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Investigating Cell Phone Radiation Exposure: Actions of the US Government

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As a non-tradition student, the completion of this degree and research truly proves that I can do all things through Christ who strengthens me. I dedicate this accomplishment to professors Dr. Randolph Burnside, Dr. LaShonda Stewart, Dr. Dhitinut Ratnapradipa, and my greatest supporter, Xavier Proctor. I could not have completed this work without you all's encouragement.

INVESTIGATING CELL PHONE RADIATION EXPOSURE: ACTIONS OF THE US GOVERNMENT

By

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TITLE: INVESTIGATING CELL PHONE RADIATION EXPOSURE: ACTIONS OF THE US GOVERNMENT

MAJOR PROFESSOR: Randolph Burnside Ph.D.

Almost every man, woman, and child in America has used a cell phone at some point in time. Cell phones make staying connected more than just a phrase. They make almost all forms of communication possible. However, the grisly reality about cell phones is, they emit radiation. The source of the radiation is the phones' antenna. Although thought to be harmless to humans, the type of radiation they emit is under investigation for causing adverse effects on human health. In 2001, peer–reviewed research findings on cell phone radiation brought to the attention of the World Health Organization caused the organization to increase the threat level of the radiation emitted by these devices. To date, there is no consensus among researchers as to whether cell phones are harmful to human health or not. Research conducted by the cellular industry refutes a link to adverse health effects, while independent research studies confirm a link. Currently, US regulatory agencies are getting the brunt of the backlash as damaging information about the devices' testing practices, radiation exposure limit, and manufacturer usage suggestions come to the forefront. Although no conclusive evidence has been established yet, a perceived threat to consumer safety has forced policy makers into action. This research attempts to answer the following question:

Research Question: What actions have the US Government taken to limit the threat of adverse effects to human health associated with cell phone radiation exposure?

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INTRODUCTION

Cell phones are now woven into the fabric of society as we know it. Currently, out of the 7 billion plus people living on this planet (UN News Centre, 2011), it is estimated that 6 billion of those people have cell phone subscriptions (Whitney, 2012). Such ubiquitous use of a product is important to consider because of its rapid growth and development. In a matter of 30 years, cell phones have advanced from just making telephone calls to making calls, checking and sending emails, surfing the internet and more. However, cellular technology has uncertain effects on human health. This is concerning from both a policy and public health stance. Currently, discrepancies exist among experts as to whether or not the radiation emitted by cell phones poses harm to humans.

The trend in recent research suggests no conclusive evidence exists proving cell phone radiation has adverse health effects on humans. But, there is no evidence conclusively proving cell phone radiation harmless, an important distinction advocates on both sides of the issue need to recognize (German, 2011). The controversy surrounding cell phone radiation is now widespread across continents and raises serious health concerns for the general public. Both policy makers and public health organizations worldwide are focused on a resolution for this matter.

A surge of information brought to the forefront through research findings revealed that cell phone manufacturers set distance requirements to minimize consumers' radiation exposure; a fact that many cell phone users are unaware exists. As a result, consumers are using cell phones improperly which, according to research findings, substantially increases their exposure rate. In an effort to get answers regarding rising concerns, organizations worldwide have launched

investigative research into the matter. In the US, policy makers have begun to create legislation to combat negative health impacts that could be the reality of the near future.

LITERATURE REVIEW

To begin an informed discussion on cell phone radiation the phrase must first be defined. Cell phone radiation is heat produced by cell phones. In some cases, this heat can cause a cell phone to warm the skin on the side of the face where the phone is held. In actuality, the heat is a form of electromagnetic radiation of which there are two types; ionizing radiation and non-ionizing radiation. Cell phone radiation is considered to be non-ionizing.

Carlton (2001) explains ionizing radiation as having energy levels high enough to strip electrons away from atoms in a molecule, this reaction is called ionization. During diagnostic x-rays exams lead shielding, impenetrable to scatter radiation, is placed on a patient to protect radiation sensitive areas of the body from exposure because ionizing radiation is used. If exposed to ionizing radiation, serious damage to biological tissue will occur. He explains non-ionizing radiation as having enough energy to move atoms in a molecule around or cause them to vibrate, but not enough to strip electrons away. Therefore, ionization does not occur. The vibrating reaction typically only causes a heat sensation. MRI exams use non-ionizing radiation which typically does not cause biological damage. However, if inappropriate settings are used to calculate the intensity of radiation needed for the exam, overexpose can occur and severe burns will result. In general this rarely occurs, but it is possible.

Non-ionizing radiation emitted by cell phones enters the body of the user as radiofrequency (RF) waves. RF waves are two-way signals that allow cell phones to communicate with base stations or what is commonly known as cell phone towers. To make a cell phone operable, RF waves act as signals that are received and transmitted between cell

towers and cell phones via an antenna built into the phone. The RF waves produce an electromagnetic field (EMF) around the cell phone. The field is an invisible pulsating energy that manifests as heat emanating from the device. Because RF waves produce EMF and both contribute to the production of non-ionizing radiation from cell phones, the abbreviation RF-EMF radiation will be used to express this information in this paper.

Cell phone users are exposed to RF-EMF radiation emitted by cell phones when the phone is placed directly against the ear to talk, or any part of the body within approximately one inch of the field surrounding the phone. Cell phone users are continually exposed to RF-EMF radiation while the device is turned on, whether the device is in use or not (GAO, 2012). The agency responsible for oversight of radiation exposure contends cell phones only emit RF energy when the device is in use (federal Communications Commission, n.d.). However another source, Cell Phone Use (2011), explained that because the antenna is built directly into cell phones, while the power is on, the device will always emit a signal because it is in constant communication with surrounding cell towers. To eliminate RF-EMF radiation exposure from a cell phone the device must be completely turned off.

Source of Radiation

Antennas, which are housed inside a cell phone receive and transmit RF signals. This function makes the antenna the main source of radiation consumers are exposed to when handling the device. The amount of radiation consumers are exposed to is regulated by the Federal Communication Commission (FCC), the main regulatory agency for wireless telecommunications in the US. This organization has the final say as to whether a cell phone is safe for consumer use.

An investigation into antennas commonly used in cell phones revealed that when held very close to the head, the standard RF exposure limit regulated by the FCC was exceeded (Faruque, Islam, & Misran, 2011). The RF exposure limit is used to determine a safe amount of radiation allowed to be absorbed into the body. Faruque, Islam, and Misran (2011) conducted a study on cell phone antennas using a simulated human head that tested different tissue types found in the head i.e. skin, muscle, fat, bone, cerebrospinal fluid, brain matter (grey and white), blood, cartilage, vitreous humor, lens, and eye sclera. The types of antenna tested in the study include the monopole, helix, patch and PIFA. The study found the monopole antenna exhibited the highest temperature levels in all the tissues tested, while the patch antenna was the most likely to meet the FCC RF radiation exposure limit. Although the amount of radiation absorbed in head tissue is regulated, when used close to the head the antenna still exceeded the FCC exposure limit. The antenna also exceeded the international exposure limit established by the International Commission on Non-Ionizing Radiation Protection (ICNRP) which is slightly different from the US limit. After contacting several brands of cell phones i.e. Apple, Blackberry and Samsung about the types of antenna used in the construction of their most popular cell phones, the companies cited the information as proprietary.

Expert Opinions

Not all cell phone radiation researchers buy into the theory of cell phones causing adverse effects on human health. Still others warn that harmful effects arise from placing the phones in direct contact with the body. The main issue triggering concern is whether RF-EMF radiation from cell phones has the energy to damage biological tissue. By definition alone, RF-EMF radiation cannot cause damage, however, it can heat human tissue the same way a microwave oven heats food. Overexposed biologic tissue may burn; its structure and function can potentially

be changed or damaged. Currently, there is no consensus among experts proving or disproving a link between RF-EMF radiation from cell phones and adverse effects on human health. Investigative research remains fervent in the pursuit of conclusive evidence.

According to reports from the United States Government Accountability Office (GAO) cell phone manufacturers explicitly state cell phones should never be held closer than the minimum safe distance of 1 inch to the body (GAO, 2012). In addition to this, Dr. Sanjay Gupta (2011) revealed that not only do the distance requirements exist, but they vary depending on the manufacturer of the phone (See Appendix A for examples). He reported that the manufacturers' of Blackberry phones print safety instructions on the operator's manual inserted in the packaging. In his interview Gupta (2011) said the insert instructs users to keep the BlackBerry device at least .98 inches from the body.

Similar peer-reviewed research findings led the World Health Organization (WHO) to revise its rating of cell phone radiation. In 2011, the WHO raised the threat level of cell phone radiation to Group 2B-possibly carcinogenic to humans, the same category as lead (International Agency for Research on Cancer, 2013). Kang (2010) emphasized that it is the mere suggestion of a link between cell phone radiation and adverse human health effects that experts warn warrants concern.

Radiation Exposure Limits

Since the WHO's rating change, the FCC has come under scrutiny for its regulation of RF exposure. The GAO (2012) explained that the FCC needs to reassess the current RF exposure limit established for cell phones. The organization stated that the current RF exposure limit was established and implemented in 1996. However, due to technological advances, the FCC's exposure limit for cell phone radiation is obsolete. The organization also revealed that the

exposure limit was set based upon recommendations made in 1991. Those recommendations came from the non-governmental organization the Institute of Electrical and Electronics Engineers (IEEE), world leading experts in technology and from federal health and safety agencies that include the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the National Institute for Occupational Safety and Health (NIOSH).

The current exposure limit sets the RF radiation exposure limit at 1.6 W/kg (watts per kilogram) over 1gram of tissue (Federal Communications Commission, n.d.). The GAO (2012) also reported that in 2006 the IEEE established updated recommendations for a new RF exposure limit based upon a better understanding of thermal heating effects. These effects can occur when biologic tissue i.e. skin, cartilage, brain matter, etc. get exposed to high levels of RF-EMF radiation from cell phones. The organization stated the newly suggested exposure limit is 2.0 W/kg over 10 grams of tissue. Although the latter radiation exposure appears greater than the former, the new limit decreases the intensity or strength of the exposure by expanding it over a larger area of tissue.

