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CELL PHONE RADIATION EXPOSURE AND REGULATION

by

Libby Pritchard

B.A., Southern Illinois University, 2010

A Research Paper

Submitted in Partial Fulfillment of the Requirements for the
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CHAPTER 1

INTRODUCTION

While cell phones have been around for several decades, they really did not become popular until 1983 (Federal Communications Commission), and finally were considered common in the 1990s (Crittenden, 2009). Today, the popularity of the cell phone is without question. With this popularity and present-day necessity of cell phones, one must wonder about the whispers of radiation.

Lloyd Morgan, electronic engineer, Director of the Central Brain Tumor Registry of the United States, member of the international science group, and volunteer with the National Brain Tumor Foundation, confirms that health risks do surround cell phone use (Morgan, 2005). Lloyd Morgan survived a massive brain tumor in the late 1990's, and when he questioned his neurosurgeon regarding the origin of the tumor, the neurosurgeon suggested, "perhaps electromagnetic fields" (Cell Phones and Brain Tumors, 2010). Lloyd Morgan began intense research into cell phone radiation at that time, researching and producing studies to bring to light any information that would prove health risks exist with cell phone use.

If cell phone radiation can produce brain tumors or other health problems, it should be highly regulated. In this paper, I will explore the information on cell phone radiation risks and attempt to determine whether the current cell phone regulations are appropriate and effective. In addition, I will review existing case studies to help establish the nature of the threat posed by cell phone use.

CHAPTER 2

USE IN THE U.S. AND WORLDWIDE

In the United States, four in five adults own a cell phone (Pew Internet). The majority of those not owning a cell phone live in the same residence as adults who do (Pew Internet). In 2007, the numbers were staggering enough. T. Stevens, writer of HuffPost Tech, previously Switched.com, put it this way, “Back in 1987, a little over a million Americans had cell phones. In 1997, the figure was 55 million. Now, it's 250 million and climbing” (Stevens, 2007, para. 2). By 2010, cell phone use in the United States grew to include 82% of the population (Pew Internet). This statistic, along with the statistics of cell phone use in the United States involving sex, age, race/ethnicity, household income, education level and geography, are visualized in Table 1: Cell Phone Ownership located in the Appendices. While these numbers represent year 2010, they were and continue to be a staggering percentage of the population. The gap between households making less than \$30,000 and households making \$75,000 or more is not as significant as might be expected. This is because cell phones are affordable. As such, they have pushed beyond the realm of luxury into a societal standard of need and necessity. According to Table 1, nearly all men and women, of nearly every age, relatively evenly distributed over race and ethnicity, household income, education level, and geography own a cell phone. The group with the lowest percentage of cell phone ownership takes place in individuals age 65 and older, with individuals having less than a high school degree taking the second lowest place. However, even this percentage continues to rise as cell phone popularity and societal necessity increase.

This is not simply an American trend. Cell phone use is climbing around the world. In 2009, Frank Jordans of USA Today shared, “Six in 10 people around the world now have cellphone subscriptions, signaling that mobile phones are the communications technology of choice,

particularly in poor countries...” (Jordans, 2009, para. 1). As expected, the numbers for 2012 have grown. “The number of mobile subscriptions in use worldwide...has grown from fewer than 1 billion in 2000 to over 6 billion now, of which nearly 5 billion in developing countries. Ownership of multiple subscriptions is becoming increasingly common, suggesting that their number will soon exceed that of the human population” (The World Bank, 2012, para. 1).

“Cell phones have essentially become an extension of the human body in most of the developed world” (Planetsave, 2010, para. 1). With virtually limitless capabilities, cell phones are replacing GPS, watches, maps, compasses, cameras, calculators, alarm clocks, flashlights, radios, notebooks, dictionaries, newspapers, and more (Aronsson, 2010). This heavy use of cell phones should not be surprising, as the factors of convenience, practicality and entertainment are being matched with affordability, creating the perfect formula for more than a new trend. In fact, this attachment to cell phones is now the cause of a new phobia – nomophobia, “the fear of being without [a] mobile device” (Gastaldo, 2012, para. 1). This new phobia demonstrates the difficulty of distancing cell phones from their users, even to protect one’s health, due to what has become a growing concern – cell phone addiction (Gastaldo, 2012).

CHAPTER 3

INITIAL CONCERNS

Cell phone radiation existed quietly for several years. In fact, the knowledge of potentially dangerous side effects surfaced somewhat recently. For instance, the scare of cell phone radiation-related cancer, tumors, and other side effects emerged in 1993 when a Florida man claimed “that his wife’s brain tumor was caused by RF (radiofrequency) radiation from her cell phone” (Kao, 2012, para. 1). While this case was dismissed for lack of conclusive evidence, many experts suggest that, “Given the latency period required for the development of cancer, it is possible that cell phones still have not been used long enough to show a detrimental effect” (Crittenden, 2009, para. 1). This attention generated numerous studies into the potential danger of cell phone radiation. Currently, most of these studies do not indicate dangerous side effects stemming from cell phone radiation. However, other studies caution cell phone users to be mindful of the time they spend on their cellular device. Given the potentially 20- to 30-year latency period of cancer development, the effect of cell phone radiation may not be truly understood for many years to come (Winerman, 2011). While evidence pointing to danger remains relatively scarce, an increasing number of studies suggest cell phone radiation presents more of a health risk than initially thought (O’Neill, 2011).

