Telephone Press Conference:
NTP Draft Conclusions for Radiofrequency Radiation Studies in Rats and Mice
02/02/18
1:00 pm ET

Operator: Good afternoon and welcome to today's briefing from the National Toxicology Program about its cellphone studies in rats and mice. This is a 60 minute call and it will include a briefing followed by a question and answer period.

At this time all participants are in a listen only mode. You may register to ask a question at any time by pressing * and 1 on your touchtone phone. When you are called upon to ask a question, please state your name and your news organization. Please note this call is being recorded.

We will now start the briefing and I'll turn the call over to Dr. John Bucher, Senior Scientist at the National Toxicology Program. Please go ahead, Dr. Bucher.

John Bucher: Hello, and thanks for joining the call. I'm Dr. John Bucher, former Associate Director of the US National Toxicology Program or NTP for short and currently a senior scientist with the program. I'm joined by Dr. Michael Wyde, study toxicologist for the NTP Cellphone Radiofrequency Radiation Studies.

The NTP is a federal interagency program headquartered at the National Institute of Environmental Health Sciences which is part of the National Institute of Health. NTP's mission is to coordinate toxicology research and testing across the Department of Health and Human Services including NIH, the Food and Drug Administration, the National Institute for

Occupational Safety and Health which is part of the Centers for Disease Control and Prevention.

One of our charges is to perform comprehensive toxicology and cancer studies on agents of public health concern. Since the inception of the NTP in 1982, we've studied thousands of agents, primarily chemicals but also physical agents such as extremely low frequency electromagnetic radiation. These are typically evaluated in experimental animal studies conducted with some rodents and are performed in response to nominations of agents for study from a variety of sources. The FDA nominated radio frequency radiation emitted by cellphones for study.

In May of 2016 we released a report on partial findings from the NTP cancer studies of cellphone radio frequency radiation in rats. The report remains available and can be accessed through the NTP website. Today we're posting on our website the complete draft technical reports from our studies in both rats and mice. We're releasing the reports for public comment prior to review by a panel of outside experts in late March.

Public release of draft reports as part of our standard process for peer review of our findings. These reports represent the conclusions of NTP's staff. The expert panel will decide whether they agree with these conclusions and will consider public comments in their deliberations.

These 10 year, $25 million studies have been some of the most comprehensive and technically challenging we've attempted.

Our May 2016 partial findings release reported small increases in the number of exposed male rats that had tumors in tissue that surround nerves in the hearts and brains. The rats had been exposed to radio frequency

radiation starting in utero and then for two years following birth. The two year old rat is of an age approximating a 70 year old human.

At that time we said the tumors we observed were likely related to the cellphone radio frequency radiation exposures but we were more confident in this conclusion for the tumors found in the hearts than for the tumors found in the brains.

Our complete findings released today conclude that the increases in tumors of nerves in the heart called malignant schwannomas were due to the exposures to radio frequency radiation in male rats. These tumors, seen in approximately 6% of the animals in the highest exposure group but in none of the controls, are proposed for classification as "some evidence of carcinogenic activity."

The designation "some evidence" is the second highest positive category of findings in our descriptors of results. The highest is "clear evidence" of carcinogenic activity.

After reviewing all of the data from these studies, the evidence for increased malignant schwannomas in the hearts of male rats is the strongest cancer finding in our study.

In our complete evaluation we again had a lower level of certainty that small increases in the numbers of male rats with tumors in the brains were associated with exposures to cellphone radio frequency radiation. These findings are termed "equivocal evidence of carcinogenic activity," meaning it was unclear if the tumors were related to the exposures.

We also determined that there was equivocal or uncertain evidence for a number of other tumors of various types in male and female rats and mice. The reports lay out the reasoning and the process used by the NTP to reach these conclusions.

We saw relatively little indication of any health problems in mice from cellphone radio frequency radiation. We also looked at other non-cancer health conditions like changes in body weight and other evidence of tissue damage. This included assessing evidence of damage to DNA and blood cells and the liver and brain of some of the animals.

We saw somewhat lower birth weights in rats and some changes in the typical patterns of age-related degeneration in specific regions of the heart in male and female rate. Evidence of DNA damage was seen in some tissues of some animals but we currently don't feel we have sufficient understanding of these results to comment on their biological significance.

To conduct the studies, we used two modulations of cellphone radio frequency radiation termed GSM and CDMA. The radio frequency radiation modulations and frequencies we used mimicked those used in 2G and 3G networks which were standard for cellphones when the study was designed. Current wireless communication networks like 4G and 4G LTE continue to utilize the earlier technologies for their voice calls and texting components.

It's important to consider the magnitude of the exposures to the animals in these studies in relation to what one might typically receive from using a cellphone.

The lowest energy level of the radio frequency radiation we studied was similar to the highest level currently permitted for cellphone emissions to local tissue and I'll explain what this means in a second. Exposures to our animals were to the whole body, meaning each organ such as the brain, heart, or liver was potentially exposed to radio frequency radiation at what's termed a specific absorption rate, or SAR, of 1.5 watts per kilogram for a little over nine hours per day throughout the studies.