The current limit of 1.6 W/kg is more localized than the newly recommended exposure limit. Kreisberg (2010) reported that researcher Dr. Sadetzk MD head of the Cancer Epidemiology Unit in Tel Aviv, Israel, found the more localized the RF-EMF radiation exposure, the greater the risk of developing adverse health effects. When the intensity is less localized, the less probability of biologic damage. However, it was also reported by the GAO (2012) that both exposure limits are set well below the threshold of thermal effects. It is unknown if technological advances were considered in the threshold measurements of the original RF exposure limit established in 1996.

The GAO (2012) reported that despite the recommendation given by the IEEE to reassess the exposure limit of RF-EMF radiation, the FCC has not revised the limit yet. The agency also confirmed with the IEEE that their new RF-EMF radiation exposure limit has reached a scientific consensus among experts in 40 countries including European Union Countries. In addition to recommendations from the IEEE, the GAO (2012) has also given the FCC recommendations for updates. Those recommendations include not only reassessing the current RF exposure limit, but also reassessing safety compliance testing to identify the maximum RF-EMF exposure to consumers.

Specific Absorption Rate (SAR) and Compliance testing

Cell phone radiation is measured by specific absorption rates called SAR values. These values measure the amount of RF energy or radiation absorbed by the body. The GAO (2012) revealed tests conducted by the FCC for cell phone safety and compliance do not test the maximum SAR values for all usage conditions; that includes holding the device directly against any part of the body. The regulatory agency only tests SAR values with minimum safe distance accessories in place; these include hands-free devices such as ear pieces. The accessories provide a 1 inch distance from the body. This distance requirement is recommended by cell phone manufactures for consumer safety (GAO, 2012). Gupta (2011) stated that only if specified by the manufacturers' operating instructions, do the FCC test for maximum SAR values from direct contact with the body. He also stated that if cell phones are held directly against the body, the FCC cannot guarantee that the cell phone is not emitting radiation beyond the RF exposure limit. Therefore, the maximum RF-EMF exposure a cell phone user receives from placing the device directly against the body is unknown and remains untested. This is extremely significant because exposure to high levels of RF-EMF radiation can lead to biologic tissue damage from thermal

heating effects (GAO, 2001). Measuring maximum SAR values for all usage conditions detects the amount of RF-EMF radiation deposited into the body which can pinpoint overexposure.

Cell phone manufacturers recognized that holding cell phones directly against the body is an unsafe practice. In recognition of this problem, minimum safe distance requirements were established and placed in the fine print of cell phone packaging. In addition, minimum safe distance accessories are made available to the general public for purchase when buying a cell phone. But, these safety accessories are not emphasized as mandatory devices for protection against adverse health effects, they are optional.

The FCC (n.d.) stated "Some parties recommend taking measures to further reduce exposure to RF energy. **The FCC does not endorse the need for these practices**…" (p. 2), but, the agency then provides the following information as precautions for concerned consumers;

- Use a speakerphone, earpiece or headset to **reduce proximity to the head (and thus exposure).** While wired earpieces may conduct some energy to the head and wireless earpieces also emit a small amount of RF energy, both wired and wireless earpieces remove the greatest source of RF energy (the cell phone) from proximity to the head and thus can greatly reduce total exposure to the head.
- **Increase the distance** between wireless devices and your body.
- Consider texting rather than talking

Despite FCC claims of safety, distance requirements and maximum SAR value testing for RF-EMF radiation exposure from cell phones is crucial because of potential overexposure that could result in thermal heating effects (GAO, 2012). These effects rapidly heat biologic tissue and can cause harm by increasing body temperature, disrupting cell behavior, and damaging the tissue (GAO, 2012). In the case of RF-EMF radiation from cell phones, the temperature of the

affected area can be increased to a level that the exposed cells can be changed or damaged from prolonged exposure and repetitive use over time. This is important when considering how cancer is developed in the body. The National Cancer Institute (2013) states that cancer is formed when the DNA of a cell becomes changed or damaged, producing mutations that affect normal cell growth and division. When this happens, cells do not die when they should and new cells form when the body does not need them. The extra cells then form a tumor. There are several ongoing studies worldwide being conducted to determine the long-term effects of RF-EMF radiation exposure on human health.

Regulatory Responsibilities

According to the FDA (2012), they share regulatory responsibilities for cell phones with the FCC. They state that the FCC certifies wireless devices, and ensures that all cell phones sold in the US comply with guidelines for the RF exposure limit. The FCC relies on the FDA and other health agencies to answer health and safety related questions about cell phones. Because the FCC's primary area of expertise is not health and safety, the agency relies on the recommendations of other agencies for guidance on issues of health and safety. The FDA (2012) states, under US law they do not have to review the safety of cell phones before they are sold, as it does with new drugs or medical devices. However, the agency does have the authority to take action if cell phones are shown to emit hazardous levels of RF radiation. The FDA reports their authority is limited to requiring cell phone manufacturers to notify subscribers of health hazards or the recall of cell phones.

Prior Research Study Findings

The GAO (2012) explained that there are two types of tests performed to understand the implications of adverse effects from RF-EMF radiation from cell phones on human health; (1)

epidemiological tests, and (2) laboratory tests. Epidemiological tests are conducted to determine associative links between health effects and the characteristics of people. The length of time people spend on their phones and the placement of the phone while in use is an example of a characteristic studied by epidemiological test. Laboratory tests determine causal links between risk factors and adverse health effects and how they occur. These tests are done on subjects like laboratory animals, tissue samples, and human volunteers.

Current, epidemiological testing has not demonstrated conclusive evidence linking RF-EMF radiation exposure from cell phones to adverse effects on human health. The largest epidemiological study to date, the INTERPHONE study, conducted by the International Agency for Research on Cancer (IARC), a specialized cancer agency of the WHO (Cardis et al., 2007), documented perplexing findings. Researchers working with the multinational study collected information that concentrated on tumors developed in human tissues most exposed to cell phone radiation (FDA, 2011). Several nations working with the study announced a possible link, but the findings were later denounced. INTERPHONE study officials cited selection and other bias in addition to recall errors as the cause.

The INTERPHONE Study Group (2010) initiated the epidemiological retrospective case-control study to investigate whether cell phone radiation increased the risk of four types of tumors in humans: Acoustic Neuromas, Meningiomas, Gliomas, and Parotid Gland tumors. More specifically, the study's focus was to determine if RF-EMF radiation from cell phones contributed to the formation of the tumors. Cardis et al. (2007) reported there were thirteen countries (Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden, and the United Kingdom) that participated in the decade long study. At the completion of the study the countries compiled their findings, creating one final

INTERPHONE study report. The researchers included 2,765 cases of Glioma, 2,425 cases of Meningioma, 1,121 cases of Acoustic Neuroma, 109 cases of malignant Parotid Gland tumors and 7,658 controls. Results from 5 of the 13 countries (Australia, Canada, France, Israel and New Zealand) revealed an increased risk of Glioma in heavy long-term cell phone use, but smaller increases of risk for Meningioma (Cardis et al., 2011). The study also revealed people with heavy cell phone usage for an average of 30 minutes per day over 10 years have a 40 % increased risk of developing a brain tumor (International Agency for Research on Cancer, 2011). As compelling as these findings appear in proving a link between RF-EMF radiation from cell phones and adverse effects on human health, Cardis et al. (2011) stated that the uncertainty of the results requires they be replicated before a causal interpretation can be made. So, n other words, it could be another 10 years or more before solid evidence either confirms or definitively denies a link exists.

Despite conflicting views of the information reported by the INTERPHONE study, the IRAC deemed it plausible to recommend the WHO increase the threat level of cell phone radiation and they did. That decision was based largely on data from the INTERPHONE study (WHO, 2011). It is important to note that according to information from the WHO the upgraded category of cell phone radiation, Group 2B, classifies something when a causal association is considered credible, but bias cannot be ruled out with reasonable confidence.

It should also be noted that while epidemiological studies are practical to use for determining the cause of diseases, inherent limitations exist with the studies (GAO, 2012). The limitations make it difficult to draw definitive conclusions for three reasons. (1) It is difficult to measure all variables that may affect the results. (2) Chosen participants already have the disease which makes it is impossible to detect incidence of disease. And, (3) the number of participants

are decided beforehand so prevalence of disease can not determined. In addition to these testing flaws, INTERPHONE study researchers relied on participants' memory of their phone use through questionnaire query instead of direct observation (INTERPHONE Study Group, 2010).

More evidence alluding to a link between cell phone radiation and adverse effects on human health exists in other studies. Kreisberg (2010) lists the following four study results as supporting evidence.

(1) The Danish National Birth Cohort study's aim was to investigate prenatal and postnatal exposure to cell phones and behavioral problems in young children. Study finding showed children that had prenatal and postnatal exposure to cell phone radiation through indirect and direct use of cell phones have an 80% increased risk of emotional and hyperactivity issues (Divan, Kheifets, Obel, & Olsen, 2008).

(2) A compilation study combined study findings that included (1) a study investigating the association between the use of cell phones and/or cordless phones and the risk of brain tumors in different urban and rural areas in central Sweden (Hardell, Carlberg, & Mild, 2005), and (2) a paper that complied the research of several cohort studies evaluating the risk of brain tumors in long-term cell phone users. The compiled findings demonstrated a consistent pattern of increased risk of acoustic neuroma and glioma for people using cell phones for more than 10 years (Hardell, Carlberg, Soderqvist, Mild, & Morgan, 2007)..

(3) The Danish Retrospective Cohort study's goal was to investigate a possible link between cell phone use and the risks for developing diseases of the central nervous system. Study findings illustrated long-term cell phone users were 10% to

20% more likely to be hospitalized for migraines and vertigo (Schuz, Waldemar, Olsen, & Johansen, 2009).

(4) The Israel component of the INTERPHONE study aimed to assess the association between cellular phone use and the development of parotid gland tumors. Study findings suggest an association between long-term heavy cell phone use and parotid gland tumors, and an increased risk for consumers who repetitively used their cell phone on the same side of the head; which supports a dose-response association between tumor development and cell phone radiation exposure. In addition, an association for cell phone use and adverse health effects in rural areas was found which was not shown in urban areas (Sadetzki et al., 2008).