CHAPTER 4

POTENTIAL DANGERS OF CELL PHONE RADIATION

Some of the effects of cell phone radiation include an increase in glucose in the brain, a process that “occurs with infections and other inflammatory processes, and leads to the production of potentially damaging reactive oxygen radicals that can alter the ways that cells and genes work” (Davis, 2011, para. 4). A 2008 study demonstrated that changes occurred in the number of human proteins when exposed to cell phone radiation (Davis, 2011). The study involved human skin biopsies from “the forearm of 10 human volunteers who were exposed for one hour to cell phone radiation” (Davis, 2011, para. 7). The danger of this alteration in proteins is not yet understood, but the results prove that cell phones do have a physical effect on the body.

In a 2006 interview of Dr. George Carlo, Chairman of the Science and Public Policy Institute, the reporter was informed that cell phone radiation can lead to “tissue dysfunction such as leakage in the protective blood brain barrier and genetic damage, including interference with deoxyribonucleic acid (DNA) repair. These biological effects lead to conditions ranging from brain tumors to learning difficulties in children” (Fosburg, 2006, para. 9). Other studies have concluded that cell phones radiate heat to the ear, eye and brain, which if too severe, could damage the tissue (Lu, 2012).

For years, consumers have compared cell phones to microwave ovens when discussing the potential dangers of radiation. It has been argued that microwave ovens are less dangerous, though, as they are insulated, they hold high levels of radiation inside, they put off less energy, and they are used less often. On the other hand, cell phones are used almost constantly by their carriers, may always be operating, whether meant to be or not, and they are not insulated. Many users carry cell phones next to their heads, in pockets, and on hips. Cell phones are a constant

presence, and wherever one goes, curtains of radiation waves from cell phone signals and cellular towers surround.

CHAPTER 5

THE BIOLOGICAL EFFECTS OF CELL PHONE RADIATION

Sue Kovach of Life Extension Magazine explains that cell phone antennas generate signals, radiation waves that are similar to those produced by our bodies' own electrical systems (Kovach, 2007). These waves of radiation seem to create confusion within our own systems, causing our bodies' defensive systems to activate through a process of protective biochemical reactions "that alter physiology and cause biological problems that include intracellular free-radical buildup, leakage in the blood-brain barrier, genetic damage, disruption of intercellular communication, and an increase in the risk of tumors" (Kovach, 2007).

According to Kovach, the danger of radiation is not from "direct damage, but rather ... due to the biochemical responses in the cell" (Kovach, 2007, *Why Cell Phones Are Dangerous*, para. 3). In other words, cell phones affect the human body physically, but not in such a way that cellular heat alone produces cancerous cells. Rather, cell phone radiation spurs the body's natural defense mechanisms, whose reactions open the body up to an increased risk of cancer development.

A common misconception lies in the source of harmful radiation, which most people believe to be in the cell phones' carrying of the call, dialing, connecting, and searching for signal. Instead, it seems the wave carrying information "necessary to interpret voice or data is the problem" (Kovach, 2007, *Why Cell Phones Are Dangerous*, para. 3). The following is one explanation of the process of cell phone radiation:

When the body recognizes the cellular energy of cell phones or wireless networks, the protective mechanisms (mentioned above) cause cell membranes to harden, in turn shutting out needed nutrients and withholding waste. As the waste accumulates, free

radicals are multiplied; leading to the body's lessened ability to repair DNA and lessened extent of cellular function. This process leads to the death of some cells, disrupting the repair of DNA and quickly reproducing damaged cells – a formula for cancer. These damaged cells lack the ability to communicate, or even repair and protect tissue, causing additional damage. Some symptoms of this process include an “inability to sleep, general malaise, and headaches” (Kovach, 2007, *Why Cell Phones Are Dangerous*, para. 4).

“When we were growing up, TV antennas were on top of our houses and such waves were up in the sky. Cell phones and Wi-Fi have brought those things down to the street, integrated them into the environment, and that's absolutely new” (Kovach, 2007, *Why Cell Phones Are Dangerous*, para. 5). Perhaps this commonality among such generations is partially to blame for such conditions as “attention-deficit hyperactivity disorder (ADHD), autism, and anxiety disorder” (Kovach, 2007, *Why Cell Phones Are Dangerous*, para. 5).

CHAPTER 6

RECORDS OF CELL PHONE RADIATION

The following case studies serve to provide an understanding of any potential harm produced through cell phone radiation, cancerous or otherwise. These studies were chosen for their ability to represent each side of the debate on cell phone radiation's potential for harm. The Interphone Project is a well-known study, referenced often, and concludes with the most widely obtained deductions. The study regarding cell phone exposure on rats, as well as the study on cell phone radiation and male fertility, each provide results showing the different levels and types of harm attributed to cell phone radiation. Lastly, the study on cell phone radiation and adolescent brain tumors was chosen for its unique circumstance of achieving one conclusion, that is, in turn, challenged by the Environmental Health Trust and ABC News, both of which are reputable organizations. The following cases, for the purpose of this paper, sufficiently represent the leading conclusions drawn from cell phone radiation studies.

