reviewed scientific research; interviewed experts in fields such as public health and engineering, officials from federal agencies, and representatives of academic institutions, consumer groups, and the mobile phone industry; reviewed mobile phone testing and certification regulations and guidance; and reviewed relevant federal agency websites and mobile phone user manuals.

What GAO Recommends

FCC should formally reassess and, if appropriate, change its current RF energy exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body. FCC noted that a draft document currently under consideration by FCC has the potential to address GAO's recommendations.

View GAO-12-771. For more information, contact Mark Goldstein at (202) 512-2834 or goldsteinm@gao.gov, or Marcia Crosse at (202) 512-7114 or crossem@gao.gov.

What GAO Found

Scientific research to date has not demonstrated adverse human health effects of exposure to radio-frequency (RF) energy from mobile phone use, but research is ongoing that may increase understanding of any possible effects. In addition, officials from the Food and Drug Administration (FDA) and the National Institutes of Health (NIH) as well as experts GAO interviewed have reached similar conclusions about the scientific research. Ongoing research examining the health effects of RF energy exposure is funded and supported by federal agencies, international organizations, and the mobile phone industry. NIH is the only federal agency GAO interviewed directly funding studies in this area, but other agencies support research under way by collaborating with NIH or other organizations to conduct studies and identify areas for additional research.

The Federal Communications Commission's (FCC) RF energy exposure limit may not reflect the latest research, and testing requirements may not identify maximum exposure in all possible usage conditions. FCC set an RF energy exposure limit for mobile phones in 1996, based on recommendations from federal health and safety agencies and international organizations. These international organizations have updated their exposure limit recommendation in recent years, based on new research, and this new limit has been widely adopted by other countries, including countries in the European Union. This new recommended limit could allow for more RF energy exposure, but actual exposure depends on a number of factors including how the phone is held during use. FCC has not adopted the new recommended limit. The Office of Management and Budget's instructions to federal agencies require the adoption of consensus standards when possible. FCC told GAO that it relies on the guidance of federal health and safety agencies when determining the RF energy exposure limit, and to date, none of these agencies have advised FCC to change the limit. However, FCC has not formally asked these agencies for a reassessment. By not formally reassessing its current limit, FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure. FCC has also not reassessed its testing requirements to ensure that they identify the maximum RF energy exposure a user could experience. Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit.

Federal agencies and the mobile phone industry provide information on the health effects of mobile phone use and related issues to the public through their websites and mobile phone manuals. The types of information provided via federal agencies' websites on mobile phone health effects and related issues vary, in part because of the agencies' different missions, although agencies provide a broadly consistent message. Members of the mobile phone industry voluntarily provide information on their websites and in mobile-phone user manuals. There are no federal requirements that manufacturers provide information to consumers about the health effects of mobile phone use.

Contents

Letter		1
	Background	4
	Research on RF Energy Exposure from Mobile Phones Has Not Demonstrated Adverse Health Effects, but More Studies Are Under Way	6
	FCC's RF Energy Exposure Limit May Not Reflect Latest Evidence on Thermal Effects, and Mobile Phone Testing Requirements May Not Identify Maximum Exposure	16
	Federal Agencies and Mobile Phone Industry Provide Information to the Public through Websites and User Manuals	24
	Conclusions	27
	Recommendations for Executive Action	28
	Agency Comments and Our Evaluation	28
Appendix I	Scope and Methodology	30
Appendix II	Studies GAO Reviewed	35
Appendix III	Comments from the Federal Communications Commission	39
Appendix IV	GAO Contacts and Staff Acknowledgments	41
Tables		
	Table 1: Ongoing NIH-Funded Studies on Health Effects of RF Energy Exposure from Mobile Phone Use	14
	Table 2: Federal Agency Website Information on Mobile Phones and Health as of June 2012	25
	Table 3: Subject Matter Experts Interviewed	32
	Table 4: Mobile Phone User Manuals Reviewed	34

Figures

Figure 1: The Electromagnetic Spectrum 5
Figure 2: U.S. Mobile Phone Certification Process 20
Figure 3: Photographs of Mobile Phone Testing near the Body 22

Abbreviations

ANSI	American National Standards Institute
CDC	Centers for Disease Control and Prevention
DNA	deoxyribonucleic acid
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FDA	Food and Drug Administration
IARC	International Agency for Research on Cancer
IEEE	Institute of Electrical and Electronics Engineers
NIH	National Institutes of Health
OSHA	Occupational Safety and Health Administration
RF	radio frequency
SAR	specific absorption rate
TCB	Telecommunication Certification Body

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.

GAO
Accountability * Integrity * Reliability
United States Government Accountability Office
Washington, DC 20548

July 24, 2012

The Honorable Henry A. Waxman
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Anna G. Eshoo
Ranking Member
Subcommittee on Communications and Technology
Committee on Energy and Commerce
House of Representatives

The Honorable Edward J. Markey
House of Representatives

Mobile phone use in the United States has risen dramatically over the last 20 years, and Americans increasingly rely on mobile phones as their sole or primary means of telephone communication.[1] The rapid adoption of mobile phones has occurred amidst controversy over whether the technology poses a risk to human health. Like other devices that transmit radio signals, mobile phones emit radio-frequency (RF) energy. At high power levels, RF energy can heat biological tissue and cause damage. Though mobile phones operate at power levels well below the level at which this thermal effect occurs, the question of whether long-term exposure to RF energy emitted from mobile phones can cause other types of adverse health effects, such as cancer, has been the subject of research and debate.

The Federal Communications Commission (FCC) and the Food and Drug Administration (FDA) share regulatory responsibilities for mobile phones. FCC, in compliance with the National Environmental Policy Act of 1969, regulates RF energy emitted from FCC-regulated transmitters, including mobile phones.[2] Toward that end, FCC has implemented a certification

[1]In this report, we use the term “mobile phone” to refer to handheld (i.e., wireless) cellular telephones, including newer personal communication devices, such as “smart phones,” that can deliver voice, data, and images.

[2]47 C.F.R. § 1.1307(b)(2).

program to ensure that all mobile phones sold in the United States comply with the agency's limit on RF energy exposure. This limit was designed to protect users from the thermal effects of acute exposure to RF energy. FDA is responsible for carrying out a program designed to protect public health and safety from electronic product radiation.[3] FDA does not review the safety of all radiation-emitting electronic products, such as mobile phones, before they are marketed. However, FDA has the authority to take action, such as requiring manufacturers to replace or recall mobile phones that are shown to emit RF energy at a level that is hazardous.[4] To date, FDA has not taken such action, but the agency regularly evaluates scientific studies on mobile phones and health to determine whether they raise public health questions.

In 2001, we reported on the status of scientific knowledge about potential health risks of RF energy exposure from mobile phones and the federal government's regulatory actions to ensure mobile phone safety.[5] We found that FDA and others had concluded that the research did not show RF energy exposure from mobile phones had adverse health effects, but more studies were needed. We also found that FCC had not issued standardized procedures for testing mobile phones and that FCC's and FDA's consumer materials could be improved. Since 2001, FCC has issued revised guidance for mobile phone testing, and both FCC and FDA have provided updated information to consumers about the health effects of mobile phone use.

At your request, we are updating information related to mobile phone health effects and regulatory issues. Specifically, this report addresses:

1. What is known about the human health effects of RF energy exposure from mobile phone use, and what are the current research activities of federal agencies and other organizations?
2. How has FCC set the RF energy exposure limit for mobile phones and how does FCC ensure compliance with the limit?

[3]21 U.S.C. §§ 360hh—360ss.

[4]21 U.S.C. § 360ll.

[5]GAO, *Telecommunications: Research and Regulatory Efforts on Mobile Phone Health Issues*, GAO-01-545 (Washington, D.C.: May 7, 2001).

3. What actions have federal agencies and the mobile phone industry taken to inform the public about issues related to mobile phone health effects?

To determine what is known about the human health effects of RF energy exposure from mobile phone use, we reviewed selected studies, including studies and reports that review and assess the scientific research as well as key individual studies. We identified these studies through literature searches in online databases, such as Embase and Medline, and interviews with officials from federal agencies, academic institutions, consumer groups, and industry associations. We also interviewed subject matter experts in a range of fields, such as public health and engineering. To determine the current research activities of federal agencies related to mobile phone use and health, we interviewed officials from FCC; the Department of Health and Human Services' FDA, Centers for Disease Control and Prevention (CDC), and National Institutes of Health (NIH); Department of Defense; Department of Labor's Occupational Safety and Health Administration (OSHA); and the Environmental Protection Agency (EPA). To determine the research activities of other organizations, we interviewed representatives of the International Agency for Research on Cancer (IARC), academic institutions, consumer groups, mobile phone industry associations, mobile phone manufacturers, and mobile phone providers. To determine how FCC set the RF energy exposure limit and ensures compliance with it, we reviewed FCC regulations and guidance. We also reviewed reports from international organizations that recommend RF energy exposure limits. We conducted interviews with officials from FCC and Telecommunication Certification Bodies (TCBs) to understand their role in certifying mobile phones. We also interviewed representatives of the mobile phone industry and consumer organizations, and experts in RF energy exposure limits to obtain their perspectives on the testing and certification of mobile phones. To determine the actions federal agencies and the mobile phone industry have taken to inform the public about issues related to mobile phone health effects, we reviewed information on the public websites of CDC, EPA, FCC, FDA, NIH, and OSHA. We also reviewed the user manuals for selected top-selling mobile phones of 2011 to identify the information manufacturers provided to consumers. (See app. I for more information on our scope and methodology and app. II for a list of studies we reviewed.)

