FAQ's on the U.S. National Toxicology Program Radiofrequency Carcinogenicity Research Study

On May 27th, 2016, the U.S. National Toxicology Program, of the U.S. National Institutes of Health, released a report with partial results of their large study on the carcinogenicity of radiofrequency radiation (RFR, also known as microwave radiation) in male and female rats and mice.

The world's largest, most well-designed study of its type, at a cost of $25 million, found increased occurrence of rare brain tumors in male rats and increases in rare heart tumors in both male and female rats exposed to RFR. The released results are "partial" because more rat results and all of the mouse study results will be forthcoming, by 2017.

Study Design and Results

How were the animals exposed?

Animals were exposed daily during gestation and for two years after their birth to two commonly used types of RFR—Global System for Mobile (GSM) and Code Division Multiple Access (CDMA). For each type of RFR there were three exposure groups: 1.5 W/kg, 3W/kg, and 6 W/kg.

The rodents were housed in specially designed underground chambers for uniform RFR exposure.

RFR exposures were 10-minutes on, 10-minutes off for 18 hours a day, resulting in a total exposure of 9 hours daily.

Exposure intensity was at low *nonthermal or non-heating levels*. Heating from microwaves is the only adverse effect recognized by US regulators, who rely on standards set almost two decades ago. The NTP study set exposures at low levels determined *not* to heat the body in order to test if biological effects occur at non-thermal levels.

What cancers and tumors were found?

Increased incidence of gliomas, a rare and aggressive, highly malignant brain cancer, as well as schwannomas (a rare tumor of the nerve sheath) of the heart were found in both sexes but reached statistical significance only in males. Overall, there were more brain abnormalities and tumors in exposed male rats than in exposed female rats. In humans, gliomas are also more common in men than in women.

In addition to the gliomas, there were significantly more rare, pre-cancerous changes in the glial cells of the brain in both sexes, while not a single one of the unexposed control animals developed these same abnormal brain cells. Male rats exposed to all levels of CDMA developed exceptional numbers of damaged, pre-cancerous brain cells (glial hyperplasia). Both male and female rats, exposed to all levels of microwave radiation, developed increased incidence of rare malignant tumors of Schwann cells (nerve sheaths) of the heart. Females exposed to all levels of CDMA also developed precancerous hyperplastic Schwann cells, while none of the unexposed controls developed this rare abnormality.

It should be noted that this partial report focused only on these brain and heart tumors, and that additional results from the rats study will be released by 2017.

How strong are these results?

“Game-changer” is increasingly being used to describe these results. For decades people believed that microwave radiation at low (non-heating) levels is safe and cannot cause harm. The NTP results clearly show that this assumption is false. Microwave radiation can cause harmful effects even at low non-heating- levels.

Although the results show “low” increases in tumors, these tumors are quite lethal. Moreover, even a small increase can have a great impact. As the NTP report stated, "*Given the extremely large number of people who use wireless communication devices, even a very small increase in the incidence of disease resulting from exposure to the RFR generated by those devices could have broad implications for public health.”*

Significantly more gliomas were seen in males exposed to CDMA (95% confidence level). Positive trends for a greater number of tumors at higher doses were observed for both gliomas and schwannomas of the heart in males. Both the trends and the replication make these very strong results.

Why is this study considered a “landmark” study?

These results are very significant for three reasons:

1. In case-controlled studies, humans develop the same types of tumors from cell phone exposures.

Epidemiological studies in humans show increased risks for gliomas and schwannomas after long-term use of cell phones – these are the same types of tumors that were found in the exposed rats.

2. The results show adverse biological effects *at non-thermal levels* meaning that current international regulations (based on avoiding heating) do not adequately protect public health.

The NTP study was designed to test if the basis for government safety standards is accurate. Current safety standards are based on the premise that only RFR levels that cause heating are harmful. The study was carefully designed to ensure that the body temperature of the exposed rats did not increase significantly. *Yet an effect was shown at non-thermal levels*. The NTP study provides well-documented, scientific evidence that current international regulations are based on a faulty assumption.