THE INTERPHONE PROJECT

The first case study was based on 966 patients, ages 18 to 69, with glioma, the most common malignancy (a tumor that invades the tissue around it and often spreads to other parts of the body) of the central nervous system in adults (BMJ 2006), as well as 1716 control subjects. Figure 1, located in the Appendices, is an x-ray of a glioma in the human brain. As shown, the glioma can be a rather large mass that may begin to spread to surrounding tissue. The study was conducted in the United Kingdom, as part of the Interphone project, "an international collaboration of 13 countries investigating mobile phone use and the risk of intracranial tumours" (BMJ 2006, *Introduction*, para. 3). Researchers conducted the study by interviewing

these individuals using questions that revealed their usage of cell phones, including the length of time since their first use of a cell phone, their years of cell phone use throughout their lifetime, and the cumulative number of hours and calls made (BMJ 2006).

The results of this study showed no relationship between the participants' use of a cell phone and the development or progress of glioma. Some areas of the study suggested that patients having glioma on one side of their head corresponded with heavy use of a cell phone on that same side. However, this suggestion was dismissed to recall bias, as many of the patients were already aware of the location of their tumor, allowing for the error of over-reporting the use of their cell phone on that side of their head, already assuming a relationship between the two (BMJ 2006).

An additional potential for bias occurred when the majority of participants were known to be those having less serious tumors. This resulted from an obstacle in interviewing more serious tumor cases due to a more rapid approach of death (BMJ 2006). In such a case, the study explained that it may have been argued that cell phone use is linked to more serious cases of tumors, but other research, in large part, does not support this (BMJ 2006).

While this study claims no relationship exists between cell phone radiation and cancer or tumors, the argument remains that insufficient time has passed to notice a relationship. In fact, regarding the lack of relationship between cell phone use and brain cancer, "researchers argue that those results don't mean much, because brain cancer can take 20 to 30 years to develop" (Winerman, 2011, para. 7).

CELL PHONE RADIATION ON RODENTS

The second case is a study of the effect of "round-the-clock cell phone radiation" on pregnant mice (Sanders, 2012, para. 1). The study included cell phones, some active, others inactive, but

without the technology of smart phones. The cell phones were placed “between 4.5 and 22.3 centimeters” from the fetuses at all times (Sanders, 2012, para. 7).

This study found that “on average, offspring from the mothers exposed to cell phone radiation performed worse on a memory test, moved around more, and were less anxious than mice who were not exposed to cell phone radiation” (Sanders, 2012, para. 4). Researchers suggested that “these behavioral and brain deficits are similar to those seen in people with attention-deficit/hyperactivity disorder, and speculate that increased cell phone use could explain an increase in ADHD in children” (Sanders, 2012, para. 5). Additional research from UCLA and the University of Southern California in Los Angeles “hinted at a possible link between pregnant women who used cell phones frequently and behavioral problems in their children” (Sanders, 2012, para. 8). Other researchers strongly disagreed, stating that “To blame the increase in ADHD on mobile phones...is premature,” especially since the study included cell phone distance much closer than any distance experienced by a human fetus and his or her mother’s cell phone (Sanders, 2012, para. 6). However, despite the lack or prematurity of such evidence, many “researchers agree that pregnant women should avoid carrying a cell phone near the abdomen” in order to maintain caution (Sanders, 2012, para. 9).

CELL PHONE RADIATION AND MALE FERTILITY

A study of the effect of cell phone radiation on male fertility conducted in 2004 and 2005 found that the amount of cell phone use greatly affected not only the sperm count, but also the health and viability of the sperm (Ferguson, 2011). The study involved the collection of semen from 361 male subjects of an infertility clinic and evaluated their health status according to the frequency of their cell phone use (Ferguson, 2011). The study concluded that sperm count and sperm health lessened greatly the more a cell phone was used, while with less cell phone use,

men produced higher sperm count, and higher quality semen (Ferguson, 2011). “ Many case studies have been completed in this area, and results seem to suggest that prolonged exposure to cell phone radiation may have negative effects on sperm motility” (Ferguson, 2011, para. 2).

These findings are representative of many other studies performed to determine the effect of cell phone exposure on fertility in men. Some of the studies “have been done in the United States, Australia, Austria, Hungary, Poland, Turkey and South Africa, using diverse methodologies” (EWG Science Review, para. 7). These studies were conducted to include the different methods of carrying a cell phone, including men who carried their cell phone in their pocket or on their hip, those carrying them in another location, and those not carrying cell phones (EWG Science Review). Some of the findings included the following:

- “Men who carried a phone in a hip pocket or on the belt had 11 percent fewer mobile sperm than men who kept a phone elsewhere on the body” (EWG Science Review, para, 8).
- “Men who carried a cell phone on the belt and used it intensively during a five-day test period had a 19 percent drop in highly motile sperm from their previous levels” (EWG Science Review, para. 8).
- “Men who talked on the phone for more than an hour a day had 17 percent fewer highly motile sperm than men who talked less than 15 minutes a day” (EWG Science Review, para. 8).

These findings suggest the importance of taking precautions with cell phone use.

CELL PHONE RADIATION AND ADOLESCENT BRAIN TUMORS

A case study of children and teenagers from ages 7 to 19, diagnosed with a brain tumor between the years of 2004 and 2008, was conducted in Denmark, Sweden, Norway, and

Switzerland to identify any links between the tumors and cell phone use (Aydin et al., 2011). The study involved interviews of these children, with questions concerning their use of cell phones, including the time they began using a cell phone, and a look at cell phone records of those children. The study did not show a relationship between the children's brain tumors and cell phone exposure (Aydin et al., 2011). In fact, the results found that there was "no elevated risk among regular users of mobile phones [looking] at the parts of the brain with the highest radio frequency exposure," (Aydin et al., 2011, *Results*, para. 5).