We conducted this performance audit from August 2011 through July 2012 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to

obtain sufficient, appropriate evidence to provide reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The United States has experienced dramatic changes in mobile phone use since nationwide cellular service became available in the mid-1980s. For example, the number of estimated mobile phone subscribers has grown from about 3.5 million in 1989 to approximately 286 million by the end of 2009, according to the most recent data reported by FCC.[6] Further, the number of Americans who rely exclusively on mobile phones for voice service has increased in recent years. For example, by the end of 2009 over 50 percent of young adults aged 25 to 29 relied exclusively on mobile phones, according to the most recent FCC data.[7] The way individuals use mobile phones has also changed. For instance, while average minutes of use per mobile phone subscriber per month has declined in recent years, mobile text messaging traffic has increased.[8] About 88 percent of teenage mobile phone users now send and receive text messages, which is a rise from the 51 percent of teenagers who texted in 2006.[9]

Mobile phones are low-powered radio transceivers—a combination transmitter and receiver—that use radio waves to communicate with fixed installations, called base stations or cell towers. The radio waves used by mobile phones are a form of electromagnetic radiation—energy moving through space as a series of electric and magnetic waves. The spectrum of electromagnetic radiation comprises a range of frequencies from very low, such as electrical power from power lines, through visible light, to extremely high, such as gamma rays, as shown in figure 1. The portion of

[6]Federal Communications Commission, *Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Fifteenth Report (June 27, 2011).

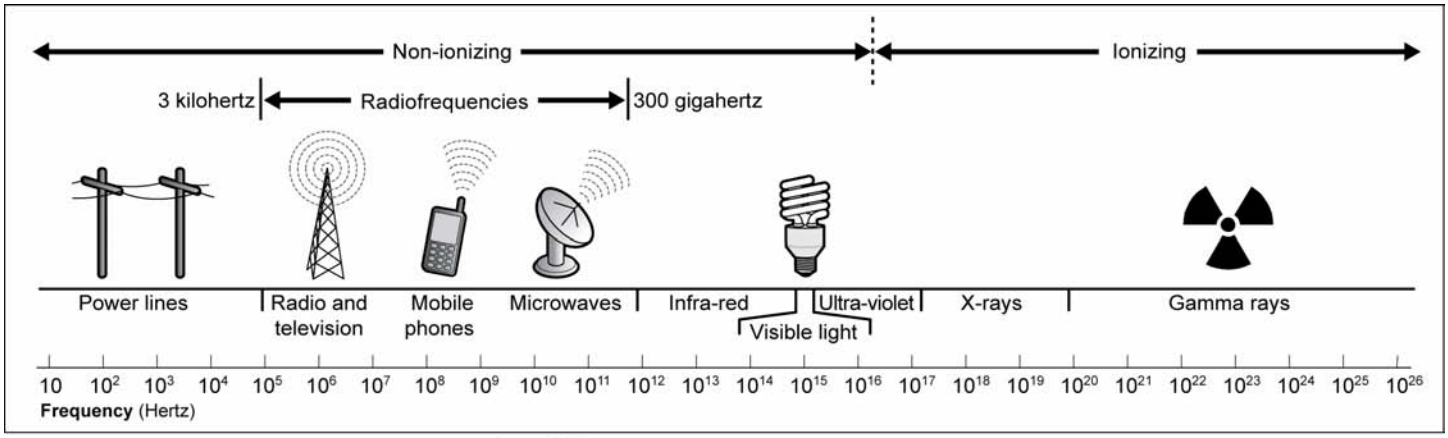
[7]*Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services* (2011).

[8]*Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services* (2011).

[9]Lenhart, A., et al, *Teens and Mobile Phones*, Pew Internet & American Life Project (April 20, 2010).

the electromagnetic spectrum used by mobile phones—as well as other telecommunications services, such as radio and television broadcasting—is referred to as the RF spectrum.

Figure 1: The Electromagnetic Spectrum



Source: FCC.

The electromagnetic spectrum includes ionizing and non-ionizing radiation. Ionizing radiation, such as gamma rays, has energy levels high enough to strip electrons from atoms and molecules, which can lead to serious biological damage, including the production of cancers. RF energy, on the other hand, is in the non-ionizing portion of the electromagnetic spectrum, which lacks the energy needed to cause ionization. However, RF energy can produce other types of biological effects. For example, it has been known for many years that exposure to high levels of RF energy, particularly at microwave frequencies, can rapidly heat biological tissue. This thermal effect can cause harm by increasing body temperature, disrupting behavior, and damaging biological tissue. The thermal effect has been successfully harnessed for household and industrial applications, such as cooking food and molding plastics. Since mobile phones are required to operate at power levels well below the threshold for known thermal effects, the mobile phone health issue has generally focused on whether there are any adverse health effects from long-term or frequent exposure to low-power RF energy emissions that are not caused by heating.

Research on RF Energy Exposure from Mobile Phones Has Not Demonstrated Adverse Health Effects, but More Studies Are Under Way

Scientific Research

Scientific research to date has not demonstrated adverse human health effects from RF energy exposure from mobile phone use, but additional research may increase understanding of possible effects. In 2001, we reported that FDA and others had concluded that research had not shown RF energy emissions from mobile phones to have adverse health effects, but that insufficient information was available to conclude mobile phones posed no risk.[10] Following another decade of scientific research and hundreds of studies examining health effects of RF energy exposure from mobile phone use, FDA maintains this conclusion. FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects. Officials from NIH, experts we interviewed, and a working group commissioned by IARC—the World Health Organization's agency that promotes international collaboration in cancer research—have reached similar conclusions. For example, in May 2011 IARC classified RF energy as "possibly

[10]GAO-01-545.

carcinogenic to humans."[11] IARC determined that the evidence from the scientific research for gliomas, a type of cancerous brain tumor, was limited—meaning that an association has been observed between RF energy exposure and cancer for which a causal relationship is considered to be credible, but chance, bias, or confounding factors could not be ruled out with reasonable confidence.[12] With respect to other types of cancers, IARC determined that the evidence was inadequate—meaning that the available studies are of insufficient quality, consistency, or statistical power to permit a conclusion about the causal association. Additionally, in April 2012 an advisory group to the Health Protection Agency—an independent organization established by the United Kingdom government to protect the public from environmental hazards and infectious diseases—concluded that although there is substantial research on this topic, there is no convincing evidence that RF energy below guideline levels causes health effects in adults or children.[13]

A broad body of research is important for understanding the health effects of RF energy exposure from mobile phone use, because no single study can establish a cause-and-effect relationship and limitations associated with studies can make it difficult to draw conclusions. Two types of studies, epidemiological and laboratory, are used in combination to examine effects from mobile phones. Epidemiological studies investigate the association, if any, between health effects and the characteristics of people and their environment. Laboratory studies conducted on test subjects—including human volunteers, laboratory animals, biological

[11]IARC's classification of RF energy is based on conclusions of an IARC working group of more than 30 scientists from 14 countries who reviewed the scientific evidence on the exposure to RF energy from personal devices, such as mobile phones and other sources. IARC published a summary of this working group's findings, see Baan, R., et al, "Carcinogenicity of Radiofrequency Electromagnetic Fields," *The Lancet Oncology,* 2011, 12(7): 624-626. According to IARC officials, the IARC Monograph containing the complete assessments of the working group will be published in fall 2012. IARC has five groups for classifying factors: 1—carcinogenetic to humans, 2A—probably carcinogenic to humans, 2B—possibly carcinogenic to humans, 3—not classifiable as to its carcinogenicity to humans, and 4—probably not carcinogenic to humans. As of July 11, 2012, IARC had classified 952 factors, of which 779 have been classified in groups 2B or 3. Factors classified in the 2B group include coffee and gasoline.

[12]IARC also determined that the evidence from the scientific research was limited for acoustic neuromas, a type of non-cancerous brain tumor.

[13]Health Protection Agency, *Health Effects from Radiofrequency Electromagnetic Fields,* RCE-20 (2012).

tissue samples, or isolated cells—are used to determine a causal relationship between possible risk factors and human health, and the possible mechanisms through which that relationship occurs.

Epidemiological Studies

Studies we reviewed suggested and experts we interviewed stated that epidemiological research has not demonstrated adverse health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have suggested a possible association with certain types of tumors, including cancerous tumors. Findings from one such study, the INTERPHONE study, were published in 2010.[14] This retrospective case-control study with more than 5,000 cases examined the association between mobile phone use and certain types of brain tumors, including cancerous tumors, in individuals aged 30-59 years in 13 countries.[15] Overall study findings did not show an increased risk of brain tumors from mobile phone use, but at the highest level of exposure, findings suggested a possible increased risk of glioma.[16] Other epidemiological studies have not found associations between mobile phone use and tumors, including cancerous tumors. For example, findings from a nationwide cohort study conducted in Denmark that originally followed 420,095 individuals did not show an association between increased risk for certain types of tumors, including cancerous

[14]This study was conducted at 16 research sites. Several publications are available on study findings from the individual research sites. Findings discussed here are the primary study findings published by the INTERPHONE Study Group. See The INTERPHONE Study Group, "Brain Tumour Risk In Relation To Mobile Telephone Use: Results of the INTERPHONE International Case-Control Study," *International Journal of Epidemiology*, 2010, 39: 675-694.

[15]A "case-control" study is a study that compares individuals with a particular disease or outcome—cases—to individuals without that disease or outcome—controls—to investigate if the outcome is associated with exposure to a specific factor. Case-control studies are sometimes called retrospective studies, because the outcome occurred before the study began.