The fourth study reporting adverse health effects in rural areas coincide with a precaution given by CNET cell phone technology expert Reardon (2011). She reported that the weaker the signal, a cell phone must boost its power to connect, which increases the amount of radiation emitted. The Sadetzki et al. (2008) segment of the INTERPHONE study reported that the decreased presence of cell phone towers in rural areas equated to weak RF signals. When the signal strength is weak, greater amounts of radiation is emitted when connecting a call. This means the RF-EMF radiation dose to a cell phone user in rural areas can be significantly increased. An increased dose of radiation increases the risk of developing adverse health effects. Experts at CNET warn consumers of increased exposure when cell phone signal strength is weak and advice them to avoid using a cell phone in places where you get a poor signal.

In another study, Nittby et al. (2009) reported that one of the known effects of cell phone radiation is a break in the Blood Brain Barrier (BBB) of laboratory animals. The BBB is a thin layer of capillaries that encapsulates the brain and prevents damage from harmful compounds in

the blood. They state that the BBB was ruptured at a RF-EMF energy level of 915 MHz, the same frequency level able to power a cell phone. Nibby et al. (2009) detected a break in the BBB 7days after a 2 hour session of exposure to RF-EMF radiation. The BBB break remained observable for 14 days. Some of the other effects reported by Nibby et al. (2009) included alterations in cognitive brain function, changes in the chemical activity of the brain, alterations in gene expression in several areas of the brain, and an impact on the EEG activity (wake and sleep cycles) of the brain using an RF-EMF exposure of only 450MHz, well below the frequency level used to power a cell phone. Most cell phones in the US operate anywhere from between 824MHz up to 1990MHz frequency levels.

Cancer Epidemiologist Dr. Devra Davis revealed that she too found evidence of a link that RF-EMF radiation from cell phones caused adverse effects. Her results showed breaks in the BBB, damaged DNA, and an increase in certain markers in the body used to predict an increased risk of cancer (Cell phone Use, 2011). Dr. Davis also mentioned two other studies that link RF-EMF radiation from cell phones to adverse health effects. The first study's results showed an increased brain glucose metabolism after a 50 minute cell phone exposure, of which the long-term effect remains unknown. But, Dr. Davis stated that the brains of Alzheimer's patients are quoted as being "full of sugar", sugar referring to glucose. The second study's results showed that RF-EMF radiation from cell phones may lead to a significant decrease in sperm morphology, motility and viability (Cell Phone Use, 2011).

Being an expert in her field, Dr. Davis reported that what is important to realize is brain cancer has a latency period of about 40 years. So, studies that show risk markers at 10 years are cause for concern. As a toxicologist who also studies the environment Dr. Davis explained that there are very few environmental causes that show impacts after 10 years which she stated raises

her concern of the negative impacts from cell phone radiation in the future (Cell Phone Use, 2011).

US Cell Phones

Cell phones have undergone many technological advances since being introduced in the US in the late 1970's (FCC, 2013). In that span of time cell phones have evolved from analog to digital. Currently, the most popular cell phone services in the US are digital and PCS (personal communication service) ("What is the Difference", 2000). Digital service uses digital phones that communicate with analog cell towers, so in a sense they are a hybrid technology that combines analog (old) and digital (new) technology. PCS is a completely digital service and incorporates the use of paging, caller ID and email into cell phones. Brian, Tyson and Layton (2000) reported that PCS phones are commonly referred to as smart phones. They report that **analog cell phones in the US operate between 824-MHz to 894-MHz** frequency bands but, **PCS (digital) cell phones operate between 1850-MHz to 1990-MHz** frequency bands. By definition, frequency bands are groupings of RF signals (Mobileburn, 2001). These bands are responsible for delivering the RF-EMF radiation exposure to consumers.

In 2001, the GAO (2001) reported that researchers debated whether digital phones had different biological effects from analog phones. The FDA concluded at that time, that the available scientific literature did not demonstrate any differences. Fast forwarding to 2013 while current evidence shows digital cell phones operate at much higher power levels than analog cell phones, the effects of biological effects remain unspecified. It is reported that damage to biologic tissue occurs at a higher level of RF-EMF exposure, but what level is considered high? An exact number is not provided.

Although PCS digital phones provide the advantage of keeping its users connected to several sources of communication at all times, the disadvantage of having such a tool is the increased RF-EMF radiation exposure. PCS digital phones exposure is significantly higher than analog phones of the past. But, the popularity of digital phones makes them the technology of the future. However, with concern that the FCC's RF exposure limit is outdated, a gap in consumer safety exists. What this means for human health, only time will tell.

US Government Actions

Because of the perceived gap in safety gap, several US government officials have proposed legislation to promote awareness of potential adverse health effects associated with cell phone radiation. This awareness came in the form of warning labels for cell phone packaging. A majority of cell phone research studies offer words of caution, warning governments across the world to adopt precautionary measures until further evidence becomes available. The warnings are disseminated because studies show that low doses of RF-EMF radiation from cell phones have effects on biological tissue (Cell Phone Use, 2011), although some of the effects realized are not fully understood.

US states taking part in the development of precautionary legislation asked that warning labels and specific language be placed on cell phone packaging. The warning labels would indicate the potential adverse effects of RF-EMF radiation from cell phones. US states with proposed legislation include Maine, California, New Mexico, Oregon, and Pennsylvania (German, 2011) and a congressional bill from Ohio congressman Dennis Kucinich (Tam, 2012).

The Legislative Process

Before exploring detailed information about the legislation presented in the US the process by which they are implemented into law is important to understand. The United States

House of Representatives (2013) explains the path of a legislative bill becoming a law as the following: A bill can originate in either the House of Representatives or the Senate, but it first has to have a sponsor. After sponsorship, the bill is then assigned to a committee for review. If the bill is not released by the committee, it becomes inactive and placed in what is called the dead files. If released by the committee, the bill is voted on, debated or amended. If the bill passes in the House of Representatives, the bill moves to the Senate. In the Senate, the bill is assigned to another committee and, if released, it is voted on. A majority vote in the Senate passes the bill. At this point, a conference committee made up of House and Senate members works out any differences between the House and Senate versions of the bill. This last draft returns to the House and Senate for final approval. Finally, the Government Printing Office prints the revised bill in a process called enrolling. After being printed the President has 10 days to sign or veto the enrolled bill.

METHODOLOGY

Legislation for warning labels on cell phone packaging was proposed in the US Senate, House of Representatives, and Congress. To address the research question in this paper (What actions have the US Government taken to limit the threat of adverse effects on human health associated with cell phone radiation exposure?) the legislation were examined to identify if their policies had any relevance to recent research findings and expert opinions (See Appendix B). The legislation were also examined to identify if bipartisanship had any bearings on whether they passed into law or failed.

Analysis

In 2010, Maine's Democratic Representative Andrea Boland introduced bill LD1706 (2010) in the 124th Legislature of the House of Representatives. The bill was co-sponsored by

Democratic Senators Lisa Tessier Marraché, John Nutting, Lawrence Bliss, Philip Bartlett, and Democratic State Representatives Seth Berry, Cynthia Dill, Stacy Dostie, Mark Eves, Teresea Hayes, Edward Legg, Peggy Pendleton, Hannah Pingree , Diane Russell, James Schatz, Peter Stuckey, Charles Theriault , Pamela Trinward, and John Tuttle. Democratic only backed legislation LD1706 (2010) required warning labels be placed on all cell phones and cell phone packaging for all phones sold in Maine. In addition, the label was to be non-removable, free from other writing, take up at least 30% of the back of the cell phone surface in writing different from all other fonts, and be in a color different from the phone with a color graphic symbol. The warning label stated "Warning, this device emits electromagnetic radiation, exposure to which may cause brain cancer. Users, especially children and pregnant women should keep this device away from the head and body (LD1706, 2010, p. 1)." This bill was referred to the Health and Human Services committee of the House. From there, it was sent to the Senate for concurrence where it was amended and referred back to the Health and Human Services committee. After being released to the House, a vote of ought not to pass (ONTP) as amended vote was entered and accepted. The bill failed 83-62 with 6 absences. Sent for concurrence in the Senate, the bill also failed there while in committee 20-14 with 1 abstention and 0 absences.

In 2011, Representative Boland introduced the same The Children's Wireless Protection Act as LD1014 (2011) in the 125th legislature as its primary sponsor. The bill kept some of its previous co-sponsors but gained others, adding a couple of republicans to its roster. The co-sponsors included Democratic Senators Larry Bliss and John Tuttle; Democratic State Representatives Ann Peoples, Stephen Lovejoy, Teresea Hayes, Michel Lajoie, Seth Berry, and Republican State Representatives Beth O'Connor and Richard Malaby. Bipartisan backed bill LD1014 (2011) required that a warning label be visible on the exterior cell packaging only that

stated “Warning: Federal health safety standards have yet to be established for non-thermal effects of cellular telephone radiation, which have been identified as reasons for health safety concerns, such as brain tumors (p. 1).” The warning label also directed consumers to the owner’s manual for more information. The bill was referred to Maine's House Committee on Energy, Utilities, and Technology where a majority vote of ONTP was entered and accepted. The bill was placed in the legislative dead file (LD1014, 2011).

In 2013, the same Children’s Wireless Protection Act was reintroduced as LD1013 (2013) by primary sponsor Representative Boland in Maine’s 126th legislature of the House of Representatives. The co-sponsors again varied, but it maintained bipartisan sponsorship. Co-sponsors of the bill included Republican Senator Ronald Collins, Democratic Representatives Teresea Hayes, Brian Jones, Karen Kusiak, William Noon, Republican Representative Allen Nadeau, and Independent Representative Jeffrey Evangelos. The bill’s goal of establishing a warning label on cell phone packaging remained the same, but the wording was changed. The warning label if implemented will state; “This device emits radiofrequency electromagnetic fields. Avoid direct contact (LD1013, 2013, p. 1).” LD1013 moved from the House to the Senate for concurrence where no other information has been released.

California bill SB1212 (2010), solely sponsored by Democratic Senator Mark Leno, was introduced in the regular session of the 2009-2010 U.S. Senate. The bill required a warning label with specific language detailing specific absorption rate by definition be included at the point of sale, on the packaging, and in the instruction manuals for all cell phones sold in the State of California. The legislation aimed at placing a warning label on the outer packaging of cell phones that originally stated: "This device emits radiation. The federal specific absorption rate (SAR; a measure of radiation) limit is ____. This device emits a maximum of ____ when held at

the ear and a maximum of ____ when attached to the body (SB1212, 2010, p1).” After several amendments to the bill and its third reading on the Senate floor, the bill failed 16-14 with 8 abstentions and 0 absences. However, it received 36 votes in favor of being reconsidered. But, at the request of Senator Leno the bill was placed in the inactive dead files.