However, the Environmental Health Trust disagreed with this conclusion, stating, "The study's data actually indicates a 115 percent increase in brain tumor risk for children after more than two years of having a cellphone subscription" (Fox News, 2012, para. 5). The Environmental Health Trust scientists explained "there was also an indication that the more a cellphone is used, the higher the risk becomes" (Fox News, 2012, para. 5).

Furthermore, in April 2012, ABC News commented on the same study, saying, "the study actually shows that cell phone use more than doubles the risk of brain tumors in children and adolescents" (Gann, 2012, para. 1). When read closely, the original study, while concluding that "the data showed no link between cell phone use and brain tumors," also states that "they could not rule out the possibility that mobile phones confer a small increase in risk" (Gann, 2012, para. 4 and 10). According to Dr. Keith Black, chairman of neurology at Cedars-Sinai Medical Center in Los Angeles, "Children's skulls and scalps are thinner. So the radiation can penetrate deeper into the brain of children and young adults. Their cells are ... dividing faster ..., so the impact of radiation can be much larger" (Dellorto, 2011, para. 12).

Despite opposing arguments, in 2011, the World Health Organization (WHO) announced, "Radiation from cell phones can possibly cause cancer" (Dellorto, 2011, para. 1).

CHAPTER 7

POPULATIONS MOST AT-RISK

Cell phone radiation puts certain populations at a higher risk of harmful health consequences than others. Pregnant women, specifically their unborn children, and young children and adolescents are at a higher risk with cell phone radiation exposure (Davis, 2011). Men desiring to father children should also take precaution against the risk cell phone radiation poses to the quality of sperm, and therefore, the health of the child (Healthy Child, 2012). Finally, cell phone users living in rural areas receive weaker reception, and therefore, their cell phones work harder, put off more radiation, and place the user at a higher risk (Fosburg, 2006).

The risk to unborn children is still very much unfounded by concrete evidence, but plenty of case studies on the effects of cell phone radiation on pregnant test animals result in behavioral disorders in the offspring. Many researchers from Yale University, including Dr. Hugh S. Taylor, professor and chief of the Division of Reproductive Endocrinology and Infertility in the Department of Obstetrics, Gynecology & Reproductive Sciences at Yale, as well as researchers at the University of California, Los Angeles (UCLA), have voiced the concern that cell phone radiation exposure should be limited for pregnant women and their unborn children. Some of the health effects experienced in lab tests resulting from such exposure include anxiety, ADHD and similar attention disorders (Sanders, 2012).

Rural cell phone users generally experience higher radiation from their cell phones, as cellular towers may not be located as closely as cell phone users in more urban areas. When cellular towers are located further away, your cell phone must work harder to send and receive signal (Fosburg, 2006). This additional work puts off more radiation than does a phone with a healthy signal. In fact, according to Dr. Carlo of the Science and Public Policy Institute, “the power bars

on your phone give you an indication of how much radiation you are being exposed to during a call--the fewer number of bars, the greater amount of radiation” (Fosburg, 2006, para. 7).

However, of all these at-risk populations, young children and adolescents are at the forefront for potential risk. Cell phone radiation exposure on young children and adolescents is and will be the most widespread. This is due to the exposure of young children and adolescents to cell phone radiation from an early age with a lifetime of cell phone use ahead of them. With a lifetime of use, young children and adolescents are opened up to any and all of the potentially harmful health risks associated with the proximity of cell phones, as well as the extent of their use over the decades. Children and adolescents are not yet fully developed, meaning that cell phone radiation penetrates much more easily and fully into their bodies. Figure 2, found in the Appendices, depicts the penetration of cell phone radiation upon the human brain. The depth of penetration is dependent upon the age and development of the individual. For instance, the pictures show a 5-year-old, a 10-year-old, and an adult, with each of their individual skull thicknesses. The first picture clearly shows that cell phone radiation penetrates tremendously deeper through the thinner, less developed skull of a 5-year-old. The second picture shows the penetration of a 10-year-old’s skull, which is twice as thick as that of a 5-year-old, and as a result, the penetration is approximately 50% less. Still, 10-year-old children receive a vastly higher degree of radiation penetration than adults. The level of penetration for an adult, whose skull is four times as thick as a 5-year-old, is shown in the third picture of Figure 2. While the radiation is still present, it is far less intrusive in an adult.

Young children are at a much higher risk for radiation penetration. In fact, these young children “are growing up in a sea of radiofrequency radiation that has never existed in human history. In America today, about twenty million children under the age of fourteen have

cellphones” (Healthy Child, 2012, para. 1). The problem with this situation lies in the fact that “children’s skulls are thinner and their brains are less dense so there’s more absorption of radio frequency signals” (Greer, 2010, para. 1). In fact, “the bone marrow of a child’s head absorbs 10 times more radiation than an adult, while those of infants and toddlers will absorb even more” (Healthy Child, 2012, para. 2).

Interestingly, many cell phone applications are made specifically for children’s use of smartphones. While the games may be educational and entertaining, children are learning earlier and earlier the widespread normalcy of cell phone use. In fact, iPhone created a “plastic baby rattle case [that] protects the phone’s glass screen from cracking when chomped on by teething babies, but does not protect the infant’s young brain from the phone’s ... radiation” (Healthy Child, 2012, para. 1).