[16]RF energy exposure levels from mobile phone use were measured in terms of (1) the number of years since first use, (2) cumulative number of calls, and (3) cumulative duration of calls. Analysis of the relationship between RF energy exposure and risk of four types of tumors—tumors of the brain including glioma and meningioma, acoustic nerve, and parotid gland—were done using these three measures. Individuals that fell into the highest level of exposure are those that reported 1,640 or more cumulative lifetime hours of mobile phone use, which ranged from less than 1 year to more than 10 years of use.

tumors, and mobile phone use.[17] Additionally, findings from a subset of the cohort—56,648 individuals with 10 or more years since their first mobile phone subscription—did not show an increased risk for brain and nervous system tumors.[18] Further, these findings did not change for individuals in the cohort with 13 or more years since their first mobile phone subscription.[19] Also, the CEFALO study—an international case-control study that compared children aged 7 to 19 diagnosed with certain types of brain tumors, including brain cancers, to similar children who were not diagnosed with brain tumors—found no relationship between mobile phone use and risk for brain tumors.[20] Findings from another study, which was conducted by NIH and examined trends in brain cancer incidence rates in the United States using national cancer registry data collected from 1992 to 2006, did not find an increase in new cases of brain cancer, despite a dramatic increase in mobile phone use during this time period.[21]

Limitations associated with epidemiological studies can make it difficult to draw definitive conclusions about whether adverse health effects are linked to RF energy exposure from mobile phone use. One such limitation is that it is difficult to measure and control for all variables that may affect results. For example, it can be difficult to accurately measure RF energy exposure from mobile phone use because humans are exposed to RF energy from many sources within their environments and mobile phone technology and user patterns frequently change. Also, epidemiological studies to date have been limited in their ability to provide information about possible effects of long-term RF energy exposure because the

[17]A "cohort" study is a study that follows a defined group of people—the cohort—over time. Outcomes of the people in subsets of the cohort are compared to examine if a particular intervention or factor is associated with a particular outcome. Cohort studies are sometimes called prospective studies, although they can be performed either retrospectively from historical records or prospectively.

[18]Schüz, J., et al, "Cellular Telephone Use and Cancer Risk: Update of a Nationwide Danish Cohort," *Journal of the National Cancer Institute,* 2006, 98(23):1707-1713.

[19]Frei, P., et al, "Use of Mobile Phones and Risk of Brain Tumours: Update of Danish Cohort Study," *British Medicine Journal,* 2011, 343: d6387.

[20]Aydin, D., et al, "Mobile Phone Use and Brain Tumors in Children and Adolescents: A Multicenter Case-Control Study," *Journal of the National Cancer Institute*, 2011, 103: 1-13.

[21]Inskip, P.D., Hoover, R.N., Devesa, S.S., "Brain Cancer Incidence Trends In Relation To Cellular Telephone Use In the United States," *Neuro-Oncology,* 2010, 12(11): 1147-1151.

prevalence of long-term mobile phone use is still relatively limited and some tumors, including some cancerous tumors, do not develop until many years after exposure. In addition, epidemiological studies, specifically cohort studies, are sometimes limited in their ability to provide information about increased risks for rare outcomes, such as certain types of brain tumors. To address challenges with assessing rare outcomes, case-control studies, which collect information about past mobile phone use among study participants, may be undertaken with large numbers of cases and controls. While these studies can potentially provide information on long-term use, and include enough cancer cases to examine whether this use is associated with rare diseases, collecting data in this way can introduce bias, such as recall bias, into study data and further limit findings. To mitigate this potential bias, some epidemiological studies, specifically cohort studies, follow large populations over time and collect data about mobile phone use before participants develop a certain outcome. In spite of these limitations, experts we spoke with told us that epidemiological studies are a key component of the body of research used for assessing the health effects of mobile phones.

Laboratory Studies

Studies we reviewed suggested and experts we interviewed stated that laboratory research has not demonstrated adverse human health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have observed effects on test subjects. Some laboratory studies have examined whether RF energy has harmful effects by exposing samples of human and animal cells to RF energy over a range of dose rates, durations, and conditions to detect any changes in cellular structures and functions. For example, some studies have examined the effects of RF energy on deoxyribonucleic acid (DNA) in rodent and human cells. While some of these studies found that RF energy exposure damaged DNA,[22] others

[22]For example see Nikolova, T., et al, “Electromagnetic Fields Affect Transcript Levels of Apoptosis-Related Genes In Embryonic Stem Cell-Derived Neural Progenitor Cells,” *The FASEB Journal*, 2005, 12: 1686-1688 and Diem, E., et al, “Non-Thermal DNA Breakage by Mobile-Phone Radiation (1800 MHz) In Human Fibroblasts and In Transformed GFSH-R17 Rat Granulosa Cells In Vitro,” *Mutation Research*, 2005, 583(2): 178-183.

failed to replicate such an effect using similar experimental conditions.[23] Other studies have exposed laboratory animals to RF energy, examined the animals for changes, and compared outcomes with a control group. For example, some studies have measured the behavior or cognitive functioning of rats to assess the neurological effects of RF energy.[24] According to some studies we reviewed, while some of these studies have observed changes in behavior and cognitive function, overall, these studies have not consistently found adverse effects from RF energy levels emitted from mobile phones. Laboratory studies also have exposed human volunteers to RF energy to investigate possible effects, such as effects on the neurological system or blood pressure. According to studies we reviewed, some studies on human volunteers have observed changes, such as changes in brain activity, but the implications of these physiological changes in relation to adverse effects on human health are unknown.[25]

Limitations associated with laboratory studies can make it difficult to draw conclusions about adverse human health effects from RF energy exposure from mobile phone use. For example, studies conducted on laboratory animals allow researchers to examine the effects of RF energy exposure on animal systems, but this type of research is limited because effects on laboratory animals may not be the same on humans. Additionally, studies on test subjects may observe biological or physiological changes, but in some circumstances it is unclear how or even if these changes affect human health. Further, to increase the strength of the evidence that observed changes in laboratory studies are

[23]For example see Speit, G., Schütz, P., Hoffmann, H., "Genotoxic Effects of Exposure To Radiofrequency Electromagnetic Fields (RF-EMF) In Cultured Mammalian Cells Are Not Independently Reproducible," *Mutation Research*, 2007, 626(1-2): 42-47 and Hook, G.J., et al, "Measurement of DNA Damage and Apoptosis In Molt-4 Cells After In Vitro Exposure To Radiofrequency Radiation," *Radiation Research*, 2004, 161(2):193-200.

[24]For example see Kumlin T., et al, "Mobile Phone Radiation and the Developing Brain: Behavioral and Morphological Effects in Juvenile Rats," *Radiation Research*, 2007, 168(4): 471-479 and Nittby, H., et al, "Cognitive Impairment in Rats After Long-Term Exposure to GSM-900 Mobile Phone Radiation," *Bioelectromagnetics*, 2008, 29(3): 219-232.

[25]For example see Volkow, N.D., et al, "Effects of Cell Phone Radiofrequency Signal Exposure on Brain Glucose Metabolism," *Journal of the American Medical Association*, 2011, 305(8): 808-813 and Regel, S.J., et al, "Pulsed Radio-Frequency Electromagnetic Fields: Dose-Dependent Effects on Sleep, the Sleep EEG and Cognitive Performance," *Journal of Sleep Research*, 2007, 16: 253-258.

the effect of RF energy exposure, studies must be replicated and confirmed with additional research using different dose rates, durations, and conditions of RF energy while observing similar effects. To date, according to FDA officials and some experts we interviewed, only a few laboratory studies that have shown effects from RF energy have been replicated, and some replicated studies have not confirmed earlier results.

Areas for Additional Research

Studies we reviewed and experts we interviewed identified key areas for additional epidemiological and laboratory studies, and according to experts, additional research may increase understanding of any possible effects. For example, additional epidemiological studies, particularly large long-term prospective cohort studies and case-control studies on children, could increase knowledge on potential risks of cancer from mobile phone use. Also, studies and experts identified several areas for additional laboratory studies. For example, additional studies on laboratory animals as well as human and animal cells examining the possible toxic or harmful effects of RF energy exposure could increase knowledge on potential biological and health effects of RF energy. Further, additional laboratory studies on human and animal cells to examine non-thermal effects of RF energy could increase knowledge of how, if at all, RF energy interacts with biological systems. However, some experts we spoke to noted that, absent clear evidence for adverse health effects, it is difficult to justify investing significant resources in research examining non-thermal effects of RF energy from mobile phone use. Another area identified for additional laboratory research is studies on human volunteers examining the effect of changes in the neurological system, which could help determine if these possible observed changes in neurological functioning from RF energy are adverse effects. In addition to conducting additional research, experts we interviewed reported that the broader body of evidence on RF energy should be re-evaluated when findings from key studies become available, to determine whether additional research in certain areas is still warranted.

Current Research Activities

Current research activities of federal agencies, international organizations, and the mobile phone industry include funding and supporting ongoing research on the health effects of RF energy exposure from mobile phones. NIH is the only federal agency we interviewed that is directly funding ongoing studies on health effects of RF energy from mobile phone use. NIH officials reported that the agency has provided about $35 million for research in this area from 2001 to 2011. (See table 1 for more information on ongoing studies funded by NIH.) Although other federal agencies are not directly funding research in this area, some

agencies are providing support for ongoing studies. For example, FDA officials reported that FDA's National Center for Toxicological Research, with funding provided by NIH as part of the National Toxicology Program, is conducting studies on rat and bovine brain cells to examine whether RF energy emitted from mobile phones is toxic.[26] Also, CDC officials reported that the agency is collaborating with others to conduct ongoing studies in this area. For example, CDC officials reported that one of the agency's staff is collaborating with researchers in seven countries to conduct additional analyses on data collected through the INTERPHONE study to determine whether occupational exposure to RF energy and chemicals was a risk factor for brain cancer.

[26]The National Toxicology Program is an interagency program that evaluates factors, such as RF energy, that could affect public health for the federal government. The three core federal agencies that make-up this program are NIH's National Institute of Environmental Health Sciences, CDC's National Institute for Occupational Safety and Health, and FDA's National Center for Toxicological Research. The National Toxicology Program is conducting comprehensive carcinogenicity studies on laboratory animals. Collectively these studies will provide information about potential human health effects of RF energy exposure.

Table 1: Ongoing NIH-Funded Studies on Health Effects of RF Energy Exposure from Mobile Phone Use

Description	NIH institute funding the study	Total NIH funding	Estimated year of completion
Examining environmental and genetic factors for meningioma, a type of brain tumor, at research sites in five states	National Cancer Institute	$8,779,998	2012
Evaluating brain cancer incidence trends in the United States using cancer registry data to determine if trends are consistent with reported epidemiological associations of mobile phone use and certain types of cancer	National Cancer Institute	Not applicable[a]	Not applicable[a]
Examining effects of mobile phones on brain glucose	National Institute on Alcohol Abuse and Alcoholism	$595,700	2012
Examining effects of exposure to mobile phones in childhood on the central nervous system using children in the Danish National Birth Cohort[b]	National Institute of Environmental Health Sciences	$423,500	2012
Examining toxicology and carcinogenic effects of RF energy in laboratory animals as part of the National Toxicology Program[c]	National Institute of Environmental Health Sciences	$25,600,000	2015

Source: GAO analysis of NIH information.