In 2011, Senator Leno solely sponsored another bill, different from the prior bill regarding cell phone radiation, SB 932 (2011). The bill was introduced in the regular session of the 2011-2012 Senate as an addition to a Health and Safety Code relating to product safety. The bill required the following notice be placed on cell phone packaging “This device emits radio-frequency energy. Consult the user's manual for additional information on safe use (SB932, 2011, p. 1).” Additional language that said, "Do not hold or carry it directly against the body when connected to a network or you may be exposed to levels greater than the safety limit established by the Federal Communications Commission (SB932, 2011, p. 1)" was amended from the bill. The bill was referred to a Senate committee twice, where after the second referral SB932, like the previous bill sponsored by Senator Leno, was also ordered to the dead files.

New Mexico's Democratic Senator Brian F. Egolf introduced House Memorial HM32 (2011) to the state’s 50th Legislature in 2011. A legislative Memorial unlike a legislative bill does not have the force of the law behind it; it expresses legislative intent or requests that Congress create a law pertaining to its subject matter (New Mexico Legislature, 2013). Solely sponsored by Senator Egolf HM32 (2011) directed New Mexico’s state government to study literature and report the effects of cell phone radiation on human health. In addition, the Department of Health and the Department of the Environment were to prepare reports recommending remedies for the effects of any adverse health effects caused by cell phone

radiation exposure. The memorial passed in the House of Representatives 43-24 with 3 absences. It is currently operative in the state.

Oregon's bill SB679 (2011) was introduced in the Senate in 2011 by primary sponsor Democratic Senator Chip Shields. The bill was co-sponsored by Democratic Senators Alan Bates, Laurie Monnes Anderson, Rod Monroe, and Representatives Democrat Ben Cannon and Republican Jim Thompson. Bipartisan sponsored bill SB679 (2011) required retailers in Oregon to put a warning label on cell phone packaging that stated "Warning: This is a radio-frequency (RF), radiation-emitting device that has non-thermal biological effects for which no safety guidelines have yet been established. Controversy exists as to whether these effects are harmful to humans. Exposure to RF radiation may be reduced by limiting your use of this device and keeping it away from the head and body (SB679, 2011, p. 1)." After being read for the first time on the Senate floor, the bill was referred to the Consumer and Small Business Protection Committee. The bill never made it out of committee; it became inactive and was placed in the dead files.

Representative Vanessa Brown of Pennsylvania introduced bill HB1408 (2011) to the House of Representatives in 2011. Co-sponsors of the bill included Democratic State Representatives Cherelle Parker, Michelle Brownlee, Margo Davidson, Babette Josephs, Phyllis Mundy, Rosita Youngblood, Peter Daley, Tony Payton Jr., Edward Staback, and Republican State Representatives Dennis O'Brien, Kate Harper, and Jerry Stern. Bipartisan sponsored bill HB1408 (2011) mandated that a warning label be placed on cell phone packaging that stated "This device emits electromagnetic radiation, exposure to which may cause brain cancer. Users, especially children and pregnant women, should keep this device away from the head and body (HB1408, 2011, p. 1)." The bill was referred to the House Committee on Consumer Affairs

where no votes were recorded. The bill became inactive while in committee and put in the dead files.

Ohio's Democratic Representative Dennis Kucinich introduced bill HR6358 (2012) in the 112th Congress in 2012. The bill was co-sponsored by Democratic Representatives Grace Napolitano, Chellie Pingree, and Elijah Cummings. The bill was entitled the Cell Phone Right to Know Act. Democratically endorsed bill HR6358 (2012) would have enacted a research program to examine, label, and communicate adverse human biological effects associated with exposure to electromagnetic fields from cell phones and other wireless devices. The bill also required the FCC, EPA, and FDA promulgate various regulatory processes that investigate the effects adverse biological effects cell phone radiation have on people especially young children and pregnant woman. These organizations were to then disseminate pertinent information to the general public. HB6358 (2012) was referred to the Energy and Commerce Committee, then to the House Subcommittee on Health where it was never voted on and became inactive.

RESULTS

All but 2 legislation, Maine's LD1013 (2013) and New Mexico's HM32 (2011) failed. During the time of this research Maine's 126th legislature of the House of Representatives as still in session and LD1013 was still under consideration. The legislative memorial investigates all research centered on RF-EMF radiation from cell phones and reports all findings and recommendations for solutions. Review of all the legislation showed that party affiliation had no effect on whether they passed or failed. A majority of the bills were bipartisan sponsored. However, it should be noted that after review results revealed Democrats more often than Republicans and Independents took the lead on endorsing the bills.

DISCUSSION

All of the legislation presented in the US address concerns brought to the forefront by current research findings. However, the trend in scientific evidence linking RF-EMF radiation from cell phones to adverse health effects is stigmatized as inconclusive among many researchers and in the public eye. What this means is any terminology used to associate scientifically unproven facts regarding adverse health effects and cell phone radiation can be debated as an untruth.

Because language used in the legislation for warning label makes inferences about causality, they too have become as controversial as the subject they intend to address. For example Maine's legislation LD1706 (2010) used the phrase "may cause brain cancer". This language can be debated as an allegation that has no scientific proof according the present trend in research findings. In addition, the bill makes a generalization about information considered specific to individual cell phones. It states to "keep this device away from the head and body." Distance specifications are different for every phone (See Appendix A for examples). Instructing consumers to keep the product "away" may be mistaken as a warning to not use the product. This could be the argument of the cell phone industry. Maine's 2011 legislation LD1014 (2011) mentioned "non-thermal effect" and "brain tumors." Again, this is inappropriate language because the evidence only alludes to such a link. Using such phrases may be misinterpreted by consumers as factual claims. Maine's 2013 legislation progressed beyond the use of terminology that alludes to any unproven allegations; it simply states the facts. LD1013 (2013) has the potential to pass into a law; however, it is still in the legislative process with no other information reported. Oregon's bill SB679 (2011) used the phrases "non-thermal biological effects", "controversy", and "harmful to humans" on its label requirement. These words may

confuse consumers. And again, according to authorities on the matter, no scientific evidence has been presented as a proven fact that RF-EMF radiation causes biologic harm. Pennsylvania's bill HB1408 (2011) used the phrases "may cause brain cancer" and "keep this device away …" All of these terms can be argued as misleading due to a lack of evidence and the omission of specific distance requirements. Therefore, these types of words and phrases should not be used on cell phone packaging until more evidence becomes available that either refute claims of a link or proves them true.

Ohio's bill HR6358 (2011) is a comprehensive research program charged with the task of investigating cell phones and other wireless devices. Upon further review of the program, it was tasked with at least 5 objectives and involved several government agencies; the FCC, FDA, Environmental Protection Association (EPA), and the Health and Human Services Department (HHS). Due to the lingering effects of the 2008 US recession, long-term funding issues could be to blame for the failure of this bill. In addition, the program's goal included the investigation of wireless technology other than cell phones in its research. The inclusion of other wireless technology may have over burdened the program's goal making it appear too comprehensive in the eyes of US government official voting on the bill.

In California, warning label legislation proposed in 2010 requested that exact SAR values be placed on the outer packaging for consumer awareness. SB1212 (2012) required the maximum SAR values that consumers are exposed to when the phones are held directly against the body be placed on the label. Not only did the bill fail to pass into law, but the state suffered retaliation effects by the cell phone industry because of the legislation. After hosting 5 cellular industry trade shows in San Francisco, the Cellular Telecommunications Industry Association (CTIA) cancelled all future trade shows in the state after the legislation was proposed. The CTIA

(2010) stated how they boosted the state's economy by over $80 million and were disappointed in the state's action against the industry. Therefore, they stated, the organization decided to relocate the trade show to a state more eager to work with them (CTIA, 2010). San Francisco persisted in its attempt to pass the legislation and he CTIA filed a lawsuit against them stating there was no scientific evidence to back the allegation that some cell phones are safer than others based upon SAR values.

What California officials need to know is that mounting evidence has shown that all cell phones, no matter the brand or specified SAR value, are capable of emitting higher than recommended rates of RF-EMF radiation not used in accordance with manufacturer suggested usage. If a cell phone is placed directly against any part of the body while turned on, SAR values given by the FCC are longer applicable. This is because the FCC does not test SAR values for direct contact with the body.

California's final amended bill SB932 (2011) stated "This device emits radiofrequency energy. Consult the user's manual for additional information on safe use" (p. 1). This version of the bill had a better chance of passing into law. However, mounting pressure from the cell phone industry may be to blame for the bill's sponsor placing the legislation in the dead files.

Because consumers remain without protection against the potential threat of adverse health effects from cell phone radiation, legislation is still needed. The fact is, evidence does exist that demonstrates a link between RF-EMF radiation from cell phones and adverse health effects such as brain tumors, sleep disorders, breaks in the protective organ surrounding the brain the BBB, memory loss and other biologic disturbances not presented in this paper. Let us not forget the historical event similar to our current dilemma regarding cell phone radiation; the fight to warn consumers about adverse health effects associated with cigarette smoking.

Bates and Rowell (1999) explained that while research linking cigarette smoking to cancer was coming to the forefront, the tobacco industry's research was simultaneously unearthing the same evidence. They reported that instead of admitting the associated health risks existed, the tobacco industry casted doubt and controversy as a strategy to buy time at the expense of the public's health. Bates and Rowell's (1999) research uncovered evidence displaying how the tobacco industry tried to look responsible in the public view and maintain a facade of ignorance about their product while millions of people died. But, privately their goal was to convince the public that tobacco was harmless. The industry did this by publicly using statements that included

> "no clinical evidence", "no substantial evidence", "no laboratory proof", "unresolved", and "still open". Nothing has been "statistically proven", "scientifically proven", "or "scientifically established". There is no "scientific causality", "conclusive proof", or "scientific proof" (p. 2)

Today, there is factual evidence exposing tobacco products as adverse to human health. The American Cancer Society (2011) lists tobacco products as Group 1-Carcinogenic to humans. Bates and Rowell (1999) warned that as a lesson to be learned "a demand for scientific proof is always a formula for inaction and delay and is usually the first reaction of the guilty." Have we not learned our lesson?