The earlier children are taught to use cell phones, the more potential danger exists for that child’s future. According to the website healthychild.org, “every major well-designed study ever conducted has found that those who use cell phones regularly for half an hour a day or more for a decade have a doubled risk of brain cancer, and those who began using cell phones as teenagers have four to five times more disease, in less than 10 years. Exposure to radiation from cell phones may also play a role for a growing spate of serious problems, including attention and hearing deficits, autism, behavioral changes, insomnia, ringing of the ears or tinnitus, Parkinson’s, Alzheimer’s and a broad array of disturbances to the nervous system” (Healthy Child, 2012, para. 4).

Aside from toddlers and infants, pre-teens and teenagers experience more radiation than they ever have before. “More than half of American teens aged 13-16 have a cell phone” and some of these teens “sleep with their cell phones under their pillows at night. That’s an additional 7 to 8

hours of radiation going directly into their brains” (Greer, 2010, para. 5).

Most populations are under some level of risk due to cell phone radiation, but young children and adolescents are exposed earlier, more frequently, and over a longer period of their lifetime. While they are at an increased risk, the popularity of cell phones and the ordinary use of wireless networks surround most people with an atmosphere charged with wireless radiation risks.

CHAPTER 8

MINIMIZING THE RISK

The prevalence of cell phone exposure can be combatted through many different means. Exposure to this radiation, whether the risks are more or less real than believed, can be reduced. Many websites and researchers offer a multitude of techniques and methods for reducing our exposure to the radiation of our cell phones. This section lists a series of these techniques gathered from several different sources.

These techniques do not promise complete protection from cell phone radiation exposure, nor do they promise to eliminate the harmful consequences of such exposure. These techniques are merely a means to reduce such risks.

“Don’t hold a cell phone directly up to your head. Use a headset or speakerphone to talk on the phone” (Healthy Child, 2012).

“Pregnant women should keep cell phones away from their abdomen and men who wish to become fathers should never keep phones on in their pocket” (Healthy Child, 2012).

“Don’t allow children to play with or use your cell phone. Older children should use a headset when talking on a cell phone” (Healthy Child, 2012).

“Turn off your wireless router at night to minimize exposure to radiation” (Healthy Child, 2012).

“Eat green vegetables and get a good night’s sleep in a dark room to enhance natural repair of DNA that may have been damaged by radiation” (Healthy Child, 2012).

“Never, ever put a cell phone up to the ear of a baby” (Greer, 2010).

“Limit your child’s use of a cell phone to essential purposes only and keep the calls short” (Greer, 2010).

“It’s best to keep your cell phone away from your body – do not clip it on your belt or put it in your pocket. Instead put it in your purse or backpack” (Greer, 2010).

“Before making a call check the number of bars that indicate reception – a good signal means that the phone is using less radiation to transmit” (Greer, 2010).

“Charging your phone creates a high level of radiation, so charge it in another room” (Greer, 2010).

“Switch ears regularly, distributing radiation more evenly” (Kreisberg, 2010).

“Research your phone to purchase one that emits a lower radiation” (Kreisberg, 2010).

“Listen more or use text— talking requires your cell phone to emit the most electromagnetic radiation. Texting occurs away from your head” (Kreisberg, 2010).

“Have the key pad face your body so that the antenna, on the back of the phone, is away from it. In a flip phone, the antennae is on the back of the earpiece part of the phone and should be facing away from the body” (Kreisberg, 2010).

“Don't sleep near your cell phone” (Kreisberg, 2010).

While many of the techniques listed above seem to be common sense, it is surprising how many people can be seen in such practices. These actions have likely become habitual, and practices like remembering to charge your cell phone in a place other than next to your pillow may prove difficult, not to mention inconvenient. Some techniques, such as eating green vegetables and getting sufficient rest, are lifestyle changes that can fight against the harmful effects of radiation, as well as improve your overall health.

CHAPTER 9

REGULATIONS

The amount of radiation a cell phone may emit is regulated by the Food and Drug Administration (FDA) and the Federal Communications Commission (FCC). The regulatory responsibilities include the certification of “all phones that are sold in the United States ... [to] comply with FCC guidelines on RF exposure” (FDA, 2012, *Federal Communications Commission*, para. 1).

RF waves are radiofrequency waves, and are forms of energy in the electromagnetic spectrum (Cell Phone Safety Guide). RF waves are most often used for means of telecommunication and can actually be absorbed by the human body (Classic, 2011). RF energy, when absorbed by the body, is measured according to the Specific Absorption Rate (SAR), or the measure of which energy is absorbed by the body when exposed to a radio frequency (Classic, 2011). The SAR is established to ensure the safety of individuals against excessive RF exposure, which “can be harmful due to the ability of RF energy to rapidly heat biological tissue” (Classic, 2011, para. 6). Severe RF exposure has the potential to lead to “tissue damage in humans...because of the body's inability to cope with or dissipate the excessive heat that could be generated” (Classic, 2011, para. 6).

With this in mind, the FDA and FCC established the SAR standard to be less than 1.6 watts per kilogram. The “SAR provides a straightforward means for measuring the RF exposure characteristics of cell phones to ensure that they are within the safety guidelines set by the FCC” (FCC.gov, para. 1).

While the FDA and FCC have limits on the amount of radiation a cell phone may emit, these limits were set in 1996 and need attention in order to be brought up to date with the newest

evidence produced on the subject of cell phone radiation exposure (Aware and Prepare, 2012). In fact, the SAR has been included in some new bills that would require warning labels to accompany cell phones. In some states, such as California, Maine, Oregon, and Pennsylvania, bills have been proposed that would require such warning labels, but all have been struck down or shelved (German, 2011). This has much to do with the resistance of the cell phone industry.