[a]The National Cancer Institute regularly monitors and evaluates the U.S. brain cancer incidence trends using Surveillance Epidemiology and End Result data. According to NIH officials, the National Cancer Institute does not separately track funding associated with performing this task. The most recent publication of data from this surveillance activity was published in 2012. See Little, M.P., et al, "Mobile Phone Use and Glioma Risk: Comparison of Epidemiological Study Results With Incident Trends In the United States," *British Medical Journal*, 2012, 344: e1147.

[b]The Danish National Birth Cohort consists of over 100,000 Danish children who were born from 1996 to 2002. Data on lifestyle factors, dietary habits, and environmental exposures have been collected on these children, and data on current mobile phone use by children have been collected since these children reached the age of seven.

[c]The National Toxicology Program is an interagency program that evaluates factors, such as RF energy, that could affect public health for the federal government. The three core federal agencies that make-up this program are NIH's National Institute of Environmental Health Sciences, CDC's National Institute for Occupational Safety and Health, and FDA's National Center for Toxicological Research. The National Toxicology Program is conducting comprehensive carcinogenicity studies on laboratory animals. According to FDA officials, FDA is conducting one of these National Toxicology Program studies in its National Center for Toxicological Research laboratory.

Federal agencies are also engaged in other activities to support research on the health effects of mobile phone use. For example, FDA collaborates with other organizations on research-related projects. According to FDA officials, the agency helped the World Health Organization develop its *WHO Research Agenda for Radiofrequency Fields* in 2001 and has provided comments to the World Health Organization on updates to this

research agenda.[27] Also, officials from federal agencies that have responsibility for different aspects of RF energy safety and work—CDC, EPA, FCC, FDA, NIH, the National Telecommunications and Information Administration, and OSHA—are members of the Radiofrequency Interagency Work Group, which works to share information on RF energy related projects at the staff level. According to FCC and FDA officials, this group periodically meets to discuss RF energy related issues, including recently published and ongoing research on the health effects of RF energy exposure.

International organizations also support research on health effects of RF energy exposure from mobile phone use. Officials from IARC told us that the organization is currently supporting research activities for ongoing studies examining health effects of mobile phone use with respect to cancer. For example, IARC is involved in the identification of research sites for and implementation of the COSMOS study—a large international, prospective, cohort study that will follow individuals for 25 or more years to examine possible long-term health effects of using mobile phones, such as brain tumors, including cancers, and other health outcomes. IARC is also coordinating additional data analyses on previously published studies examining mobile phone health effects. For example, IARC is coordinating additional analyses of data collected for the INTERPHONE study. Additionally, the European Commission—the European Union's executive body that represents the interest of Europe as a whole—is supporting research in this field. Under its research program—the Seventh Framework Programme—the European Commission has provided funds for the MOBI-KIDS study, an international case-control study examining the possible association between communication technology, including mobile phones and other environmental exposures, and the risk of brain tumors in people aged 10 to 24 years.

The mobile phone industry supports research by providing funding for studies. According to representatives from mobile phone manufacturers, service providers, and industry associations, most industry funding for scientific research is provided by the Mobile Manufacturers Forum—an international not-for-profit association that is largely comprised of wireless

[27]The World Health Organization most recently updated this research agenda in 2010. See The World Health Organization, *WHO Research Agenda for Radiofrequency Fields*, Geneva, Switzerland (2010).

device manufacturers. According to representatives from the Mobile Manufacturers Forum, the association has provided about $46 million for RF energy research since 2000 and is currently providing support for epidemiological and laboratory studies. Although representatives from all four mobile phone manufacturers that we interviewed reported that their companies support research through their industry associations, representatives from one manufacturer reported that it is also funding two studies examining the effects of RF energy emitted from mobile phones on human hands and the head.

FCC's RF Energy Exposure Limit May Not Reflect Latest Evidence on Thermal Effects, and Mobile Phone Testing Requirements May Not Identify Maximum Exposure

RF Energy Exposure Limit

In 1996, FCC adopted the RF energy exposure limit for mobile phones of 1.6 watts per kilogram, averaged over one gram of tissue, a measurement of the amount of RF energy absorbed into the body.[28] FCC developed its limit based on input from federal health and safety agencies as well as the 1991 recommendation by the Institute of Electrical and Electronics Engineers (IEEE) that was subsequently approved and issued in 1992 by the American National Standards Institute (ANSI).[29] This recommended limit was based on evidence related to the thermal effects

[28]61 Fed. Reg. 41017, August, 7, 1996. This measurement is called the specific absorption rate (SAR) and is the widely accepted measurement of RF energy absorbed into the body in watts per kilogram, averaged over an amount of tissue ranging from the entire body to one gram.

[29]See IEEE Std. C95.1-1991 and 47 CFR Sec. 2.1093(d)(2).

of RF energy exposure[30]—the only proven health effects of RF energy exposure—and was set at a level well below the threshold for such effects. FCC noted that the limit provided a proper balance between protecting the public from exposure to potentially harmful RF energy and allowing industry to provide telecommunications services to the public in the most efficient and practical manner possible.

In 2006, IEEE published its updated recommendation for an RF energy exposure limit of 2.0 watts per kilogram, averaged over 10 grams of tissue.[31] This new recommended limit could allow for more RF energy exposure from mobile phone use, although actual exposure depends on a number of factors, including the operating power of the phone, how the phone is held during use, and where it is used in proximity to a mobile phone base station.[32] According to IEEE, improved RF energy research and a better understanding of the thermal effects of RF energy exposure on animals and humans, as well as a review of the available scientific research, led to the change in recommended RF energy exposure limit. IEEE's new recommended limit was harmonized with a 1998 recommendation of the International Commission on Non-Ionizing Radiation Protection, which has been adopted by more than 40 countries, including the European Union countries.[33] Both of these recommendations call for an exposure limit of 2.0 watts per kilogram averaged over 10 grams of tissue, which according to IEEE represents a scientific consensus on RF energy exposure limits.

[30]In scientific tests, animals had adverse behavioral effects once they absorbed enough RF energy to increase their body temperature by 1 degree Celsius. IEEE incorporated a safety factor into its standards for general human exposure by setting them at one-fiftieth the exposure shown to cause adverse effects in animals. Because this limit is based on whole-body exposure, it was further adjusted to account for the fact that mobile phones expose only a part of the body to RF energy.

[31]See IEEE Std. C95.1-2005.

[32]The output power of a phone is variable, using the minimum necessary for successful communication, and at any time will be a function of distance to the nearest mobile phone antenna and the presence of obstructions.

[33]See International Commission on Non-Ionizing Radiation Protection, *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)* (1998). The International Commission on Non-Ionizing Radiation Protection is an independent scientific organization that provides guidance and advice on the health hazards of non-ionizing radiation exposure. Its recommended exposure limit is for frequencies up to 10 gigahertz. The IEEE recommendation was made for frequencies between 100 kilohertz and 3 gigahertz.

According to senior FCC officials, the agency has not adopted any newer limit because federal health and safety agencies have not advised them to do so. FCC officials told us that they rely heavily on the guidance and recommendations of federal health and safety agencies when determining the appropriate RF energy exposure limit and that, to date, none of these agencies have advised FCC that its current RF energy limit needs to be revised. Officials from FDA and EPA told us that FCC has not formally asked either agency for an opinion on the RF energy limit. FDA officials noted, though, that if they had a concern with the current RF energy exposure limit, then they would bring it to the attention of FCC.

Although federal guidance states that agencies should generally use consensus standards, FCC officials provided reasons why they did not have current plans to change the RF energy exposure limit. Office of Management and Budget Circular A-119 concerning federal use of technical standards states that federal agencies must use "consensus standards in lieu of government-unique standards," except where inconsistent with law or otherwise impractical. FCC officials noted that no determination has been made that the new recommended RF energy exposure limit is inconsistent with law or impractical. FCC has recognized that research on RF energy exposure is ongoing and pledged to monitor the science to ensure that its guidelines continue to be appropriate.[34] FCC officials noted that an assessment of the current limit and the new recommended limit could be accomplished through a formal rulemaking process, which would include a solicitation of information and opinions from federal health and safety agencies.[35] FCC could alternatively release a Notice of Inquiry to gather information on this issue without formally initiating rulemaking.

Stakeholders we spoke with varied on whether the current U.S. RF energy exposure limit should be changed to reflect the new recommended limit. For instance, a few experts and consumer groups we spoke with said FCC should not adopt the new recommended exposure

[34]In re Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, 11 FCC Rcd 15123, 15125 (1996).

[35]FCC's rulemaking process includes multiple steps as outlined by law, with several opportunities for public participation. FCC generally begins the process by releasing a Notice of Proposed Rulemaking and establishing a docket to gather information submitted by the public or developed within FCC to support the proposed rule. FCC analyzes information in the docket and drafts a final rule.

limit because of the relative uncertainty of scientific research on adverse health effects from mobile phone use. An official from one consumer group told us that adopting the 2.0 watts per kilogram exposure limit would be a step back, since it could allow users to be exposed to higher radiation levels. Conversely, some experts we spoke with maintained that both the 1.6- and 2.0-watts-per-kilogram limits protect users from the thermal effects of RF energy exposure—which the experts maintained are the only conclusively demonstrated effects of exposure—since a safety factor of fifty was applied to obtain the limits, meaning that the maximum permitted exposure is a fiftieth of what was determined to be the exposure at which potentially deleterious thermal effects are likely to occur.