3. The results add significant weight to the scientific evidence that radio frequency radiation is carcinogenic.

In 2011, the International Agency for Research on Cancer of the World Health Organization (IARC/WHO) classified radio frequency radiation as a Class 2B "possible carcinogen." One of the reasons for the classification "possible" was because human epidemiological studies showed increased brain tumors after long term exposures, however, *more evidence* was needed from animal studies showing carcinogenicity and a mechanism of action. The recent NTP results provide new, well-designed research evidence in animal models that links RFR to cancer. As the NTP stated, "These findings appear to support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR."

Is it true that the NTP study found DNA damage in the exposed animals?

Yes - the NTP study found statistically significant evidence of DNA damage. The preliminary data with comet assay showed a statistically significant trend in RF-induced DNA damage in both rat and mice brain tissues. These findings were shared by the National Toxicology Program during the BIOEM 2016 Annual Meeting.

Associate Director of NTP John Bucher described some of the DNA findings in a Science Magazine interview stating that, "In a small side experiment of the NTP study, DNA

from the tissues of 80 mice and rats that had spent 90 days in the reverberation rooms were examined for breaks in the DNA strands. There was more DNA damage in some of the rodents that received the highest radiation levels."

Genotoxicity findings will be published in the forthcoming paper from the NTP rodent study entitled "Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure" (as noted on page 3 of the released NTP Report).

Is this study well designed?

This $ 25 Million Study is, in fact, the world's largest and most comprehensive rodent study of radiofrequency electromagnetic fields. The design of this study was presented at an annual meeting of the Bioelectromagnetics Society prior to the start of these studies.

According to Ron Melnick PhD, *"the overwhelming opinion expressed by the meeting participants was that this would be the largest and most comprehensive study in animals exposed to cell phone radiation, and that the results from this study would trump all other animal carcinogenicity studies of this agent."*

Seven thousand rodents were used for the entire study, which used a three-phased study design: (1) Pilot studies to establish field strengths that did not excessively raise body temperatures; (2) Subchronic toxicology studies in which the rodents were exposed to various low-level field strengths for up to two months; and (3) Chronic toxicology and carcinogenicity studies in which the rodents were exposed prenatally and for the majority of their lifetime (up to 24 months). The chronic exposure study employed seven groups of 90 rats: a sham control group that was not exposed to the radiation, and three groups for each of two common types of cell phone signal.

Why was this study initiated?

The US Food and Drug Administration (FDA) nominated this study because, "There is currently insufficient scientific basis for concluding either that wireless communication technologies are safe or that they pose a risk to millions of users. A significant research effort, including well-planned animal experiments, is needed to provide the basis to assess the risk to human health of wireless communications devices." Read the FDA Nomination here.

The National Toxicology Program Testified to US Congress that, "The FDA nomination was based on the following concerns:

● There is widespread human exposure;

● Current exposure guidelines are based on protection from acute injury from thermal effects;

● Little is known about the potential for health effects of long-term exposure; and

● Sufficient data from human studies to definitively answer these questions may not be available for many years."

The recommendation for the NTP study was made in 1999 with a contract signed in 2005. It is years behind schedule as results were due to be published in 2014. See the slide presentation that the NTP gave in 2013 here describing the experiments initial results. See slides from 2009 NTP presentation describing the experiment setup.

What was the objective of the study?

According to Ron Melnick who lead the study design, the researchers wanted to test the hypothesis that *cell phone radiation could not cause adverse health effects at levels that did not cause heating*. The study was designed to provide data to characterize dose-response for any detected toxic and/or carcinogenic effects of cell phone radiofrequency radiation (RFR) in Sprague-Dawley rats and B6C3F1 mice exposed unconstrained in reverberation chambers.