Most recently, in August 2012, Rep. Dennis Kucinich “introduced legislation that cell phone packages ... be labeled with radiation emissions as well as the government standards. The legislation also called for development of a research program to study cell phones and for the EPA to update its standards” (Trujillo, 2012, para. 17). This bill would require the standards of the SAR to be updated from the 1996 regulations (Trujillo, 2012). According to Rep. Kucinich, something must be done to protect the health of cell phone users as future research unveils new dangers (Trujillo, 2012). He stated,

"It took decades for scientists to be able to say for sure that smoking caused cancer.

During those decades, the false impression created by industry supporters was that there was no connection between smoking and cancer, a deception which cost many lives.

While we wait for scientists to sort out the health effects of cell phone radiation, we must allow consumers to have enough information to choose a phone with less radiation. As long as cell phone users may be at increased risk of cancer or reproductive problems, Americans must have the right to know the radiation levels of cell phones” (Classic, 2011, para. 6).

Knowing the radiation levels of our cell phones may or may not change our habits. In fact, with today’s level of addiction to cell phones, it may not even be likely that cell phone use declines. Rather, other options would be in demand, such as radiation shields, improved

speakerphone technology, and public awareness. In 2010, an ordinance was passed in San Francisco that could be considered an important step towards public awareness.

“The San Francisco Board of Supervisors voted Tuesday to make the city the nation's first to require that retailers post cellphone radiation levels prominently in their stores. The cellphone right-to-know ordinance, which passed 9 to 1, arose out of officials' concerns about possible long-term health effects of using the ubiquitous gadgets, even though there is no scientific consensus regarding their potential danger” (La Ganga, 2010, para. 1 and 2).

If San Francisco citizens felt the situation important enough to make such changes, why doesn't the FCC or FDA reevaluate the 1996 regulations? According to RF Safety Solutions, lack of public interest, difficulty in measuring exposure, lack of necessary equipment, and the constant turnover within the FCC keep regulations the same (RF Safety Solutions). The argument is as such: with these obstacles, the processes of reevaluation and revision of regulations become too difficult to spark change. The reasoning, however, is questionable. With this awareness, simple changes should be implemented to spark public interest and streamline the processes of measurement by providing the correct tools. The FCC plays the role of an agency that cares, but cannot bring about change or make a difference. Such an attitude is useless, if not harmful. The FCC, with appropriate actions and motives, could quickly and simply catch the awareness of the public through its power of influence.

CHAPTER 10

RESISTANCE OF THE CELL PHONE INDUSTRY

The United States cell phone industry “grew by 3.2% in 2010 to reach a value of \$10,707 million” (DataMonitor, 2010, p. 2). By the year 2015, “the United States mobile phones market is forecast to have a value of \$12,440.7 million, an increase of 16.2% since 2010” (DataMonitor, 2010, p. 2). It comes as no surprise that the cell phone industry is protective of its freedoms. The industry uses the lack of conclusive evidence tying cell phone radiation to cancer, or other health hazards, to fight the involvement of the federal government (Diaz, 2011). In the case of San Francisco, when the city attempted to pass an ordinance requiring cell phone stores to display the cell phone radiation levels, the cell phone industry claimed the city was pushing cell phone stores to provide “‘misleading’ and ‘inaccurate’ disclosures” (Diaz, 2011, p. 1, para. 8). Such resistance by the industry leaves the public open to ignorance.

Many such efforts have been obstructed by cell phone industries; industries that are so healthy and experiencing such wealth, that they have no reason to comply. For instance, upon the mention of public awareness via radiation levels being labeled, the Cellular Telecommunications and Internet Association (CTIA) responded, “all phones marketed in the United States are considered safe by the Federal Communications Commission” (Knight, 2011, para. 4). Such a statement clearly contradicts the World Health Organization’s announcement that, “cell phones [classify] as a possible carcinogen in the same category as lead, engine exhaust and chloroform” (Edwards, 2011, para. 1).

CHAPTER 11

PRECAUTIONS OUTSIDE THE U.S.

The United Kingdom's Health Protection Agency, upon learning of unsafe levels of radiation on school children due to wireless networks, imposed immediate efforts to halt installation of wireless networks, as well as removing existing networks (Fawcett, 2008). The UK did not wait for proof of cancer, disability or illness, but reacted immediately to potential dangers not yet proven. The FCC, FDA, and WHO are all aware of potential dangers from cell phone radiation, yet cautionary measures are postponed until the arrival of conclusive evidence of harm – or in other words, a death, disability, or other condition that is a direct result of cell phone radiation that can be linked to widespread impact. At such a point, research has procrastinated to an extent that it outlives its usefulness.

Other examples of precautionary measures include the North Shore Hospital in Sydney, Australia, a teaching institution, which “issued advice to staff in March of last year (2000) to avoid unnecessary use of mobile phones to minimize potential risk from microwaves. This hospital is also involved in the currently running NSW mobile phone/brain tumor study that is examining brain tumor patients use of mobile phones” (Maisch, 2001, *Examples*, para. A). In addition, “the British Public and Commercial Services Union, representing some 266,000 members, issued advice to its members on ways to reduce microwave exposure from cell phone use” (Maisch, 2001, *Examples*, para. B).