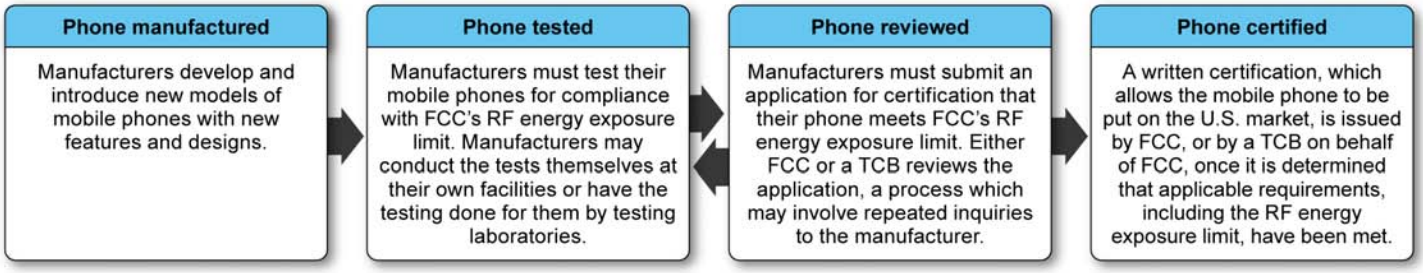
Nevertheless, by not formally reassessing its current RF energy exposure limit, FCC cannot ensure that it is using a limit that reflects the latest evidence on thermal effects from RF energy exposure, and may impose additional costs on manufacturers and limitations on mobile phone design. FCC's current limit was established based on recommendations made more than 20 years ago. According to IEEE, the new recommended limit it developed is based on significantly improved RF research and therefore a better understanding of the thermal effects of RF energy exposure. Additionally, three of the four mobile phone manufacturers we spoke with favored harmonization of RF energy exposure limits, telling us that maintaining the separate standards can result in additional costs and may affect phone design in a way that could limit performance and functionality. According to some manufacturers we spoke with, many of their phones are sold in multiple countries. As a result, the manufacturers have to develop and test phones based on different exposure limits, which can require additional resources and slow the time it takes to get new phones into the market. Additionally, one manufacturer indicated that some features are not enabled on phones sold in the United States that are available in other countries to comply with FCC's current limit. A reassessment by FCC would help it to determine if any changes to the limit are appropriate.

Mobile Phone Certification

FCC ensures compliance with its RF energy exposure limit by certifying all mobile phones sold in the United States. In its application for certification, manufacturers must provide evidence that their mobile phones meet FCC's RF energy exposure limit. FCC has authorized 23 TCBs in the United States and other countries to review applications that involve evaluation of RF exposure test data and issue certifications on behalf of the agency. TCBs are private organizations that have been

accredited to perform these functions.[36] TCBs now perform the majority of mobile phone certifications, with FCC generally only handling the more complex certifications, such as mobile phones with multiple transmitters using third generation and fourth generation technology.[37] Figure 2 illustrates the mobile phone certification process.

Figure 2: U.S. Mobile Phone Certification Process



Source: GAO.

Representatives from mobile phone manufacturers we spoke with were generally satisfied with how TCBs review and certify mobile phones, but noted that complex certifications handled by FCC can take a long time to process. For instance, since there are generally no established test procedures for new technologies, FCC must work with the manufacturer to develop appropriate procedures by which the agency can determine if the device meets the RF energy exposure limit. According to FCC, part of this review may result in changes to testing guidance. For example, representatives from one manufacturer told us that FCC may take many months to process an application for a newer product. FCC officials told us that over the last 10 years, the average time to review an application

[36]In 1999, FCC established a TCB program and requested that the National Institute of Standards and Technology accredit entities to perform TCB functions. The National Institute of Standards and Technology determined, in accordance with its procedures and in consultation with the FCC, that it would recognize qualified accreditation bodies to accredit TCBs. Subsequently, the National Institute of Standards and Technology approved ANSI in May 2000 and the American Association for Laboratory Accreditation in April 2007 as accreditation organizations for TCBs. These accreditation bodies assess new and current TCBs to ensure they comply with relevant requirements.

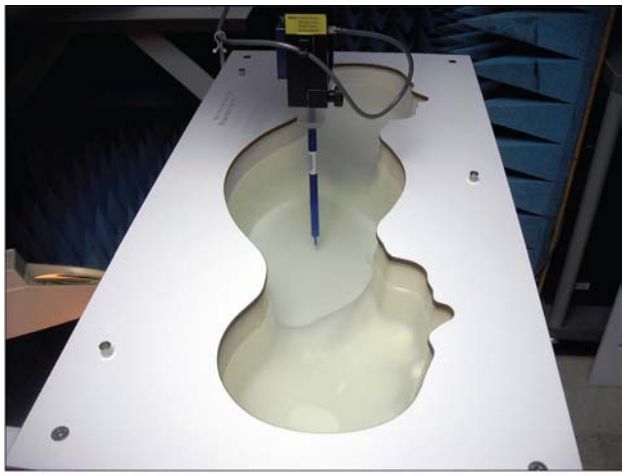
[37]According to FCC, third and fourth generation mobile phone technologies allow consumers to access a variety of different services and functionalities, such as Web browsing, e-mail, access to application stores, video conference or chat, mapping and navigation systems, mobile commerce, and the downloading of content.

submitted directly to the agency has ranged from 45 to 60 days. Representatives from one TCB we spoke with noted that the TCB review can be as short as a week, though FCC does not collect data on how long it takes TCBs to process applications.

Mobile Phone Testing

To ensure that mobile phones comply with FCC's RF energy exposure limit, manufacturers conduct tests at their own laboratories or have the testing conducted for them by private laboratories. Laboratories must follow standardized FCC testing procedures or work with FCC to develop acceptable alternatives in some complex cases. These procedures require that the SAR be measured to ensure the mobile phone's compliance with the FCC exposure limit, which was designed to ensure that mobile phones do not expose the public to levels of RF energy that could be potentially harmful. FCC periodically updates the testing procedures as new mobile phone technology is introduced. A typical testing set-up is shown in figure 3.

Figure 3: Photographs of Mobile Phone Testing near the Body



Source: GAO.

Source: GAO.

Note: To test mobile phones, a mold in the shape of an adult torso and head is filled with fluid mixture designed to simulate the electrical properties of human tissue. A phone is placed near the head or torso (the torso, or body, testing is illustrated above) and operated at maximum power. A probe attached to a computer-controlled mechanical arm is inserted into the mixture at various locations to measure SAR. This procedure is repeated for a number of closely specified phone positions and operating frequencies. To receive FCC certification, none of the SAR measurements can exceed FCC's exposure limit of 1.6 watts per kilogram.

FCC has implemented standardized testing procedures requiring mobile phones to be tested for compliance with the RF energy exposure limit when in use against the ear and against the body while in body-worn

accessories, such as holsters, but these requirements may not identify the maximum exposure under other conditions.[38] The specific minimum separation distance from the body is determined by the manufacturer (never to exceed 2.5 centimeters), based on the way in which the mobile phone is designed to be used.[39] The results of these testing requirements are two different values: a maximum SAR value for the head and a maximum SAR value for the body. However, these testing procedures may not identify the maximum SAR for the body, since some consumers use mobile phones with only a slight distance, or no distance, between the device and the body, such as placing the phone in a pocket while using an ear piece. Using a mobile phone in this manner could result in RF energy exposure above the maximum body-worn SAR determined during testing, although that may not necessarily be in excess of the FCC's limit. In such a case, exposure in excess of FCC's limit could occur if the device were to transmit continuously and at maximum power.

FCC has not reassessed its testing requirements to ensure that testing identifies the maximum RF energy exposure for the other usage conditions a user could experience when mobile phones are in use without body-worn accessories or as advised by the manufacturer's instructions, rather than the head. Although FCC officials said that they provide case-by-case guidance for many mobile phones operating with new technologies, they do not require testing of mobile phones when used without body-worn accessories unless such conditions are specifically identified by the manufacturer's operating instructions. Representatives of some consumer groups we spoke with expressed concern about the exposure to RF energy that can come with such use. Officials from IEEE, though, told us that the average power and resultant radiation level of mobile phones while in use is very low, such that even when a mobile phone is used against the body it is unlikely that the RF energy exposure would exceed the FCC limit. Nevertheless, FCC has not

[38]These procedures were based on IEEE Std. 1528-2003. Because mobile phones are not tested when in use directly against the body, FCC recommends that mobile phone user manuals note that a minimum separation distance must be maintained between the user's body and the phone to comply with RF exposure limits.

[39]FCC guidance states that mobile phone body-worn tests should be conducted with belt-clips and holsters attached to the phone and positioned against the flat surface of the mold in normal use configurations. If the manufacturer does not supply these accessories, a predetermined distance from the back of the mobile device to the flat surface of the mold is recommended.

reassessed its testing requirements to ensure that mobile phones do not exceed the RF energy exposure limit in all possible usage conditions.

Beyond the testing required for certification, FCC also ensures that mobile phones meet its RF energy exposure limit by reviewing information collected as part of routine surveillance of mobile phones on the market. FCC requires TCBs to carry out this post-market surveillance program, through which each TCB tests one percent of the mobile phones they have certified for RF energy exposure, to ensure that the phones continue to meet FCC's RF energy exposure limit.[40] According to FCC, no mobile phone tested under this surveillance program has been found in violation of the RF energy exposure limit.

Federal Agencies and Mobile Phone Industry Provide Information to the Public through Websites and User Manuals

Information Provided by Federal Agencies

Federal agencies provide information to the public on the health effects of mobile phone use and related issues primarily through their websites. This information includes summaries of research, and agencies' conclusions about the health effects of mobile phone use, as well as suggestions for how mobile phone users can reduce their exposure to RF energy. Table 2 summarizes selected information on mobile phones and health provided by six federal agencies on their websites.

[40]Testing may be performed at either the TCB's testing facilities or at a subcontracted test facility.