Safeguards must be put in place to defend cell phone users against adverse health effects already revealed and those potentially in the incubation stage of development, such as brain tumors. A safeguard like SAR testing is not new when limiting radiation exposure, nor is the use the ALARA concept. ALARA is an acronym for As Low As Reasonable Achievable, a concept that means keeping exposure to hazardous radiation as far below the exposure limit as possible

(Statkiewicz-Sherer, Visconti, & Ritenour, 1993). This concept utilizes three principles; (1) **time**: decrease exposure time, (2) **distance**: increase distance from exposure, and (3) **shielding**: shield to protect against overexposure. After reviewing numerous research studies, evidence of the FCC and cell phone manufacturers utilizing 2 of the 3 principles that create ALARA was found. But, the formal name (ALARA) was never used. ALARA is usually implemented when dealing with biologically hazardous ionizing radiation. The ALARA principles given passively by the FCC and other government agencies as suggestions to decrease exposure are (1) **time** (reducing the amount of time of exposure) and (2) **distance** (increasing the distance from the source of radiation). Given the mounting evidence, these suggestions should be mandated safety precautions that warn consumers of a threat to their health. However, no official warning from the US government has been established.

In further support of this observation, the National Cancer Institute (2013) provided the following suggestions given by the FCC and FDA: (1) Reserve the use of cell phones for **shorter conversations** or for **times** when a landline phone is not available, and (2) Use a hands-free device, which places **more distance between the phone and the head** of the user. Again, the use of reduced time and increased distance is usually reserved for limiting exposure to ionizing radiation, known to cause biological damages in humans. Yet, these principles are provided as suggestions to decrease exposure to on-ionizing RF-EMF radiation from cell phones. If there were no threat of adverse effects to human health, then the use of ALARA would be irrelevant.

Although researchers' opinions are split, evidence of biological effects from low level RF-EMF radiation emitted by cell phones does exist and people are dying from it. The Group 2B threat level is further explained as having limited evidence of cancer in humans (International Agency for Research on Cancer, 2006; International Agency for Research on Cancer, 2013). So,

while evidence of RF-EMF radiation from cell phones causing cancer in humans exists, not enough cases have surfaced according to scientific standards to definitively state it is harmful to human health.

Consumers need to be adequately warned about distance specifications of cell phones and the very present health threat that looms if the requirements are not adhered to. If a better warning system is not implemented, one has to wonder about the emergency preparedness of the US, is our nation equipped to handle a pandemic of brain tumors and various types of cancer? Waiting for incidence levels to rise only creates a disaster that is preventable by having a better warning system in place?

Some researchers are convinced that research findings proving a link between RF-EMF radiation and adverse health effects in humans is accurate. The EM Radiation Research Trust (2009) a non-governmental organization aimed at providing facts about electromagnetic radiation and human health comprised of the EM Radiation Research Trust and the EMR Policy Institute in the U. K., and ElectromagneticHealth.org and the Peoples Initiative foundation in the US, released the collaborative report *Cellphones and Brain Tumors: 15 Reasons for Concern*. The published report listed concerns stating that research funded by the cell phone industry found conclusive evidence that cell phone use is linked to brain tumors. The organization reported studies funded by the cell phone industry had highly questionable results in comparison to independent studies. Independent studies consistently showed a significant risk of brain tumors from cell phone use where industry funded studies repeatedly report inconclusive findings. The EM Radiation Research Trust (2009) report stated:

> "If studies are funded by an entity with a financial interest in the findings, it has been shown, more often than not, the findings of such a study are favorable to the financial interest compared to studies where the funding has no financial interest (p. 27)."

To test this theory, a close examination of funding sources for the INTERPHONE study was completed. A review of the funders revealed several cellular industry contributors that included the Mobile Manufacturers' Forum and GSM Association, funds from mobile phone service license fees, the Canadian Wireless Telecommunications Association, the Ministry of Internal Affairs and Communications of Japan, and the Mobile Telecommunications, Health and Research Program (The INTERPHONE Study Group, 2010). The Proceedings of the Policy Studies Organization, No. 11 (2010) also cited funding as a potential trigger for skewed research results for the INTERPHONE study. They found that a significant portion of the study's funding was provided by GSM Association and the Mobile manufacturers Forum, organizations listed as funders for the study by the INTERPHONE Study Group (2010). And, just as the EM Radiation Research Trust (2009) suggested the INTERPHONE study partially foundered by the cellular industry reported inconclusive findings in establishing a link between cell phone radiation and adverse effects on human health. The INTERPHONE Study Group (2010) also revealed that the cell phone industry funded or were affiliated with 7 studies, of which, 6 found no correlation between cell phone radiation and adverse health effects: Cell phone industry researchers found no correlation in 85.71% of the studies funded by cell phone companies.

Recommendations

As far as research of cell phone radiation and the implication of adverse effects on human health are concerned, there needs to be a uniformed method of detecting overexposure. The attention of researchers should focus on the overexposure process: at what intensity does a RF-

EMF emitting device operating between a frequency of 1850-MHz to 1990-MHz become ionizing. Once this information is established it should then be used to determine a universal rate of overexposure for regulatory consideration and consistent reporting.

Once established the overexposure rate should be implemented in all research. Because researchers currently utilize a variety of different techniques to detect overexposure, studies reveal a variety of results. If a consistent method of detection were implemented, findings will unanimously prove or disprove a link between RF-EMF radiation and adverse effects on human health. Until this takes place, there may never be a consensus regarding research findings.

In addition, legislation for the creation of warnings labels on cell phone packaging should not be dismissed because of suggested inconclusive findings. Instead, the labels should be made simpler and include what is already known. For example "This device should be used with hands-free distance accessories that keep this device at a safe distance from the body. See inside packaging for manufacturers' suggestions for this device." The packaging should also include the definition of hands-free accessories and name several that function with the phone's model.

Another route of action to take for the sake of consumer safety is requiring manufactures to supply each cell phone purchase with a minimum safe distance accessory at a nominal charge to the consumer. Distancing the body from the source of radiation is a requirement established by the manufacturers'. Therefore, the accessories should not be optional, but mandatory. While this suggestion is no panacea for eliminating cell phone radiation exposure, it will certainly be revered as a progressive step in the right direction (Proctor, 2013). It is the words of wisdom from a US Judge in our nation's not so distant past that reminds us of what is most important.

> "All too often in the choice between the physical health of consumers and the financial well-being of business, concealment is chosen over disclosure, sales over safety, and

> money over morality. Who are these persons who knowingly and secretly decide to put the buying public at risk solely for the purpose of making profits and who believe that illness and death of consumers is an apparent cost of their own prosperity… (Bates & Rowell, 1999, p. 11)."

Limitations

This research did not investigate a full scope of studies conducted on RF-EMF radiation from cell phones. For example, only 1 of the 7 research studies funded by or affiliated with the cellular industry was examined for a correlation between funding and study results. In addition, this research only skimmed the surface of the potential adverse effects on human health from cell phone radiation. Other adverse health effects have been reported that significantly affect subcultures that include pregnant woman and children. In conclusion, more research should be done to investigate (1) the full relationship of cellular industry funded studies and their research results, (2) all illnesses and diseases reported in connection to RF-EMF radiation from cell phones, and (3) how policies diffuse to explain why so few legislation have been developed to combat such a large issue that affects billions of people in the US.

CONCLUSION

The facts presented in this paper should give US government officials pause before all evidence pertaining to cell phone radiation is dismissed as inconclusive. When deciding if warning labels should be placed on cell phone packaging, we must think of what the evidence has already shown us; cases of brain cancer on a small scale, latency periods for cancer development, BBB breaks, sleep disorders, reproductive issues and more. According to the cell phone industry and backed by the FCC, FDA and other government agencies, scientific evidence of RF-EMF radiation from cell phones has not proven a correlation to adverse human health

effects (See Appendix C for opinions). But, independent research studies illustrated the exact opposite. To add to the confusion, the FCC openly states on their website that they do not endorse the need for safety precautions, but the organization provides precautionary measures for consumer safety. As a cell phone user, reading the agencies' statement was just as confusing as the double minded reports that downplay the effects of prolonged exposure to RF-EMF radiation from direct contact to the body.

What must be considered is microwave oven energy, one step above RF energy on the electromagnetic spectrum, passes non-ionizing radiation and becomes ionizing radiation at a frequency near 2.45 GHz, and Bluetooth technology operates at 2.4 GHz (Define Microwaves, n.d.). When converted, 2.4 GHz equals 2400MHz, an incremental difference from the highest level of non-ionizing RF-EMF energy used in PCS digital cell phone technology which is 1990 MHz or 1.9 GHz. RF-EMF energy like microwave energy is non-ionizing. But, at a certain heat level RF-EMF radiation can ionize because the intensity of the exposure is strong enough for the reaction to occur. It is at this level that free radicals (broken valence electron pairs) that damage DNA are produced. Intensity works by placing the device in direct contact with the body, the longer the contact the greater the intensity of the exposure. This information brings the evidence of heavy users reporting the highest incidence of brain tumors in the INTERPHONE study full circle. Because heavy users of cell phones receive greater doses of RF-EMF radiation exposure from longer periods of usage, the intensity of the exposure is increased which substantially increased their exposure, causing damage to biologic tissue and the production of a disease process.

A valid reason to focus on stronger precautionary measures like warning labels is the fact that cell phone manufacturers explicitly state that consumers are to hold cell phones at a required

minimum safe distance from the body. Distancing the body from radiation exposure is explained as a precautionary measure in the ALARA concept. So what is it exactly that we need protection from? Studies independent from cell phone industry funding have reported what we need protection from, a possible pandemic of cancer. The revelation of the distancing requirement alone is evident that it is time to take action.

Humans are creatures of habit. Often times, we do what we see done. So, when people see cell phones pressed against the head or in shirt or pant pockets in television commercials and other visual advertisements, that action is replicated because it is widely accepted as a safe practice. The same can be said of visual advertisements that warn people i.e. texting and driving, drug use, and now tobacco consumption. These actions are considered unsafe practices and therefore, should not be replicated; the choice is left to the consumer. In the case of RF-EMF exposure from cell phones, consumers are not aware of the ramifications of a choice to not use safe distance accessories. Warning label legislation for cell phone packaging would bring that choice to the forefront, in addition to bringing forth much needed awareness of the minimum safe distance requirement specified for their cell phone. At worst, the legislation would have consumers using their cell phones properly. Bringing awareness to distance requirements already established for consumer protection should be considered an advertisement for an important product feature, the distance can save your life feature, not a threat to the cellular industry. We live in an age where a majority of people rely on cell phones as their sole method of communication and are not willing to abandon their subscriptions. The cellular industry should not be threatened by potential loses, instead work with governments worldwide to improve the safety of the devices.