Furthermore, the following is a list of actions taken outside of the United States to protect children and teens from cell phone-related health risks.

- The German Academy of Pediatrics has warned parents to limit cell phone use among children (Fosburg, 2006)

- The Russian Radiation Protection Bureau has advised pregnant women and children under the age of 16 to avoid mobile phone use altogether (Fosburg, 2006)
- Parliamentary health officials in Great Britain have twice urged the nation's wireless industry to refrain from promoting mobile phone use in children and publicly discourage children from using mobile phones for non-essential calls (Fosburg, 2006)
- Scandinavian health authorities have recommended that all consumers, especially children, should use whatever means possible to reduce their exposure to mobile phone radiation emissions (Fosburg, 2006)
- Health officials in Israel and Austria continue to recommend that children under the age of 16 not use cell phones at all (Fosburg, 2006)

CHAPTER 12

SUGGESTIONS FOR PUBLIC AWARENESS

The current approaches to cellular radiation are not adequate. While the potential dangers remain in need of further evidence, precautionary measures should be implemented. Although only limited evidence suggests cell phone radiation increases human risks of brain cancer, fertility complications, and behavioral changes, consumers have the right to understand the risks of the products they use on a daily basis.

Efforts could begin with a public announcement by the FCC or FDA alerting the public to studies conducted concerning cell phone regulation. These announcements must be handled carefully so as not to induce fear on the public, but as a cautionary measure to let the public know of techniques to reduce their risk. These actions should stress the importance of protecting young children and adolescents, who experience cell phone radiation at a higher rate physically, considering their cell phone use from a younger age, more frequently, and throughout their lifetime. In addition, labeling cell phones with information on radiation and the SAR allows consumers full knowledge on the matter. The product labeling should be nationwide, rather than determined by individual business owners, cities, or states.

Public health educators need to assume responsibility and bring awareness to the public. Alerting the public to the entire story is the beginning. The public should be provided the information obtained from studies showing the lack of relationship between cell phone radiation and cancer, fertility issues, tumors, and behavioral changes, as well as those studies that express a connection between the two. By alerting the public to the safety of cell phones due to regulations, as well as the risks associated with the radiation exposure, the consumer will be free to decide which precautions to take, if any. Above all, public health educators need to bring the

public awareness on the potential dangers our most at-risk populations face.

Public awareness should be captured through the FCC and FDA. The FCC and FDA might explain the value of the current regulations, including the specific absorption rate (SAR), which, as explained, is a way of measuring the amount of radiation absorbed by one's body. Generally, the lower the SAR associated with a cell phone, the lower your exposure to the cell phone's radiation (Serrano). Knowing such information, consumers may then turn to the owner's manuals of their cell phones and make sense of the SAR numbers that slip the attention of most. Some individuals may even take efforts to reduce the amount of time their young children spend on cell phones, or even purchase their young children cell phones that have a better SAR.

The public should also be aware of the protection devices available for cell phones. These scientifically validated electromagnetic field (EMF) protection devices have been made to ward off the effects of cell phone radiation to the human body (Serrano). However, as these chips are already costly, any demand on part of the public would quite likely result in a further increase in product cost.

CHAPTER 13

INDUSTRY REGULATIONS

Along with providing public awareness of the potential dangers of cell phone radiation, industry regulations may provide a measure of safety by maintaining up-to-date information on the health risks associated in some studies of cell phone radiation. The cell phone industry might impact public health for the better by regulating the strength and power of cell phones, and in turn, lowering the SAR. Cell phone industries could tighten the limits for exposure, providing cell phones to consumers that meet stricter standards of safety. As quickly as the rotation of new cell phones emerges to the market, the cell phone industry would be well-advised to begin providing options for cell phones that have high performance with lowered radiation and SARs.

If the cell phone industry modeled the automobile or healthcare industries, it would find that products can and should be reevaluated, revamped, and released to the public as a better model than the last.

Take the Prius, for example, which was introduced as an environmentally friendly, newer model of automobile that heeded the public's concern of high fuel prices and pollution levels of the previous options. Toyota delivered, rather than patiently assume the role of advocate for pollution and high fuel prices. Similarly, the healthcare industry spends more time reinventing medicines and procedures, and less time trying to convince the public that any currently questionable methods are safe. However, in order for cell phone industries to comply with tighter regulations, or in fact, explore those regulations on their own, government support is needed to motivate the industry and build the public's trust.

If cell phone industries would regulate according to worst-case scenarios, cell phones could operate much more safely. With the mountains of innovation present in our engineers,

programmers, and scientists, cell phone radiation inhibitors could be simple fixes to a potentially complex, worldwide problem.

CHAPTER 14

CONCLUSION

Many studies show that cell phones do not actually emit dangerous levels of radiation. These same studies also show that cell phones do not impact the overall health of the cell phone's human host. These studies are quite common.

Other studies show that cell phones do emit dangerous levels of radiation. These studies show cell phone radiation preceding cancer and/or tumor development for many individuals, primarily after a prolonged period of use (often 10 or more years of use). This exposure to radiation has also been shown to negatively affect the fertility of male cell phone users who pocket their phones or utilize belt clips. Additionally, lab studies indicate that prolonged cell phone exposure by pregnant women may result in birth defects in the child, such as behavioral disorders. The increasingly young age at which children operate cell phones is also shown to have the potential of causing behavioral issues like ADHD.