At the time the study was initiated, slightly more more than 100 million Americans used wireless communication devices, yet guidelines for cell phone radiation were (and still are) are based largely on protection from acute injury from thermal effects. The researchers were aware of several ongoing animal studies, but felt they might not provide an adequate challenge to the null hypothesis, so the NTP set out to design the world's largest animal study on radiofrequency radiation to date.

Some Clarifications in Response to Concerns Raised In the Media

Does the fact that increased numbers of tumors were statistically significant in the male rats, but not in the female rats, mean the findings of carcinogenicity can be dismissed?

No. In *previous* NTP toxicology studies male rats were *more than ten times more likely* to develop malignant gliomas (brain tumors) than females. For malignant schwannoma of the heart, males were *more than twice as likely* to develop this type of cancer than the females.

(These statistics called "historical control incidence" are documented in the NTP report at the bottom of the tables starting at page 9.)

Microwave News quoted Ron Melnick's comments on the sex differences:

> "It is not surprising that the exposed males had more tumors than the females given what we have seen in the historical controls. But we can go one step further, the fact that we saw any of these tumors in the exposed females but none in the concurrent controls adds support to the conclusion that cell phone radiation leads to cancer among rats."

These gender-specific results are not uncommon in animal carcinogenicity research studies. As the American Cancer Society explains in their statement about the NTP results, "It's important to note that these sorts of gender differences often appear in carcinogenic studies, so the fact they show up here should not detract from the importance of the findings."

Analyses of NTP bioassays show that "male rats are more sensitive to chemical carcinogens compared to female rats." The fact that male rats are more likely to show carcinogenesis in NTP studies is well documented in "Gender differences in chemical carcinogenesis in National Toxicology Program 2-year bioassays".

It is also important to note that in human studies, gender differences in cancer incidence and mortality is a regular finding.

Notably, in the NTP study, increased incidence of rare malignant tumors of Schwann cells (nerve sheaths) in the heart was found in both male *and* female rats, as were precancerous hyperplastic Schwann cells. The findings in the female rats were not statistically significant, but these tumors are known to occur more rarely in females.

The NTP findings cannot be dismissed because of the gender differences.

Were the results peer reviewed?

The findings have undergone extensive reviews. The biological tissue analyses were reviewed by multiple pathologists and statisticians who were unaware of the test agent being evaluated, and looked solely at the obtained slides. The report has addressed several expert reviews with responses that are appended to the online document.

The National Toxicology Program states in the abstract, "The findings in this report were reviewed by expert peer reviewers selected by the NTP and National Institutes of Health (NIH). These reviews and responses to comments are included as appendices to this report, and revisions to the current document have incorporated and addressed these comments."

Results have not yet been published in a journal but were released early by the NTP because of their importance for public health.

Is the statistical power strong?

Typically, in this type of testing the NTP uses 50 animals per group. For this study they used 90 animals per group, as such, so it may be considered a large study relative to other similar animal studies. The expected background rate of the two tumors that have been found (glioma and Schwannoma of the heart) is also extremely low.

The chances of finding a true effect--or power of a study-- depend on two principal things: (1) the size of the sample studied and (1) the size of the expected occurrence of the endpoints under study. With smaller numbers of animals, the chances of finding an effect—called the statistical power—would have been lower. Studies that are underpowered do not have enough data to present a full and clear picture. Had more animals been studied, there might have been further positive associations, possibly resulting in statistical significance in the female rats as well. The NTP finding of positive results in *multiple* tumor types means that these study results are even more important.

As Associate Director of the U.S. National Toxicology Program John Bucher stated in the May 27, 2016 NTP Press conference, "The power to detect these tumors is probably in the range of between 10% and 20%, which also actually makes it more interesting that we have found statistically significant findings."

Contrary to some claims about this study, false positives are not a significant concern. The reason that clinical trials (such as those Dr. Lauer conducts) use large numbers of people is to *increase* their chances of finding a true effect. The smaller the sample, the greater the chance of NOT finding an effect *when one is actually there*--also called a false negative.