Table 2: Federal Agency Website Information on Mobile Phones and Health as of June 2012

Types of information provided	Agency
What RF energy or radiation is	CDC, EPA, FCC, FDA, NIH, OSHA
Current mobile phone RF energy exposure limits	CDC, FCC, OSHA
How mobile phones are tested or certified	FCC
Thermal effects of RF energy exposure	CDC, FCC, NIH, OSHA
Non-thermal effects of RF energy exposure	CDC, FCC, OSHA
Health issues and research related to mobile phones	CDC, FCC, FDA, NIH, OSHA
Summaries or links to ongoing studies	CDC, FDA, NIH
Information on how to minimize or reduce RF energy exposure from mobile phone use	CDC, EPA, FCC, FDA, NIH, OSHA

Source: GAO analysis of federal agency websites.

Note: Some federal agency websites include additional information on mobile phones and health beyond the major topics listed above.

The types of information that federal agencies' websites provide on mobile phone health effects and related issues vary, in part because of the agencies' different missions, though the websites provide a broadly consistent message. For instance, NIH primarily provides information about the research on health effects of RF energy exposure from mobile phone use, while FCC provides information on how mobile phones are tested and certified. Nevertheless, the concluding statements about whether RF energy exposure from mobile phone use poses a risk to human health are generally consistent across selected federal agencies' websites that we reviewed, though the specific wording of these concluding statements varies.

Representatives from some consumer groups and experts we spoke with raised concerns that the information on federal agency websites about mobile phone health effects is not precautionary enough, among other things. In particular, these representatives and experts said that federal agencies should include stronger precautionary information about mobile phones because of the uncertain state of scientific research on mobile phone health effects as well as the fact that current testing requirements may not identify the maximum possible RF energy exposure. Representatives from one consumer group also said that federal agency websites should provide more consumer information, such as the impact of different mobile phone technologies on RF energy exposure. Officials from FCC and NIH maintained that the information on their websites reflects the latest scientific evidence and provides sufficient information for consumers concerned about potential health effects related to mobile phones.

Some consumer groups noted that they would like FCC to mention IARC's recent classification of RF energy exposure as "possibly carcinogenic" on FCC's website. FCC noted that it generally defers to the health and safety agencies for reporting on new research, though FCC's website did include information on the recent INTERPHONE study when we reviewed the site in June 2012. FCC does provide links to CDC, EPA, FDA, and other websites, some of which have information about the IARC's classification.[41] FDA notes on its website that the IARC classification means there is limited evidence showing RF carcinogenicity in humans and insufficient evidence of carcinogenicity in experimental animals.

Some local governments are taking steps to provide precautionary information to consumers. For example, the city of San Francisco has developed a Web page on mobile phone health issues, including steps to reduce RF energy exposure from mobile phone use, and has passed an ordinance requiring local mobile phone retailers to distribute a flyer on ways that consumers can reduce their exposure.[42]

Information Provided by Mobile Phone Industry

The mobile phone industry provides information to consumers on the health effects of mobile phone use and related issues through user manuals and websites. The information provided in user manuals by manufacturers is voluntary, as there are no federal requirements that manufacturers provide any specific information to consumers about the health effects of mobile phone use.[43] Most manuals we reviewed provide information about how the device was tested and certified, as well as the highest energy exposure measurement associated with the device. Some manufacturers also provide suggestions, often based on information from FDA, to consumers about how to minimize their exposure, among other things.

[41]FCC's links to the EPA and FDA websites were not functional when we reviewed them in April 2012. After we provided our draft report to FCC these links were fixed and were functional as of July 2012.

[42]The ordinance has been challenged in federal court. The case is currently being considered by the U.S. Court of Appeals for the 9th Circuit.

[43]FCC does require a statement that the mobile phone complies with the agency's RF energy exposure limit, among other things. 47 CFR § 2.1077.

All manuals we reviewed, except one, include a statement that, when used on the body, as opposed to against the ear, a minimum distance between the body and the mobile phone should be maintained. These distances ranged from 1.5 to 2.5 centimeters. Since all mobile phones are tested for RF energy exposure compliance at a distance from the body, as discussed previously in this report, these instructions are consistent with how the devices were tested and certified by FCC. Some consumer groups and experts we spoke with noted that consumers could be unaware of these instructions if they do not read the entire user manual.

Conclusions

FCC's current RF energy exposure limit for mobile phones, established in 1996, may not reflect the latest evidence on the thermal effects of RF energy exposure and may impose additional costs on manufacturers and limitations on mobile phone design. FCC regulates RF energy emitted from mobile phones and relies on federal health and safety agencies to help determine the appropriate RF energy exposure limit. However, FCC has not formally asked FDA or EPA for their assessment of the limit since 1996, during which time there have been significant improvements in RF energy research and therefore a better understanding of the thermal effects of RF energy exposure. This evidence has led to a new RF energy exposure limit recommendation from international organizations. Additionally, maintaining the current U.S. limit may result in additional costs for manufacturers and impact phone design in a way that could limit performance and functionality. Reassessing its current RF energy exposure limit would ensure that FCC's limit protects the public from exposure to RF energy while allowing industry to provide telecommunications services in the most efficient and practical manner possible.

The current testing requirements for mobile phones may not identify the maximum RF energy exposure when tested against the body. FCC testing requirements state that mobile phone tests should be conducted with belt-clips and holsters attached to the phone or at a predetermined distance from the body. These requirements were developed by FCC to identify the maximum RF energy exposure a user could experience when using a mobile phone, to ensure that the mobile phone meets the agency's RF energy exposure limit. This limit was designed to ensure that mobile phones do not expose the public to levels of RF energy that could be potentially harmful. By testing mobile phones only when at a distance from the body, FCC may not be identifying the maximum exposure, since some users may hold a mobile phone directly against the body while in use. Using a mobile phone in this manner could result in RF energy

exposure above the maximum body-worn SAR determined during testing, although that may not necessarily be in excess of FCC's limit. Reassessing its testing requirements would allow FCC to ensure that phones used by consumers in the United States do not result in RF energy exposure in excess of FCC's limit.

Recommendations for Executive Action

We recommend that the Chairman of the FCC take the following two actions:

- Formally reassess the current RF energy exposure limit, including its effects on human health, the costs and benefits associated with keeping the current limit, and the opinions of relevant health and safety agencies, and change the limit if determined appropriate.
- Reassess whether mobile phone testing requirements result in the identification of maximum RF energy exposure in likely usage configurations, particularly when mobile phones are held against the body, and update testing requirements as appropriate.

Agency Comments and Our Evaluation

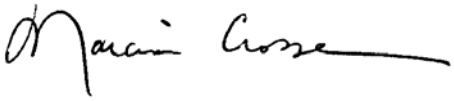
We provided a draft of this report to the Department of Commerce, Department of Defense, Department of Health and Human Services, Department of Labor, EPA, and FCC for review and comment. FCC provided comments in a letter from the Chief, Office of Engineering and Technology. (See app. III.) In this letter, FCC noted that FCC's staff has independently arrived at the same conclusions about the RF exposure guidelines as GAO. FCC also noted that a draft Order and Further Notice of Proposed Rulemaking, along with a new Notice of Inquiry, which has been submitted by FCC staff to the Commission for their consideration, has the potential to address the recommendations made in this report. We agree that FCC's planned actions may address our recommendations. However, since FCC has not yet initiated a review of the RF energy exposure limit or mobile phone testing requirements, our recommendations are still relevant. FCC and the Departments of Commerce, Defense, and Health and Human Services also provided technical comments, which were incorporated as appropriate. The Department of Labor and EPA did not provide comments on the draft.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Chairman of the FCC, the

Administrator of the EPA, as well as the Secretaries of the Departments of Commerce, Defense, Health and Human Services, and Labor. The report will also be available at no charge on GAO's website at http://www.gao.gov.

If you or your staff have any questions or would like to discuss this work, please contact Mark Goldstein at (202) 512-2834 or goldsteinm@gao.gov or Marcia Crosse at (202) 512-7114 or crossem@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Individuals making key contributions to this report are listed in appendix IV.

Mark L. Goldstein
Director, Physical Infrastructure



Marcia Crosse
Director, Health Care

Appendix I: Scope and Methodology

To determine what is known about the human health effects of radio-frequency (RF) energy exposure from mobile phone use, we reviewed selected studies including studies and reports that review and assess the scientific research, such as meta-analyses and government reports, as well as key individual epidemiological and laboratory studies.[1] We identified 384 studies that examine the health effects of RF energy emitted from mobile phone use through literature searches and interviews. We conducted literature searches in six online databases with health and engineering content—Embase, Inspec, Medline, National Technical Information Service Bibliographic, SciSearch, and SocialSciSearch—containing peer-reviewed publications and government reports to identify studies published from January 2006 through September 2011 using health-, mobile phone-, and RF energy-related search terms. Additionally, we interviewed officials from federal agencies and representatives of academic institutions, consumer groups, and industry associations to identify studies published through December 2011. To select studies for our review, we conducted a preliminary review of the 384 studies and included those that met the following criteria: (1) reviewed and assessed the scientific research in a systematic way, such as meta-analyses, and discussed their methods for identifying, selecting, and assessing the scientific research that were used to draw conclusions or (2) were key reports that identify areas for additional research in these fields, such as the 2008 National Research Council's *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication*.[2] We selected 38 studies that met these criteria. (See app. II for a list of the 38 studies we reviewed.)

To collect information on the 38 selected studies, we developed a data collection instrument that contained 16 open- and closed-ended questions about the entity or entities that published and funded the study; the study methods, key findings, and limitations; and additional research needs. To apply this data collection instrument, one analyst reviewed each study

[1]Epidemiological studies investigate the association, if any, between health effects and the characteristics of people and their environment. Laboratory studies conducted on test subjects—including human volunteers, laboratory animals, biological tissue samples, or isolated cells—are used to determine a causal relationship between possible risk factors and human health, and the possible mechanisms through which that relationship occurs.

[2]See National Research Council, *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication* (Washington, D.C.: 2008).

and recorded information in the data collection instrument. A second analyst then reviewed each completed data collection instrument to verify the accuracy of the information recorded. We summarized the findings and limitations of studies based on the completed data collection instruments, as well as areas for additional research identified in the studies. Additionally, we used this analysis to identify key, individual, epidemiological and laboratory studies.