While humans may be swathed in wireless technology and radiation, our cell phones are our nearest companion, rarely leaving our side. Studies continue to have inconclusive data concerning the dangers of cell phone radiation, and researchers suggest concrete evidence may take 20-30 years, leaving lifetime cell phone users either quite relieved by the results (radiation exposure as harmless), or grieving in the consequences of innocent ignorance (radiation exposure as causing human harm).

Ultimately, the cell phone regulations set in place by the FCC and FDA in 1996 are dated and due a reevaluation. Most cell phones and computers are considered nearly obsolete after only a few years, yet the regulations we use to set the standard for cell phone radiation safety were created more than 15 years ago.

The International Agency for Research on Cancer (IARC) concluded recently that cell phone radiation is “possibly carcinogenic to humans” (National Cancer Institute, 2012, *What do expert organizations conclude?*, para. 1). The American Cancer Society (ACS) concluded that, while evidence is inconclusive, “individuals who are concerned about radiofrequency exposure can limit their exposure, including using an ear piece and limiting cell phone use, particularly among children” (National Cancer Institute, 2012, *What do expert organizations conclude?*, para. 2). The National Institute of Environmental Health Sciences (NIEHS) concluded that “more research is needed” (National Cancer Institute, 2012, *What do expert organizations conclude?*, para. 3). These responses contradict cell phones’ supposed safety.

As cell phones have become such an integral part of our lives, we have demanded more and more from them. Cell phones have replaced many things, yet are continuously improved to offer newer, better features. With these new, better phones that do more than the last model, they are becoming much more highly powered, as well. This higher power translates into higher radiation, oftentimes, which should then translate into higher standards for safety. This is wherein the failure lies.

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APPENDIX

APPENDIX

Table 1: Cell Phone Ownership

% of all adults in each group who have a cell phone

Total	85%
Gender	
Men	88
Women	82
Age	
18-29	96
30-49	90
50-64	85
65+	58
Race/Ethnicity	
White, non-Hispanic	85
Black, non-Hispanic	79
Hispanic	84
Household Income	
Less than \$30,000	75
\$30,000-\$49,999	90
\$50,000-\$74,999	93
\$75,000+	95
Education level	
Less than High School	69
High School Diploma	82
Some College	91
College+	90
Geography	
Urban	84
Suburban	86
Rural	77

(Crockett, 2010)



Figure 1: X-ray of a Glioma
(Priya, 2009)

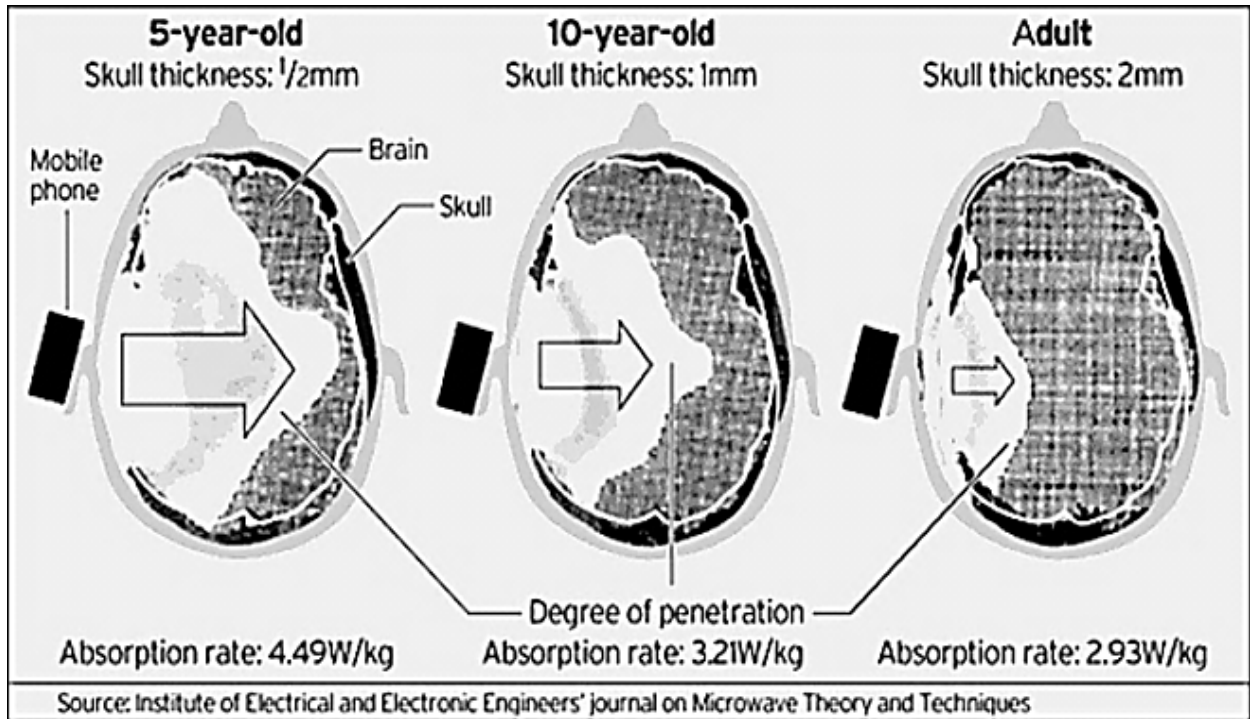


Figure 2: How Mobile Phone Radiation Penetrates the Brain

(Inspiration Green, 2012)

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