Control group animals did not develop either schwannomas in the heart or gliomas. The control group animals also did not live as long as those that were exposed. Does this call into question the validity of the study?

NTP scientists carefully considered this question. Control group lifespans were within historical ranges, and a statistical procedure was used so as not to over-estimate risks. In fact, it is not surprising to see that the stresses of RFR exposure might contribute to increased lifetime while also contributing to serious health damage. For example, calorie-restricted animals live longer on average. It is important to note that other statistically significant effects from exposure were seen early on, as the pups exposed *in*

utero had lower body weights at birth and remained at a lower weight throughout their lifetimes.

The mortality rates are not as important a fact as it seems when the data is analyzed. First, there was no statistical difference in survival between control male rats and those exposed to CDMA at 6 W/kg (the group with the highest rate of gliomas and heart schwannomas); at week 94, survival of rats in these two groups were the same. Second, no glial cell hyperplasias (potential precancerous lesions) or heart schwannomas were observed in any control rat, even though glial cell hyperplasia was detected in a CDMA-exposed rat *as early at week 58* **a**nd heart schwannomas were detected as early as week 70 in exposed rats. If the control rats were going to develop tumors, these precancerous lesions and tumors *would have already been present*. Yet not a single control had any evidence of an effect.

It is notable that a US Air Force study from the 80's which *also found increased cancer* also showed chronic RF exposure increased life span in rodents. The median survival time was 688 days for exposed animals and 663 days for the sham-exposed.

In this study, the exposed group developed tumors at rates comparable to historic rates of tumors in rats in other such studies. How is this finding considered statistically significant?

Most importantly, in every study, *the preferred control group is the present one*, as every detail of feed, housing, etc. is truly identical. If all groups of rats are treated the same in the same experiment and only the exposed group has a statistically significant effect, then an effect has been shown.

A crude analysis comparing all controls—historic and present—with all exposed animals in the present study still shows a consistently increased probability of developing cancer.

This chart shows the percentage of exposed rats that got tumors as compared with the percentage of the same tumor in all current and historical control rats. *In every case there were more tumors in the exposed group than in the control group*.

Probability of cancer compared with all controls, in rats in NTP wireless radiation study

	Ratio of % exposed cases / % cases in all controls including historic
Glioma	

Male	1.19
Female	3.50*
Schwannoma	
Male	3.08
Female	2.19

*gliomas are extremely rare in these female rats; there were more gliomas in males, both in unexposed and exposed animals, so the ratio is lower.

The rats were exposed for nine hours per day for two years, over the whole body, with some at levels higher than cell phones. How is this study relevant to people?

The study is relevant to humans because it tests the scientific basis for current cellular communication safety regulations, which are intended to protect humans from adverse health effects.

In case-control studies that compare persons with brain cancer to matched controls without the disease, increased gliomas have been seen with less than 1,000 hours of cell phone exposure. Animal studies typically last two years, or the lifetime of the rodent. The animals are specially bred in an attempt to induce tumors in an animal with a short lifetime. The overall exposure of the rats is set to approximate that of humans.

Government safety regulations for microwave radiation are based on the assumption that "*as it does not heat you, it will not hurt you."* To test the "no-heating" cut-off for harm, animals were exposed up to almost the maximum dose they could tolerate with no increase in body temperature. The animals in this experiment never had an increase in body temperature over one degree Celsius. This study shows that adverse biological effects occur at non-thermal (non-heating) levels.

Dr. Moskowitz calculated the overall risk for the male rats in the group exposed to the lowest intensity of cell phone radiation (i.e., 1.5 watts/kilogram or W/kg). He found 12 of 180 (or 1 in 15) male rats in the exposed group developed cancer or a precancerous lesion. He concluded that, "This latter finding has policy implications as the FCC's current cell phone regulations allow cell phones to emit up to 1.6 W/kg at the head or near the body (partial body SAR)." Read his review here.