We also interviewed subject matter experts to determine what is known about the human health effects of RF energy exposure from mobile phone use. First, we identified 123 potential subject matter experts to interview through the following sources: (1) interviews with officials from federal agencies and representatives of academic institutions, consumer groups, and industry associations and (2) participant lists of recent expert panels and workgroups on this topic. These panels and workgroups included:

- The National Research Council's Committee on Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communications Devices,[3]
- The International Agency for Research on Cancer's (IARC) Monograph Working Group on RF electromagnetic fields,[4]
- The INTERPHONE Study Group,[5] and
- The European Commission's Scientific Committee on Emerging and Newly Identified Health Risks.[6]

Second, we assigned each expert to one or more broad categories that captured his or her general area of expertise. Next, we e-mailed those experts who, based on our initial review, (1) were identified through at

[3]National Research Council, *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication* (Washington, D.C.: 2008).

[4]Baan, R., et al, "Carcinogenicity of Radiofrequency Electromagnetic Fields," *Lancet Oncology,* 2011, 12(7): 624-626.

[5]The INTERPHONE study is a retrospective case-control study that examined effects of mobile phone use on certain types of brain cancers or tumors in more than 5,000 cases aged 30-59 years in 13 countries. See Cardis, E, et al, "Brain Tumor Risk in Relation to Mobile Telephone Use: Results of the INTERPHONE International Case-Control Study," *International Journal of Epidemiology*, 2010, 39: 675-694.

[6]European Commission, *Health Effects of Exposure to EMF*, 2009.

least one source and we had information on their general area of expertise or (2) were identified through at least two sources regardless of whether we had information on their general area of expertise. We received responses from 42 experts agreeing to help us with our study. Based on these responses, we selected a judgmental sample of 11 experts who represented a range of expertise and professional backgrounds including public health and policy; biology and medicine; biostatistics; epidemiology; engineering, including bioelectrical engineering; and RF energy standards. (See table 3 for the list of individuals interviewed.) These experts were interviewed as individuals, not as representatives of any institution. Further, all of the experts completed a form stating that they had no conflicts of interest that would affect their ability to provide us with their perspectives on what is known about the human health effects of RF energy exposure from mobile phone use and related issues.

Table 3: Subject Matter Experts Interviewed

Name	Title	Institution[a]
Carl Blackman	a founder and former President (1990-91)	Bioelectromagnetics Society
Linda Erdreich	Senior Managing Scientist	Center for Epidemiology and Computational Biology, Exponent
Jukka Juutilainen	Professor of Radiation Biology and Radiation Epidemiology	Department of Environmental Science, University of Eastern Finland
Leeka Kheifets	Professor of Epidemiology	Department of Epidemiology, School of Public Health, University of California, Los Angeles
Henry Lai	Research Professor	Department of Bioengineering, University of Washington
James Lin	Professor of Electrical Engineering, Bioengineering, Physiology, and Biophysics	University of Illinois, Chicago
David McCormick	Senior Vice President and Director	IIT Research Institute
Martin Röösli	Assistant Professor	Unit for Environmental Exposures and Health, Swiss Tropical and Public Health Institute, Basel
Siegal Sadetzki	Head	Cancer and Radiation Epidemiology Unit, The Gertner Institute, Chaim Sheba Medical Center, Israel
	Associate Professor	Sackler School of Medicine, Tel-Aviv University, Israel
Jonathan Samet	Professor and Flora L. Thornton Chair	Department of Preventive Medicine, Keck School of Medicine, University of Southern California
Bernard Veyret	Senior Scientist	National Center for Scientific Research, Bordeaux University, France

Source: GAO.

[a]We interviewed experts as individuals, not as representatives of any institution. We provide information on institutions to help readers identify experts.

To determine the current research activities of federal agencies and other organizations related to mobile phone use and health, we interviewed representatives from various agencies and organizations. We identified agencies and organizations by reviewing information on their websites on RF energy and conducting interviews with officials from federal agencies and representatives of organizations familiar with research on health effects of mobile phone use. To determine the current research activities of federal agencies related to mobile phone use and health, we interviewed officials from the Department of Defense; Department of Health and Human Services' Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA), and National Institutes of Health (NIH); Department of Labor's Occupational Safety and Health Administration (OSHA); Environmental Protection Agency (EPA); and Federal Communications Commission (FCC). To determine the research activities of other organizations, we interviewed representatives from IARC, academic institutions, consumer groups, mobile phone industry associations, mobile phone manufacturers, and mobile phone providers.

To determine how FCC set the RF energy exposure limit and ensures compliance with it, we reviewed and summarized FCC regulations and guidance as well as reports from international organizations that recommend RF energy exposure limits. We also reviewed and summarized FCC testing and certification regulations and guidance for mobile phones. We conducted interviews with officials from FCC and representatives from selected Telecommunication Certification Bodies (TCBs). We selected the four TCBs that approved the most mobile phone certification applications for fiscal years 2000-2011 according to FCC: PCTEST Engineering Laboratory, Inc.; ACB, Inc.; CETECOM ICT Services GmbH; and Timco Engineering, Inc. These four TCBs have approved 69 percent of all U.S. mobile phone applications since 2000. We interviewed representatives from National Institute of Standards and Technology, American National Standards Institute, and American Association for Laboratory Accreditation to discuss their role in accrediting entities as TCBs and monitoring the activities of current TCBs. We also conducted interviews with representatives of the mobile phone industry and consumer groups for their perspectives on RF energy exposure limits as well as the testing and certification of mobile phones. Representatives of the mobile phone industry we spoke with included industry associations (CTIA-The Wireless Association and Mobile Manufacturers Forum) as well as the top four mobile phone service providers (AT&T, Sprint, T-Mobile, and Verizon) that represent about 90 percent of U.S. mobile phone service subscribers. We also spoke with

representatives from four mobile phone manufacturers that represent over 70 percent of the U.S. market (LG, Motorola, Nokia, and Samsung).

To determine the actions federal agencies and the industry take to inform the public about issues related to mobile phone health effects, we reviewed the information on federal agency websites. We identified six federal agencies that have information about mobile phones and health-related issues on their websites: CDC, EPA, FCC, FDA, NIH, and OSHA. We conducted interviews with officials from those federal agencies to learn how they developed and update their websites. We spoke with representatives of the mobile phone industry noted above and consumer groups to obtain perspectives on the strengths and limitations of federal agency public-information-sharing efforts. We also spoke with the representatives of the mobile phone industry about how and why manufacturers include warnings or specific usage guidelines in their user manuals. Finally, we reviewed the user manuals of selected mobile phones (see table 4) to identify the usage and health information being provided to consumers, including any instructions to hold the mobile phone away from the body during use. The specific mobile phone models were identified by the manufacturers we spoke with as their top selling models in 2011.

Table 4: Mobile Phone User Manuals Reviewed

Manufacturer	Phone model
Apple[a]	iPhone 4
LG	Octane
	Optimus
Motorola	Bionic
	Razr
Nokia	1616
	6350
	X2-01
Samsung	GoPhone
	Gusto
	TracFone

Source: GAO.

[a]We included the Apple iPhone because of its prominence in the industry. Representatives from Apple declined to speak with us for this report.

Appendix II: Studies GAO Reviewed

Ahlbom, Anders, Maria Feychting, Adele Green, Leeka Kheifets, David A. Savitz, and Anthony J. Swerdlow. "Epidemiological Evidence on Mobile Phones and Tumor Risk: A Review." *Epidemiology*, vol. 20, no. 5 (2009): 639-652.

Balbani, Aracy Pereira Silveira, and Jair Cortez Montovani. "Mobile Phones: Influence on Auditory and Vestibular Systems." *Brazilian Journal of Otorhinolaryngology*, vol 74, no. 1 (2008): 125-131.

Clapp, Richard W., Molly M. Jacobs, and Edward L. Loechler. "Environmental and Occupational Causes of Cancer: New Evidence 2005-2007." *Reviews on Environmental Health*, vol. 23, no. 1 (2008): 1-37.

Committee on Man and Radiation. "COMAR Technical Information Statement: Expert Reviews on Potential Health Effects of Radiofrequency Electromagnetic Fields and Comments on the Bioinitiative Report." *Health Physics*, vol. 97, no. 4 (2009): 348-356.

Edumed Institute for Medicine and Health. *Non-Ionizing Electromagnetic Radiation in the Radiofrequency Spectrum and its Effects on Human Health*. Latin American Experts Committee on High Frequency Electromagnetic Fields and Human Health. June 2010.

European Health Risk Assessment Network on Electromagnetic Fields Exposure. "Risk Analysis of Human Exposure to Electromagnetic Fields." *Deliverable Report D2*, Executive Agency for Health and Consumers Framework of the Programme of Community Action in the Field Of Health 2008-2013. July 2010.

European Health Risk Assessment Network on Electromagnetic Fields Exposure. "D3 – Report on the analysis of risks associated to exposure to EMF: in vitro and in vivo (animals) studies." July 2010.

French Environmental Health and Safety Agency. "AFSSE Statement on Mobile Phones and Health." AFSSE. April 16, 2003.

German Mobile Telecommunication Research Programme. "Health Risk Assessment of Mobile Communications." Department Radiation Protection and Health. Germany: 2008.

Habash, Riadh W.Y., J. Mark Elwood, Daniel Krewski, W. Gregory Lotz, James P. McNamee, and Frank S. Prato. “Recent Advances in Research On Radiofrequency Fields and Health: 2004-2007.” *Journal of Toxicology and Environmental Health*, Part B, vol. 12 (2009): 250-288.

Han, Yueh-Ying, Hideyuki Kano, Devra L. Davis, Ajay Niranjan, and L. Dade Lunsford. “Cell Phone Use and Acoustic Neuroma: The Need for Standardized Questionnaires and Access to Industry Data.” *Surgical Neurology*, vol. 72 (2009): 216-222.