REFERENCES

Bates, C. & Rowell, A. (1999). *Tobacco Explained...The truth about the tobacco industry...in its own words*. eScholarship, University of California.

Brain, M., Tyson, J., & Layton, J. (2000). How cell phones works. Retrieved from http://electronics.howstuffworks.com/cell-phone8.htm

Cardis, E., Armstrong, B. K., Bowman, J. D., Giles, G. G., Hours, M., Krewski, D., ... Vrijheid, M. (2011). Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries. *Occupational and Environmental Medicine, 68*(9), 631-40.

Cardis, E., Richardson, L., Deltour, I., Armstrong, B., Feychting, M., Johansen, ... Yamaguchi, N. (2007). The INTERPHONE study: design, epidemiological methods, and description of the study population. *European Journal of Epidemiology, 22*(9), 647-664.

Carlton, R. R. (2001). *Principles of radiographic imaging: An art and a science*. Albany: Delmar Thomson Learning.

CA SB1212 [2009-2010] Regular Session. (2010, June 24). *LegiScan.* Retrieved from http://legiscan.com/CA/bill/SB1212/2009

CA SB932 [2011-2012] Regular Session. (2012, February 01). LegiScan. Retrieved from http://legiscan.com/CA/bill/SB932/2011

Cell Phone Use-Is it Safe? An Interview with Devra Lee Davis, PhD, MPH. (2011). *Alternative & Complementary Therapies*, *17*(4), 202-205.

Cell phones. (2008). Report on: Cell phone history. Retrieved from http://cellphones.org/cell-phone-history.html

Center for Disease Control and Prevention. (2011). Frequently asked questions about cell phones and your health. Retrieved from http://www.cdc.gov/nceh/radiation/cellphones.FAQ.html

Children's Wireless Protection Act of 2010. LD1706 124th Legislature. Prior Session. (2010). Retrieved from http://www.mainelegislature.org/legis/bills/bills_124th/billpdfs /HP120701.pdf

CTIA. (2010). CTIA-the wireless association filed lawsuit against San Francisco for the so-called "cell phone right-to-know" ordinance. Retrieved from http://www.ctia.org/media/ press/body.cfm/prid/1989

CTIA. (2010) CTIA–the wireless association statement on the San Francisco board of supervisors vote on the cell phone labeling ordinance. Retrieved from http://www.ctia .org/media/press/body.cfm/prid/1971

Define microwaves. (n.d.) Extensive Definition. Retrieved from http://microwaves.askdefine .com/

Divan, H. A., Kheifets, L., Obel, C., & Olsen, J. (2008). Prenatal and postnatal exposure to cell phone use and behavioral problems in children. *Epidemiology, 19*(4), 523-9.

EM Radiation Research Trust (2009). Cell phones cause brain tumors. Retrieved from http:// archive.radiationresearch.org/pdfs/reasons_quotes.pdf

Faruque, M. R. I., Islam, M. T., & Misran, N. (2011). Analysis of SAR levels in human head tissues for four types of antennas with portable telephones. *Australian Journal of Basic and Applied Sciences, 5,* 3, 96-107.

FDA. (2011). Radiation-emitting products: Current research results. Retrieved from http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProducts andProcedures/HomeBusinessandEntertainment/Cellphones/ucm116335.htm

FDA. (2012). Radiation-emitting products: Cell Phones. Retrieved from http://www.fda.gov/ Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusiness andEntertainment/CellPhones/default.htm

Federal Communications Commission. (n.d.). Wireless Devices and health Concerns. *Current Exposure Limits*. Retrieved from http://www.fcc.gov/guides/ wireless-devices-and-health-concerns

German, K. (2011). Report on: Cities and states consider cell phone radiation laws. Retrieved on, from http://www.cnet.com/8301-17918_1- 20058696-85/cities-and-states-consider-cell-phone- radiation-laws/

Gupta, Dr. S. (2011). Is your cell phone safe? CNN News. Retrieved from http://www. cnn.com/video /#/video/podcasts/gupta/site/2011/05/23/sgmd.cell.phone.safe.cnn

Hardell, L., Carlberg, M., & Mild, K. H. (2005). Use of cellular telephones and brain tumour risk in urban and rural areas. *Occupational and Environmental Medicine, 62*(6), 390-394.

Hardell, L., Carlberg, M., Soderqvist, F., Mild, K. H., & Morgan, L. L. (2007). Long-term use of cellular phones and brain tumours: increased risk associated with use for >=10 years. *Occupational and Environmental Medicine, 64*(9), 626-632.

Health and Safety Code relating to Product Safety Act 2011. SB 932, 2011-12 Session. (2012). Retrieved from http://info.sen.ca.gov/cgi-bin/postquery?billnumber=sb_932&sess=CUR &house=B&site=sen

International Agency for Research on Cancer. (2006). *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. Retrieved from http://monographs.iarc.fr/ENG/Preamble /currentb6evalrationale0706.php

International Agency for Research on Cancer. (2013). *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. Retrieved from http://monographs.iarc.fr/ENG/Classification/

INTERPHONE Study Group. (2010). Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. *International Journal of Epidemiology, 39*(3), 675-94.

Kang, C. (2010). Cellphone industry attacks San Francisco's ruling on radiation. Retrieved from http://www.washingtonpost.com/wp-dyn/content/article/2010/06/28/AR2010062805231.html

Kreisberg, J. (2010). Cell phones and electromagnetic radiation: what we do not know. *Integrative Medicine: A Clinician's Journal*, *9*(3), 54-55.

Kundi, M. (2009). The Controversy about a Possible Relationship between Mobile Phone Use and Cancer. *Environmental Health Perspectives*, 117(3), 316-324.

Maisto, Michelle. (2012). Kucinich bill heads to Congress. Retrieved from http://www.eweek.com/c/a/Mobile-and-Wireless/Kucinich-Cell-Phone-Radiation-Bill-Heads-to-Congress-891191/

ME LD1013 [2013-2014] 126th Legislature. (2013, July 10). LegiScan. Retrieved from http://legiscan.com/ME/bill/LD1013/2013

ME LD1014 [2011-2012] 125th Legislature. (2011, June 03). LegiScan. Retrieved from http://legiscan.com/ME/bill/LD1014/2011

ME LD1706 [2009-2010] 124th Legislature. (2010, March 26). LegiScan. Retrieved from http://legiscan.com/ME/bill/LD1706/2009

Mobileburn. (2001). What is “frequency band”?. Retrieved from http://www.mobileburn.com /definition.jsp?term=frequency+band

MobiThinking. (2013). Global mobile statistics 2012 part A: Mobile subscribers; handset market share; mobile operators. Retrieved 2010 from http://mobithinking.com/mobile-marketing -tools/latest-mobile-stats/a#subscribers

National Cancer Institute. (2013). Cell phones and cancer risk. Retrieved from http://www. cancer.gov/cancertopics/factsheet/Risk/cellphones

New Mexico Legislature. (2013). Glossary of Legislative Terms. Retrieved from http://www. nmlegis.gov/lcs/glossary.aspx

Nittby, H., Brun, A., Eberhardt, J., Malmgren, L., Persson, B. R. R., & Salford, L. G. (2009). Increased blood-brain barrier permeability in mammalian brain 7 days after exposure to the radiation from a GSM-900 mobile phone. *Pathophysiology, 16,* 103-112.

NM HM32 [2011] Regular Session. (2011, March 05). *LegiScan*. Retrieved from http://legiscan. com/NM/bill/HM32/2011

OR SB679 [2011] Regular Session. (2011, June 30). *LegiScan*. Retrieved http://legiscan.com/ OR/bill/SB679/2011

PA HB1408 [2011-2012] Regular Session. (2011, April 28). *LegiScan*. Retrieved from http:// legiscan.com/PA/bill/HB1408/2011

Proceedings of the Policy Studies Organization, No. 11. (2010). *Review of Policy Research*, *27*(6), 831-870.

Proctor, T. (2013). Investigating cell phone radiation exposure. *PA TIMES Online.* Retrieved from http://patimes.org/investigating-cell-phone-radiation-exposure/

Reardon, Marguerite. (2011). Cell phone radiation a self-defense guide (FAQ). *CNET.com*. Retrieved from http://news.cnet.com/8301-30686_3-20068419-266/cell-phone-radiation-a-self-defense-guide-faq/

Sadetzki, S., Chetrit, A., Jarus-Hakak, A., Cardis, E., Deutch, Y., Duvdevani, S. … Wolf, M. (2008). Cellular phone use and risk of benign and malignant parotid gland tumors – a nationwide case-control study. *American Journal Of Epidemiology*, *167*(4), 457-467.

Schuz, J., Waldemar, G., Olsen, J. H., & Johansen, C. (2009). Risks for central nervous system diseases among mobile phone subscribers: a Danish retrospective cohort study. *Plos One, 4,* (2).

Statkiewicz-Sherer, M. A., Visconti, P. J., & Ritenour, E. R. (1993). *Radiation protection in medical radiography*. St. Louis: Mosby.