Why was keeping the rats from overheating so important?

Exposure to high levels of RFR energy, particularly at microwave frequencies, can rapidly heat biological tissue. This is known as a *thermal effect*. Thermal effects can cause harm by disrupting biological processes, and damaging tissue. Government safety regulations require mobile phones and wireless devices to operate at power levels well below the threshold for known thermal effects.

The study was carefully designed to ensure that the exposed rats did not have an increase in temperature beyond one degree, so the tumor development reflects a "non-thermal" mechanism of action. If adverse non-thermal effects are confirmed, then cell phone and wireless device emissions regulations will need to be re-evaluated *because they would not be protecting humans from non-thermal effects*. This is precisely why this NTP study is so significant.

Why were effects for CDMA-modulated RFR exposures different from GSM?

Code Division Multiple Access (CDMA) and Global System for Mobile (GSM) are two *different* communication technologies. CDMA is the primary type of technology used for cell phones in the United States with providers including Verizon, Sprint, and US Cellular. GSM is the primary type of technology used for cell phones in the rest of the world. In the United States, T-Mobile and AT&T use GSM. Europe adopted GSM technology in the 1980s, and users will not find access to CDMA networks in any European countries.

It is unclear why the more modern modulation (CDMA) proved to be more harmful, and there is no way to determine this from the NTP study. However, it makes sense that the body, at a cellular level, might have a different reaction to a different types of exposures and waveforms, *even if the power level is the same*.

Swedish cancer researchers have reported differences in gliomas associated with different modulations, with the more recent technologies appearing to have more of a biological effect. Modulations are evolving to transmit more data faster at a given frequency, and this results in higher peak to average power ratios. In the lab, it is notable that experiments using real-life devices are much more likely to find significant effects.

This is an important finding, that hopefully will spur researchers to explore in future studies how different radio frequency radiation technology impacts the body. Until recently, regulators considered the power density of the radiation (linked to heating) important for human health and the issue of modulation was assumed to be less

significant. *However, the reality is that cellular communication signals are very complex and all signal characteristics, such as modulation, waveform, and power density, must be considered.*

This is a topic of great concern as we prepare to move to newer technologies, driverless cars, and more and more wireless in schools with young children.

The study is not applicable to modern cell phones and wireless devices. Cell phones are now using even newer technology that uses *even lower power*.

In fact, the newer technology may have more adverse effects. These newer devices involve technology with greater variations in pulsed signaling the information content of signals that are being used. The pulse of the signals may well prove to be more important biologically than their power. The biological effects of the NTP study that produced an increase in cancer occurred *without heat*.

In addition, the NTP animals were exposed solely to *one frequency* throughout their lifetimes. This scenario does not even compare to the real life exposures *we* are exposed to. People are now exposed to *multiple exposures* from multiple devices in our everyday environment. Each device itself often has multiple antennas. The combined effect of such microwave radiation exposures is a matter of serious concern in light of these findings of increased cancer in the NTP animals which were exposed to just *one frequency* at non-thermal levels.

Cell Phones have been around for decades and if they caused cancer brain, then cancer rates would be rising. Instead research shows brain cancer rates to be steady for the last few decades. These results must then be wrong.

Brain tumours are now the leading cancer in American adolescents, and *the incidence of the most aggressive gliomas (a category of brain tumors) are rising in young US adults* according to the American Brain Tumor Association's largest, most comprehensive analysis of these age groups to date. This study shows increased yearly incidence of the following brain tumors: anaplastic astrocytoma, tumors of the meninges, tumors of the sellar region and unclassified tumors. Glioblastomas, the type of brain cancer found to be linked to cell phone radiation in the NTP study and in human studies, are increasing in those age 15-39 in the United States.

These increases are *not* evident in population based research studies when the incidence of *all* brain cancers "overall" are considered. As Microwave News points out in a detailed

analysis of this rise of glioblastomas, "The higher incidence of glioblastomas is being masked by the lower rates of the other types of brain cancer."