Health Council of the Netherlands. “Electromagnetic Fields: Annual Update 2008.” The Hague: Health Council of the Netherlands, 2008; publication no. 2009/02.

HERMO. *Health Risk Assessment of Mobile Communications*. A Finnish Research Programme. Finland: 2007.

Institution of Engineering and Technology. “The Possible Harmful Biological Effects of Low-Level Electromagnetic Fields of Frequencies up to 300 GHz.” 2010 Position Statement, Institution of Engineering and Technology. United Kingdom: 2010.

International Commission on Non-Ionizing Radiation Protection. *Exposure to high frequency electromagnetic fields, biological effects and health consequences* (100 kHz-300 GHz). Germany: 2009.

Juutilainen, Jukka, Anne Höytö, Timo Kumlin, and Jonne Naarala. “Review of Possible Modulation-Dependent Biological Effects of Radiofrequency Fields.” *Bioelectromagnetics*, vol. 35 (2011): 511-534.

Khurana, Vini G., Charles Teo, Michael Kundi, Lennart Hardell, and Michael Carlberg. “Cell Phones and Brain Tumors: A Review Including the Long-Term Epidemiological Data.” *Surgical Neurology*, vol. 72 (2009): 205-215.

Kohli, D., A. Sachdev, and H. Vats. “Cell Phones and Tumor: Still In No Man’s Land.” *Indian Journal of Cancer*, vol. 46, no. 1 (2009): 5-12.

Kundi, Michael. “The Controversy About a Possible Relationship Between Mobile Phone Use and Cancer.” *Ciencia & Saude Coletiva*, vol. 15, no. 5 (2010): 2415-2430.

Levis, Angelo G., Nadia Minicuci, Paolo Ricci, Valerio Gennaro, and Spiridione Garbisa. “Mobile Phones and Head Tumours. The Discrepancies in Cause-Effect Relationships in the Epidemiological Studies – How Do They Arise?” *Environmental Health*, vol. 10, no. 59. (2011): 1-15.

Marino, Andrew A., and Simona Carrubba. “The Effects of Mobile-Phone Electromagnetic Fields of Brain Electrical Activity: A Critical Analysis of the Literature.” *Electromagnetic Biology and Medicine*, vol. 28 (2009): 250-274.

McKinlay, A.F., S.G. Allen, R. Cox, P.J. Dimbylow, S.M. Mann, C.R. Muirhead, R.D. Saunders, Z.J. Sienkiewicz, J.W. Stather, and P.R. Wainwright. “Advice on Limiting Exposure to Electromagnetic Fields (0-300 GHz).” *Documents of the NRPB*, vol. 15, no. 2. National Radiological Protection Board, 2004.

Mobile Telecommunications and Health Research Programme. “*Report 2007*.” United Kingdom: October 2007.

Myung, Seung-Kwon, Woong Ju, Diana D. McDonnell, Yeon Ji Lee, Gene Kazinets, Chih-Tao Cheng, and Joel M. Moskowitz. “Mobile Phone Use and Risk of Tumors: A Meta-Analysis” *Journal of Clinical Oncology*, vol. 27, no. 33 (2009): 5565-5572.

National Council on Radiation Protection and Measurements. “Biological Effects of Modulated Radiofrequency Fields.” *NCRP Commentary*, no. 18. Bethesda, MD: 2003.

National Research Council. *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication*. Washington, D.C.: 2008.

Nieden, Anja zur, Corrina Dietz, Thomas Eikmann, Jürgen Kiefer, and Caroline E.W. Herr. “Physicians Appeals On the Dangers of Mobile Communication – What Is the Evidence? Assessment of Public Health Data.” *International Journal of Hygiene and Environmental Health*, vol. 212 (2009): 576-587.

Pourlis, Aris F., “Reproductive and Developmental Effects of EMF in Vertebrate Animal Models.” *Pathophysiology*, vol. 16 (2009): 179-189.

Regel, Sabine J., and Peter Achermann. “Cognitive Performance Measures in Bioelectromagnetic Research – Critical Evaluation and Recommendations.” *Environmental Health*, vol. 10, no. 10 (2011).

Röösli, Martin, and Kerstin Hug. “Wireless Communication Fields and Non-Specific Symptoms of Ill Health: A Literature Review.” *Weiner Medizinische Wochenschrift*, vol. 161, no. 9-10 (2011): 240-250.

Scientific Committee on Emerging and Newly Identified Health Risks. *Health Effects of Exposure to EMF*. European Commission. January 19, 2009.

Sixth Framework Programme. “*EMF-NET: Effects of the Exposure to Electromagnetic Fields: From Science to Public Health and Safer Workplace*.” WP2.2 Deliverable report D4bis: Effects on Reproduction and Development. Italy: 2007.

Swedish Radiation Protection Authority. *Recent Research on EMF and Health Risks Fifth Annual Report from SSI:s Independent Expert Group on Electromagnetic Fields*, 2007, Sweden: 2008.

Swedish Radiation Safety Authority. *Recent Research on EMF and Health Risk Seventh Annual Report from SSM:s Independent Expert Group on Electromagnetic Fields*, 2010. Sweden: 2010.

Valentini, E., G. Curcio, F. Moroni, M. Ferrara, L. De Gannaro, and M. Bertini. “Neurophysiological Effects of Mobile Phone Electromagnetic Fields on Humans: A Comprehensive Review.” *Bioelectromagnetics*, vol. 28 (2007): 415-432.

Vanderstraeten, Jacques, and Luc Verschaeve. “Gene and Protein Expression Following Exposure to Radiofrequency Fields from Mobile Phones.” Environmental Health Perspectives, vol. 116, no. 9 (2008): 1131-1135.

Vijayalaxmi, and Thomas J. Prihoda. “Genetic Damage in Mammalian Somatic Cells Exposed to Radiofrequency Radiation: A Meta-Analysis of Data from 63 Publications (1990-2005).” *Radiation Research*, vol.169 (2008): 561-574.

World Health Organization. *WHO Research Agenda for Radiofrequency Fields*. Switzerland: 2010.

Appendix III: Comments from the Federal Communications Commission

Federal Communications Commission
Washington, D.C. 20554

July 6, 2012

Mr. Mark Goldstein
Director, Physical Infrastructure Issues
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Goldstein,

Thank you for providing the Federal Communications Commission with the opportunity to comment on your draft Report: *Mobile Phone Exposure and Testing Should Be Reassessed.*

The report presents a thorough and cogent explication of the challenging and complex area of the potential health effects of radiofrequency (RF) emissions from cell phones. Notably, the report finds that scientific research to date has not demonstrated adverse human health effects of radiofrequency (RF) exposure from mobile phone use, but that the FCC's current RF exposure guidelines for mobile phones may not reflect the latest standards and information on the thermal effects of RF exposure and the current testing requirements may not reflect the maximum exposure for certain use cases.

The Commission staff has continuously paid close attention to developments related to RF exposure and has worked closely with other federal agencies with health expertise such as the Food and Drug Administration. At this juncture, we believe our current standards are appropriate and protect the public against the possible harmful effects of RF exposure. However, we appreciate that it has been many years since the Commission conducted a formal review of the current standard.

As you are aware, the Commission issued a Notice of Proposed Rule Making (*Notice*) in ET Docket 03-137 in 2004 to clarify various of the RF exposure rules. The Notice specifically excluded consideration of the RF exposure standards. Many of the issues in the *Notice* that were related to equipment certification have been addressed through our equipment authorization program. Meanwhile the staff continued to work on a draft decision and proposal as a next step. With the passage of time and the increase in research and other developments, the staff appreciated that it would be appropriate to review the standards as well. Accordingly, the Commission staff has drafted and presented to the Commission for consideration a combined Order and Further Notice of Proposed Rulemaking in ET Docket 03-137, along with a Notice of Inquiry under a new docket number to review the standards and related matters.

In short, the Commission's staff had independently arrived at the same conclusions as are reflected in the GAO report. We believe that the draft document currently under consideration by the Commission has the potential to address and even expand on the recommendations in the GAO report to thoroughly review our RF safety rules.

In discussing our referral of consumers to other agencies' websites for information about research in this area, you note that our weblinks to the websites of the Food and Drug Administration and the Environmental Protection Agency were not functional when you tried to use them in April of this year. We can advise you that those weblinks are currently functioning properly.

Thank you again for the opportunity to provide comments and further information with respect to this GAO Report. If you have any questions, please contact Bruce Romano at 202-418-2124 or bruce.romano@fcc.gov.

Sincerely,

Julius P. Knapp
Chief
Office of Engineering and Technology
Federal Communications Commission

Appendix IV: GAO Contacts and Staff Acknowledgments

GAO Contacts

Mark L. Goldstein, (202) 512-2834 or goldsteinm@gao.gov

Marcia Crosse, (202) 512-7114 or crossem@gao.gov

Staff Acknowledgments

In addition to the contacts named above, Janina Austin and Teresa Spisak, Assistant Directors, as well as Kyle Browning, Owen Bruce, Marquita Campbell, Leia Dickerson, Kristin Ekelund, Lorraine Ettaro, Colin Fallon, David Hooper, Rosa Leung, and Maria Stattel made key contributions to this report.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's website (www.gao.gov). Each weekday afternoon, GAO posts on its website newly released reports, testimony, and correspondence. To have GAO e-mail you a list of newly posted products, go to www.gao.gov and select "E-mail Updates."

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, http://www.gao.gov/ordering.htm.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on Facebook, Flickr, Twitter, and YouTube. Subscribe to our RSS Feeds or E-mail Updates. Listen to our Podcasts. Visit GAO on the web at www.gao.gov.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Website: www.gao.gov/fraudnet/fraudnet.htm
E-mail: fraudnet@gao.gov
Automated answering system: (800) 424-5454 or (202) 512-7470

Congressional Relations

Katherine Siggerud, Managing Director, siggerudk@gao.gov, (202) 512-4400, U.S. Government Accountability Office, 441 G Street NW, Room 7125, Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548

Please Print on Recycled Paper.