Tam, D. (2012). Congressman introduces new bill for cell-radiation warning labels. Retrieved from http://news.cnet.com/8301-1035_3-57487852-94/congressman-introduces-new-bill-for-cell-radiation-warning-labels/

The National Cancer Institute. (2013). Cell phones and cancer risk. Retrieved from http://www.cancer.gov/cancertopics/factsheet/Risk/cellphones

UN News Centre. (2011). As world passes 7 billion milestone, UN urges action to meet key challenges. Retrieved from http://www.un.org/apps/news/story.asp?NewsID=40257#.UnPZhFOzLv4

United States Government Accountability Office. (2001). *Research and regulatory efforts on mobile phone health issues*. Retrieved from http://www.gao.gov/assets/240/231564.pdf

United States Government Accountability Office. (2012). *Telecommunications: Exposure and testing for mobile phones should be reassessed*. Retrieved from http://gao.gov/assets/600/592901.pdf

United States House of Representatives. (2012) The House explained: The legislative process Retrieved from http://www.house.gov/content/learn/legislative_process/

US HB6358 [2011-2012] 112th Congress. (2012, August 03). LegiScan. Retrieved from http://legiscan.com/US/bill/HB6358/2011

Warning Labels on Cellular Telephones Act 2011, HB1408, 2011-12Cong. Sess. (2011) retrieved from http://www.legis.state.pa.us/cfdocs/billinfo/BillInfo.cfm?syear=2011&sind=0&body=H&type=B&bn=1408

What is the difference between analog and digital cell phones? (2000). Retrieved from http://electronics.howstuffworks.com/question31.htm

Whitney, Lance. (2012). 2011 ends with almost 6 billion mobile phone subscriptions. Retrieved from http://news.cnet.com/8301-1023_3-57352095-93/2011-ends-with-almost-6-billion-mobile-phone-subscriptions/

World Health Organization. (2011). Electromagnetic fields and public health: Mobile phones. Retrieved from http://www.who.int/mediacentre/factsheets/fs193/en/

World Health Organization, International Agency for Research on Cancer. (2011) IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans. [Press Release]. Retrieved from http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf

APPENDICES

Appendix A

German (2011) provided distance specifications given by manufacturers of several phone reviewed by CNET. This information can be found in the operator's manual of the cell phone, or in the health and safety insert in the phone's packaging. Information for cell phone models not included in this appendix can be found on file with the FCC.

- **RIM BlackBerry Curve 9330**
  "To maintain compliance with FCC RF exposure guidelines when you carry the BlackBerry device on your body, use only accessories equipped with an integrated belt clip that are supplied or approved by Research in Motion. Use of accessories that are not expressly approved by RIM may violate FCC exposure guidelines and might void any warranty applicable to the BlackBerry device. If you do not use a body-worn accessory equipped with an integrated belt clip supplied or approved by RIM when you carry your BlackBerry device, **keep the BlackBerry device at least 0.98 inch (25mm) from your body** when the BlackBerry device is transmitting. When using any data feature of the BlackBerry device, with or without a USB cable, **hold the BlackBerry device at least 0.98 inch (25mm) away from your body."**
- **T-Mobile (LG) G2X**
  "This device has been tested for body-worn operation with the distance at of 0.79 inch (2cm) for a normal mode and with the distance of 0.39 inch (1cm) for a hot-spot mode from the user's body**. To comply with FCC RF exposure requirements, a minimum separation distance of 0.79 inch (2cm) for a normal mode and 0.39 inch (1cm) for a hot-spot mode must be maintained from the user's body."**
- **Casio G'zOne Commando**
  "For body-worn operation, this phone has been tested and meets the FCC RF exposure guidelines when used with an accessory that has no metal parts and that positions the handset a **minimum of 2cm from the body**. Noncompliance with the above restrictions may result in violation of RF exposure guidelines."
- **Pantech Caper**
  "This device was tested for typical body-worn operations with the back of the phone kept 2cm from the body. To maintain compliance requirements, use only belt clips, holsters, or similar accessories that **maintain a 2cm separation distance between the user's body and the back of the phone, including the antenna**."
- **HTC ThunderBolt**
  "This device was tested for typical body-worn operations. To comply with RF exposure requirements, **a minimum separation distance of 1cm must be maintained** between the user's body and the handset, including the antenna."
- **Sony Ericsson Xperia X10**
  "For body-worn operation, this phone has been tested and meets FCC RF exposure guidelines when the handset is positioned **a minimum of 15mm away from the body** without any metal parts in the vicinity of the phone or when used with the original Sony Ericsson body-worn accessory intended for this phone. Use of other accessories may not ensure compliance with FCC RF guidelines."

- **Motorola Atrix**
  "If you wear this mobile device on your body, always place the mobile device in a Motorola-supplied or approved clip, holder, holster, case, or body harness. If you do not use a body-worn accessory supplied or approved by Motorola, **keep the mobile device and its antenna at least 2.5cm (1 inch) away from your body."**
- **Apple iPhone 4**
  "For optimal mobile device performance and to be sure that human exposure to RF energy does not exceed the FCC guidelines, always follow these instructions and precautions: When on a call using the built-in audio receiver in iPhone, hold iPhone with the dock connector pointed down toward your shoulder to increase separation from the antenna. When using iPhone on your body for voice calls, or wireless data transmission over a cellular network, keep iPhone at least 15mm (5/8 inch) away from the body and only use carrying cases, belt clips, or holders that do not have metal parts and that **maintain at least 15mm (5/8 inch) separation between iPhone and the body."**
- **Kyocera Echo**
  "To maintain compliance with FCC RF exposure guidelines, if you wear a handset on your body, use a Sprint-supplied or Sprint-approved carrying case, holster, or body-worn accessory. If you do not use a body-worn accessory, **ensure the antenna at least 0.886 inch (2.2cm) away from your body** when transmitting. Use of non-Sprint-approved accessories may violate FCC exposure guidelines."
- **Samsung Galaxy S 4G**
  "For body-worn operation, this phone has been tested and meets FCC RF exposure guidelines when used with an accessory that contains no metal and that positions the mobile device a **minimum of 1.5cm from the body**."

Appendix B

The EM Radiation Research Trust (2009) in the United Kingdom, part of a collaborative comprised of the EMR Policy Institute in the UK, ElectromagneticHealth.org, and The Peoples Initiative Foundation in the US, released the following quotes from Scientists, Physicians and other experts and researchers around the world regarding cell phone radiation.

United States

Ronald B. Herberman, MD, Director Emeritus, University of Pittsburgh Cancer Institute; United States

> "Based on substantial evidence, especially from industry-independent studies that long term exposure to radiofrequency radiation may lead to increased risk for brain tumors, I issued a precautionary advisory last year to faculty and staff of the University of Pittsburgh Cancer Institute. Since then, my particular concern about exposure of children to radiofrequency has been supported by a report from Dr. Lennart Hardell. Some of my scientific colleagues have expressed skepticism about the reported biological effects, especially DNA damage by radiofrequency radiation, because of the absence of a demonstrated underlying molecular mechanism. However, based on the precautionary principle, I believe it is more prudent to take seriously the reports by multiple investigators that radiofrequency can damage DNA and increase the risk for brain tumors, and for industry-independent agencies to provide needed funding for detailed research to ascertain the molecular basis for such effects."

L. Lloyd Morgan, BSc, Member, Bioelectromagnetics Society and Lead and Author, "Cellphones and Brain Tumors: 15 Reasons for Concern, Science, Spin and The Truth Behind Interphone"

> "The largest health experiment ever undertaken, without informed consent, has some 4 billion participants enrolled. To date science papers have shown an increased risk of brain tumors, eye cancer, salivary gland tumors, testicular cancer, non-Hodgkin's lymphoma, and leukemia from cell phone use. The public must be informed"

Jerry L. Phillips, PhD, Director, Science Learning Center, University of Colorado at Colorado Springs; United States

> "It is indisputable that exposure to radiofrequency radiation at cell telephone frequencies produces biological changes that are consistent with potential adverse effects on human health and development. Moreover, these biological effects are consistent with recent epidemiological studies of long-term cell phone users that have shown increased risks for tumor development. What should be a major concern for scientists and non-scientists alike is industry's misleading and scientifically inaccurate use of available data.

Industry's claims of studies negating one another, their misuse of "weight of evidence," and their overt support of studies designed to produce negative data, all in the name of increasing the profit line, are shameful and should not be tolerated."

Paul J. Rosch, MD, FACP, Clinical Professor of Medicine and Psychiatry, New York Medical College; President, the American Institute of Stress; Emeritus Member, the Bioelectromagnetics Society; United States

"If cell phones use is not curtailed or made significantly safer, particularly for children, we may be facing and unprecedented disaster that is preventable, The 15 reasons listed to support this is the tip of the iceberg. A very recent Australian report in men who wear cell phones below their waist confirms the striking adverse effect on sperm and fertility previously suggested by animal studies. (See John Aitken's paper published July 31 in PLoS ONE)

Bert Schou, PhD, CEO, ACRES Research; United States

"The capability for biological organisms, and even humans, to be extremely sensitive is well within the realm of biological reactions. I have witnessed one person develop sensitivities to radio frequencies and learned about many more individuals who are sensitive. The electromagnetic radiation effects are understood by motivated and dedicated scientists. Realizing and respecting risks from radiation are needed."

Narendra P. Singh, Research Associate Professor, Department of Bioengineering, University of Washington; United States

"Independent research findings, including our own, show that cell phone damages the DNA of brain cells and sperms in animal models. Research lavishly funded by industry to counteract the results from the independent science should be taken with caution."

Austria

Gerd Oberfeld, MD, Public Health Department, State Government Salzburg, and Speaker for Environmental Medicine for the Austrian Medical Association, Vienna; Austria

"The scientific data show, with a high degree of confidence, that mobile phone exposure is associated with an increased brain tumor risk. The age group below 20 years is facing the greatest risk, for malignant (deadly) brain tumors, of about 400 percent, compared to non- exposed. When we take the long latency period of up to some decades into account, and the fact that large parts of our society and especially more and more teenagers and even children are using mobile phones on a daily basis, we may well expect a brain tumor epidemic. From a public health perspective there is an urgent need not only for a wake-up

call for our society, but for measures that are able to combat this public health threat effective now."

Brazil

Alvaro Augusto A. de Salles, PhD, Professor, Federal University of Rio Grande do Sul UFRGS; Brazil

"Due to the available health effects research results of low level long term non ionizing radiation exposure and since more than four billion people now are using mobile phones, the precautionary Principle should be adopted promptly for these issues. Otherwise later it can be too late to recover the health public damage. People should be advised to reduce RF/MW exposure, for example using head phones and hands free kits until new technologies or new health effect research results are available".

Finland

Mikko Ahonen, Researcher, University of Tampere, Finland—He quotes legendary scientist, Neil Cherry

"The standard based on the ICNIRP Guidelines is focused on avoiding tissue heating, not based on biological and epidemiological evidence. The maintenance of the standard is obtained by ignoring or rejecting any and all evidence that contradicts it." —Dr Neil Cherry (2002)

France

Daniel Oberhausen, Physicist, Association PRIARTÉM; France

"Today mobile phone technologies as well as WiFi, WiMAX etc. use EM radiations whose frequencies are in the 1 to 10 GHz range. Proteins and DNA show resonant absorptions in these bands indicating non-thermal effects which may damage living matter. Independent research has to be conducted to clear up those facts. On Earth the cosmic noise between 1 and 10 GHz is extremely low and there are good reasons to think living beings are adapted to that environment."