International registries have *also* indicated an increase. Zada et al, 2012 shows an increase in brain tumors in three major cancer registries in the United States. An Australian study showed an overall significant increase in primary malignant brain tumors from 2000 to 2008, particularly since 2004 (Dobes 2011).

Brain cancers are slow growing and can take decades to develop after a toxic exposure. For example, studies of smokers found no increase in risk just ten years after most have begun to smoke. While cell phones have been around for decades, the majority of cellphone users have only become heavy users recently, so it is not likely that a large *overall* increase in incidence rates will have appeared yet. Research shows increased prevalence in the most aggressive malignant forms of brain cancer in younger people; however, since brain tumors are predominantly a disease of aging, and there are not increases in all *other* tumor types, the level of brain tumors "overall" is not rising.

More importantly, population based studies are not the best way to assess the cell phone cancer link. Instead, research looking at high-risk groups using case-control designs are more suited to showing cancer risk from cell phones. All independant research using a case control design that looked at long term (ten years plus) users have showed increases in brain cancer.

Read Dr. Davis, Dr. Miller and Lloyd Morgan's response in Oxford University Press: Why there can be no increase in all brain cancers tied with cell phone use where they state:

> "The link between the carcinogenic effects of tobacco and cancer did not come about from studying population trends, *but by special study of high-risk groups using case-control designs of selected cases and comparing their histories with those of persons who were otherwise similar but did not smoke, and cohort studies of groups with identified smoking histories followed for up to 40 years,* as in the American Cancer Society and British Doctors studies. The fact that population-based trends in Australia do not yet show an increase in brain cancer does not mean it will not be detectable in the future—perhaps soon."

While glioblastoma is a very rare cancer, it is an often fatal one.

Putting the National Toxicology Program Study in Context

Have any other animal studies shown a link to cancer?

Yes. With the results of the NTP, there are now *three* important animal studies within the past six years showing increased development of cancers after RF-EMF exposure. A German study published in 2015 replicated 2010 research which showed carcinogen-induced tumor rates were significantly higher in the lung and liver of animals exposed to RF -EMF along with a known carcinogen.

Furthermore, there are many examples of research over the last few decades which have indicated that radiofrequency radiation is carcinogenic and can damage DNA.

A 5 year, $5 Million U.S. Air Force study conducted in the early 1980's and later published in Bioelectromagnetics (Chou et al., 1992) also found that significantly higher numbers of male rats exposed to low-intensity microwave radiation developed cancer in comparison to those not exposed. The Chou study exposed experimental animals to 2450 MHz, which is similar to the frequencies used for WiFi, whereas the NTP study exposed rodents to 900 MHz and 1800 MHz microwave radiation. However in the Air Force Study, the rats' average exposure was about 4-10 times *lower* than in the NTP study. Read more about this study in Dr. Moskowitz analysis.
It is notable that in this study the researchers state, "Only male rats were used to minimize statistical variation, i.e., to avoid the hormonal variations characteristic of female rats. Use of female rats would have required a substantial increase in the number of animals."

In the 1990's, Henry Lai and V.J. Singh demonstrated that low levels of microwave radiation (2.45GHz) well below that of cell phone radiation levels could increase the frequency of single-strand DNA breaks in the brain cells of live rats. The in-vitro studies of the $15 Million dollar REFLEX project *lead by Franz Adlkofer* also indicated a genotoxic effect of RF-EMFs at levels below proposed radiation safety levels. In an June 2016 interview, Professor Adlkofer commented that the NTP and Reflex study complement each other, and "intensify in their significance."

In the late 90's, the $25 Million Wireless Technology Research (WTR) project (funded by the Wireless Industry) researchers found genetic damage inside cells exposed to RF radiation in two separate studies, an increased risk of a non-malignant tumor called acoustic neuroma, and an increased risk of neuroepithelial cancer (both rare brain

tumors). The WTR epidemiologist George Carlo, later wrote the book Cell Phones, Invisible Hazards in the Wireless Age documenting the suppression of these research results by the Wireless Industry. The research studies listed above are just a few examples of the past research demonstrating the link between radiofrequency and radiation cancer.

How could radiofrequency radiation "cause "cancer?

A 2016 review paper reported that in 93 of 100 studies RFR produced a cellular stress response which can lead to DNA damage and cancer. In 2001, Catholic University physics professor Theodore A. Litovitz briefed US Congressional members on how chronic exposure to non-thermal levels of electromagnetic radiation can diminish DNA repair and the body's immune response. His conclusion, "because stress proteins are involved in the progression of a number of diseases, *heavy daily cell-phone usage* could lead to great incidence of disorders such as Alzheimer's and cancer" has been reiterated by two leading EMF/RF researchers, Frank Barnes and Ben Greenebaum in a 2016 article published in *IEEE Power Electronics Magazine*. Barnes and Greenebaum stated, "We present the possible theoretical mechanisms and experimental data that show long-term exposures to relatively weak static, low-frequency, and RF magnetic fields can change radical concentrations. As a consequence, a long-term exposure to fields below the guideline levels may affect biological systems and modify cell growth rates, while an organism's built-in mechanisms may compensate for these changes."

Notably, in 2002, Leszczynski and colleagues published the results of an experiment using a human cell line and *just like in the NTP rat study*, the researchers ensured that the exposures were non thermal. They found that after merely one hour of exposure to a 900 MHz GSM signal at an average SAR of 2 W/kg , a specific type of cellular stress response was activated. They hypothesized that this effect links the radiation to cancer because "These events, when occurring repeatedly over a long period of time, might become a health hazard because of the possible accumulation of brain tissue damage. This suggests that the presently allowed radiation emission levels for the mobile phones, although low, might be sufficient to induce biological effects."

Why was this study released *before* it was published in a journal?

According to page 4 of the NTP Report, these findings were released after extensive reviews because:

> "Given the extremely large number of people who use wireless communication devices, even a very small increase in the incidence of disease resulting from exposure to RFR resulting from those devices could have broad implications for public health."
>
> "Lastly, the tumors in the brain and heart observed at low incidence in male rats exposed to GSM- 2 and CDMA-modulated cell phone RFR in this study are of a type similar to tumors observed in some epidemiology studies of cell phone use. These findings appear to support the International Agency for Research on Cancer (IARC) conclusions regarding the possible carcinogenic potential of RFR."

The NTP has now created a new webpage on cell phones and posted a link to the FDA's recommendations on how to reduce cell phone radiation exposure.

How are humans exposed to radiofrequency radiation?

The International Agency for Research on Cancer (IARC) of the World Health Organization classified the range of radio frequency from 30 kHz to 300 GHz as a "Possible Human Carcinogen." The classification is for radio frequency *from any source,* be it a cell phone, laptop, Wi-Fi, baby monitor, cell tower, tablet or electric utility meter.

Dr. Robert Bann, the World Health Organization International Agency for Research on Cancer Secretary stated in a 2011 lecture and in his writing found here.

> *"It should be noted that the working group in the overall evaluation decided to make a generic evaluation of radio frequency fields and did not want to limit it to mobile telephone use and all other exposures .. that was based on the diversity of the exposures in the animal cancer studies where different types of radiation with different frequencies across the radio frequency part of the emf spectrum were noted and* ***the radiation from the environmental sources.(i.e Wi-Fi, Cell Towers etc) and from the mobile telephones is basically and physically speaking the same type of agent ."***

Considering we now use cell phones all day and even sleep with them at night, cell phones probably expose humans to radio frequency more than any other single device. Indoor exposures are primarily from wireless computer networks, home cordless phones and the myriad of wireless devices we purchase and bring into our home. In addition, homes, offices and buildings now have various built-in wireless equipment and

apparatus such as thermostats, security networks, sound systems, appliances and utility meters called “Smartmeters”.