Germany

Christine Aschermann, MD, Psychiatry, Psychotherapy. Originator of Doctors' Appeal (2002 Freiburg Appeal); Germany

"I developed an interest in the risks of mobile phones and their masts as I observed that - since 1996- an increasing number of my patients began to show organic brain disorders

such as lack of concentration, memory loss, difficulty finding words, parapraxis up to personality changing- beside various somatic symptoms (e.g. headache, high blood pressure, tiredness, tinnitus, digestive troubles, soft tissue pains). In my opinion, these disorders can be attributed to the extension of the mobile telecommunication networks. As the brain is our most important organ responsible for the somatic regulation and for the specific human spirit a failure will have extremely serious consequences for our health, our lives and our civilization. Unfortunately, industry dependent science and those obviously addicted to their mobile phones are still denying health effects. I hold the hypothesis that cancer and brain tumors are the end of a long story of suffering, of the person himself and those closely connected with him, too. I hope that, after all, "five minutes after twelve ", the general public will heed the results of independent studies and take steps to ban this fatal technology.

Horst Eger, MD, Bavarian Ärztekammer Medical Quality No. 65143: "Elektromagnetische Felder in der Medizin Diagnostik, Therapie, Umwelt"

"Our research has not especially worked on brain tumour cases. But for better understanding of the already known mechanisms of cancer induction, I send you the studies of Schmid and Schrader, which show a clear dependency of disturbed mitosis and HF radiation below the limits. Cells with lacking DNA will have a chance to get malign cells. The increase of disturbed mitosis is up to 10 fold. Count that in relation of 10 billion or more brain cells."

Ulrich Warnke, Dr. rer. nat., Academic High Counselor, Biosciences, University of Saarland; Germany

"Electromagnetic waves like that of mobile-communication-systems can cause mechanisms together with magnet-fields that damage cells and functions in human beings caused by activated oxidative and nitric stress and followed by inflammations. It is known that the risk of tumour-development exists as a consequence of a long lasting influence. If the population is not informed about it in detail, epidemic illnesses–also with children and teenagers - cannot be excluded."

Greece

Lukas H. Margaritis, PhD, Professor of Cell Biology and Radiobiology, Dept. of Cell Biology and Biophysics Faculty of Biology, University of Athens Adamantia Fragopoulou , MSc, Medical Biology, PhD (cand.), Electromagnetic Biology Research Group, Athens University ; Greece

"The undersigned Lukas H. Margaritis , Professor of Cell Biology and Radiobiology and

Adamantia F. Fragopoulou , BSc, MSc, doctorate student, having research experience with mobile phone radiation exposure on animal models, strongly support the above text and believe that the possible damage of brain cells following exposure to this type of radiation within the so called safety limits have been highly underestimated by certain studies, possibly due to wrong experimental design. It is therefore our duty as academic citizens to warn the public, through this work, as we do in our country through the media, at every opportunity. Man-made electromagnetic radiation has no safety limits since it was developed long after the evolution of life in earth. The actual effects at the molecular, cellular and organism level are very hard to evaluate due to the complexity of the exposure conditions and the still unknown metabolic mechanisms (signal transduction, tumor formation, cell-cell interactions) taking place within a tissue".

Russia

Professor Yury Grigoriev, Chairman of Russian National Committee on Non Ionizing Radiation Protection, a member of WHO International Advisory Committee on "EMF and Health"; Russia

The members of the Russian National Committee on Non-Ionizing Radiation Protection emphasize ultimate urgency to defend children's health from the influence of the EMF of the mobile communication systems. We appeal to the government authorities, to the entire society to pay closest attention to this coming threat and to take adequate measures in order to prevent negative consequences to the future generation's health. The children using mobile communication are not able to realize that they subject their brain to the EMF radiation and their health – to the risk. We believe that this risk is not much lower than the risk to the children's health from tobacco or alcohol. It is our professional obligation not to let damage the children's health by inactivity.

Sweden

Orjan Hallberg, MSEE, Hallberg Independent Research, Sweden

"According to my own studies there is a clear trend of increasing brain cancer rates, hearing problems, increasing incidence of acoustic neuroma and also increasing mortality among people having Alzheimer's disease in more sparsely populated areas in Sweden. This fits well with the higher average output power from mobile phones in sparsely populated areas and should be taken seriously by responsible authorities."

United Kingdom

Ian Dring, Dr., Independent Scientist; United Kingdom

> "The overwhelming weight of evidence clearly shows that people are suffering from the significant change to our natural environment that has been caused by microwave communication systems. The issue has gone beyond an academic debate. The cold fact is that you, I, your children, my children might die as a result of over exposure to microwaves. It is now time that this is recognized and that we move to a more sensible precautionary approach. It is our responsibility to protect the health of our children."

Ian Gibson, PhD, biologist and geneticist, cancer researcher, ex-senior M.P. and Chair of Science and Technology Select Committee, UK Parliament, Trustee, Radiation Research Trust United Kingdom

> "We need more research to combat the arrogance of those scientists and politicians who fail to see how we must continue to ask for explanations." Jill Evans, MEP "I very much welcome this report which provides vital information needed by those of us campaigning to ensure new technology is safe. I know the concern amongst my constituents in Wales about microwave radiation. Raising awareness of the problems will ensure we address them effectively."

Andrew Goldsworthy BSc, PhD, UK, Imperial College London, Lecturer in Biology (retired); United Kingdom

> "As an ex-amateur radio enthusiast and a professional biologist, I do not doubt the value of mobile telecommunications. The ability to communicate easily is what sets us apart from the lower animals; and cell phones are an aid to this. However, as presently configured, their radiation is potentially damaging, both to ourselves and the environment. The main problem is not the microwaves themselves, but the sharp changes in signal strength that occur when they are modulated to carry digital information. These make cell membranes leak and give many unwanted biological effects at signal levels well below current safety guidelines. The good news is that, by involving both biologists and engineers in the necessary research, it should be possible to change the way in which the information is encoded to eliminate most of these effects. The bad news is that the mobile telecommunications industry is not prepared to do this, since it involves admitting that their present systems are unsafe, which could result in damaging litigation. We must find some compromise, or there will be serious consequences for human health and fertility, and the damage to the human genome may be irreparable."

Mae Wan Ho, PhD, FRSA, Founder and Director Institute of Science in Society; United Kingdom

> "Ban wireless from your home and neighborhood if you have small children. This includes wireless installations in your home computers and cordless phones. Non-thermal effects from electromagnetic radiation are irrefutable. This important report should be read and acted on by policy-makers worldwide."

Dr Caroline Lucas, Green Party MEP for SE England Radiation Research Trust trustee; United Kingdom

> "This report raises further concern about the health and other risks of mobile phone technology, especially for children. Government action to protect us from the dangers of electromagnetic radiation is long overdue, so I hope this new evidence of the link between brain tumors and mobile phone use is given the serious attention it deserves."

Andrew Mitchell, Member of Parliament, Shadow Secretary of State for International Development, United Kingdom

> "I welcome the scientific debate about cell phones and brain tumors and a serious discussion of any design flaws of the Interphone study."

Philip Parkin, General Secretary, Voice, union for education professionals; United Kingdom

> "I have become increasingly concerned about the general public's lack of awareness of the HPA advice on the use of mobile phones and children; and where it is known it is often being ignored. I was amazed and appalled recently when the government's own Training and Development Agency was advocating, through an article in its own magazine for schools, the use of mobile phones in the classroom as an aide to teaching and learning. This study of the available evidence on Cell phones and Brain Tumors is a sharp reminder to all of the care that needs to be taken in the introduction of new technologies and strengthens the case for the Precautionary Principle in using them. I would endorse it as essential reading for all parents and all frequent, long-term users of mobile phones."

Chris Woollams, M.A. Biochemistry (Oxon), Editor, Integrated Cancer and Oncology News (icon magazine), CEO CANCERactive ; United Kingdom

> "In a world where a drug cannot be launched without proof that it is safe, where herbs and natural compounds available to all since early Egyptian times are now questioned, their safety subjected to the deepest scrutiny, where a new food cannot be launched without prior approval, the idea that we can put up mobile telephony masts and introduce Wi-Fi willy-nilly around our 5 year olds is double-standards gone mad. And I speak, not

just as an editor and scientist that has looked in depth at all the research, but as a father that lost his beloved daughter to a brain tumor."

Appendix C

The National Cancer Institute (2013) reported the following as the conclusions of several expert organizations in the US regarding RF-EMF radiation from cell phones and reports of adverse effects on human health

- **The International Agency for Research on Cancer** (IARC), a component of the World Health Organization, recently classified radiofrequency fields as "possibly carcinogenic to humans," based on limited evidence from human studies, limited evidence from studies of radiofrequency energy and cancer in rodents, and weak mechanistic evidence (from studies of genotoxicity, effects on immune system function, gene and protein expression, cell signaling, oxidative stress, and apoptosis, along with studies of the possible effects of radiofrequency energy on the blood-brain barrier).
- **The American Cancer Society** (ACS) states that the IARC classification means that there could be some risk associated with cancer, but the evidence is not strong enough to be considered causal and needs to be investigated further. Individuals who are concerned about radiofrequency exposure can limit their exposure, including using an ear piece and limiting cell phone use, particularly among children.
- **The National Institute of Environmental Health Sciences** (NIEHS) states that the weight of the current scientific evidence has not conclusively linked cell phone use with any adverse health problems, but more research is needed.
- **The U.S. Food and Drug Administration** (FDA), which is responsible for regulating the safety of machines and devices that emit radiation (including cell phones), notes that studies reporting biological changes associated with radiofrequency energy have failed to be replicated and that the majority of human epidemiologic studies have failed to show a relationship between exposure to radiofrequency energy from cell phones and health problems.
- **The U.S. Centers for Disease Control and Prevention** (CDC) states that, although some studies have raised concerns about the possible risks of cell phone use, scientific research as a whole does not support a statistically significant association between cell phone use and health effects.
- **The Federal Communications Commission** (FCC) concludes that there is no scientific evidence that proves that wireless phone use can lead to cancer or to other health problems, including headaches, dizziness, or memory loss.

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