Outdoor exposures are primarily from base stations (cell towers) and building mounted cellular antennas *in addition to* the cell phone you may carry in your pocket as you walk down the street.

The Bottom Line

Wireless radiation from phones, tablets, routers, baby monitors, and a growing number of applications has never been tested for safety, because it was assumed to have no effect except heating. That assumption is no longer valid. While details relating to the increased cancer will continue to be evaluated, this study clearly shows that wireless radiation produces biological impacts in animals. The weight of evidence has significantly *increased* now that the the NTP study findings are placed in the context of the epidemiological, animal and in vitro studies done to date.

Rates of cancers specifically associated with cell phones are increasing; especially the most aggressive forms. In February 2016, the CBTRUS (Central Brain Tumor Registry of the US) reported that brain tumors are now the leading type of cancer in adolescents, surpassing leukemia and lymphoma.

It is imperative that there be experimental testing, now, of newer technologies *before* they enter the marketplace. Data on wireless exposures must be collected in a systematic way to understand real life exposures, and to enable correlation with health. Without such testing and monitoring, we are engaging in a massive experiment with no controls and without the public’s knowledge or consent.

Based on this new information, regulatory and health agencies should make strong recommendations for consumers to take precautionary measures, to choose non-wireless devices whenever possible, and to avoid close contact with their cell phones and Wi-Fi devices. Since children and pregnant women are more vulnerable to radiation exposures, health authorities must especially educate families and communities about how to reduce children’s exposures. Schools, offices and homes can be equipped with non-wireless internet connections to significantly reduce indoor exposures. Technology companies must design and provide safer communication devices so that the public can reduce exposure.

Most importantly, international regulations on cell phones and radiofrequency radiation exposures need to be immediately updated. The NTP study provides strong evidence

that the current limits- based on thermal effects only- *do not adequately protect us.* New regulations must protect against these non-thermal biological effects.

NATIONAL TOXICOLOGY PROGRAM (NTP) INFORMATION

Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure)

NTP Press Conference Audio is online to listen to here.

NTP Press Release: Media Telebriefing: NTP Cell Phone Radiofrequency Radiation Study: Partial Release of Findings

New NTP Webpage on Cell Phones

NEWS MEDIA COVERAGE

Wall Street Street Journal: Cell Phone Study Fans Cancer Worries
Consumer Reports: Does Cell Phone Use Cause Brain Cancer? What the New Study Means For You
Science Magazine: Questions abound after study links tumors to cellphone radiation
Mother Jones: Game-Changing" Study Links Cellphone Radiation to Cancer
PBS: How Might Cell Phone Signals Cause Cancer May 30, 2016
Scientific American: How Might Cell Phones Cause Cancer in Rats
Scientific American: Major Cell Phone Radiation Study Reignites Cancer Questions: Exposure to radiofrequency radiation linked to tumor formation in rats
Science Magazine: Questions abound after study links tumors to cellphone radiation

ADDITIONAL RESOURCES ON THE NTP STUDY RESULTS

Environmental Health Trust: Everything You Wanted to Know About the National Toxicology Program Rodent Study on Cell Phone Radiation

Microwave News Cell Phone Radiation Boosts Cancer Rates in Animals

Joel Moskowitz, PhD. Summary and preliminary analysis EMR Safety; May 27, 2016

- National Toxicology Program Finds Cell Phone Radiation Causes Cancer
- Spin Versus Fact on the NTP Study by Dr. Moskowitz Download the Factsheet

Dr. Gautam Khurana, NeuroSurgeon, Comments: Breaking News – Cell Phones and Brain Tumors – Leaked Insight from the U.S. National Toxicology Program?

Interview with Prof. Adlkofer the NTP study of the US government: Translate the page.

American Cancer Society Press Release: ACS Responds to New Study Linking Cell Phone Radiation to Cancer