The current limit for human exposures to cellphone emissions is 1.6 watt per kilogram in a defined local area closet to the cellphone when held next to the body. This maximum energy level is only approached when the phone is having difficulty in making or maintaining a connection with a base tower. Energy levels of emissions during a typical call are much lower than this highest permitted level.

So keeping this in mind, the energy levels used in the rat studies were 1.5 watts per kilogram, 3 watts per kilogram, or 6 watts per kilogram and those for mice were 2.5 watts per kilogram, 5 watts per kilogram, and 10 watts per kilogram.

Earlier I mentioned that the organs of the animals were potentially exposed to these energy levels but not all organs absorbed radio frequency radiation energy to the same extent. One of the manuscripts that describe the technical aspects of our study by Gong et. al includes simulations that predict the relative absorption rates of different organs. This publication, which is on our website, predicts absorption of energy by the heart to be relatively high in relation to other organs.

Lastly, I'd like to acknowledge that the equipment used to expose the animals was designed and constructed in collaboration with experts from

the National Institute of Standards and Technology here in the United States, the IT'IS Foundation in Switzerland, and IITRI Laboratories in Chicago. The actual animal exposures were carried out at the laboratory in Chicago.

The next step for these reports is to convene a scientific peer review by experts from outside the NTP. These scientists will fully vet all aspects of the performance and the reporting of our studies and our conclusions.

The reports have been posted to the NTP website so the public has an opportunity to read them and provide comments. The peer review meeting will be held March 26th through 28th at the NIEHS in Research Triangle Park, North Carolina.

In a final word, these experimental animal studies are but one approach to understanding whether exposures to radio frequency radiation pose a risk to human health. Studies continue at the NTP on the molecular changes in tissues from these animals, and our partners at the National Cancer Institute and at research institutions around the world are actively engaged in monitoring cancer incidences in humans and conducting epidemiological studies to evaluate exposures to these evolving technologies.

With that, thank you and we're happy to take your questions.

Operator: Thank you. At this time if you'd like to ask a question, please press the * and 1 on your touchtone phone. You may withdraw your question at any time by pressing the # key. Once again to ask a question, please press the * and 1 on your touchtone phone. We can pause a few moments to allow

questions to enter the queue. We can take our first question from Paul Kirby with TR Daily. Please go ahead. Your line is open.

Paul Kirby: Thanks for taking my question. My question is in the press release and in this call you said that you can't really extrapolate because your lowest power was the highest power allowed in cellphones. So if you were trying to see whether there was a link between exposure in these various tumors and other things, why did you use mostly higher powers than people would actually be exposed to using their cellphones?

John Bucher: So this is a typical way that toxicology studies are done. We're trying to understand the potential biological effects of a technology that has been traditionally predicted to not be particularly damaging to tissues.

In toxicology studies, we are projecting in essence the results over a large population of individuals who are actually exposed to radio frequency radiation. Individuals may have a variety of different sensitivities to radio frequency radiation and it's important that we challenge animals to levels at which we believe these exposures are still relevant to human exposures but they need to be challenged with respect to detecting effects.

I will say that these studies that we did were designed to limit the exposure to these animals to those that were lower than those that would cause greater than a 1°C in body temperature which is part of the guideline regulations that currently govern how much exposure you can receive as a human being using a cellphone.

Paul Kirby: Thank you.

Operator: Thank you. We can go next to Maggie Fox with NBC News. Please go ahead. Your line is open.

Maggie Fox: Thanks. I'm wondering if you can characterize if there's much new that you've learned since 2016. I remember the last time we asked you if you in particular had changed your cellphone use and I would like to ask you that again. Have you changed your cellphone use or what you recommend to your family based on these finding? Thanks.

John Bucher: So in finishing these studies, we have evaluated the entirety of the tissues. We have come up with a number of what we were terming equivocal findings but in general, the only positive finding that we'd really been able to have confidence in I think is the malignant schwannomas in the heart, which is what we described in the 2016 report.

I think that it's important to be able to put all of the content or all of the findings in the report in the context of understanding what happened across the entire body of animals throughout the experiment. So we've done that. We're reasonably sure we understand what's going on in these studies at this point and the reports that you can see on the web outline the full findings.

That said, I think that the reports don't go much further than what we have reported earlier and I have not changed the way I use the cellphone, no.

Maggie Fox: Thank you.

Operator: Thank you. We can go next to Ryan Knutson with Wall Street Journal. Please go ahead. Your line is open.

Ryan Knutson: Great. Thanks. Just quickly, just a follow up on that previous reporter's question. Did you recommend anything for your family whether that's change - but then also my main question is it said in the report that there was significant increases of DNA damage in some parts of the mice and rats and certain parts of their brains like the central cortex, but then you're not sure what it means, what the biological importance of that is. Can you elaborate on that a bit in finding DNA damage significant because non-ionizing radiation was always thought to not be possible to damage DNA or are you sort of saying that you're not sure if it has anything to do with RF exposure?

John Bucher: So the first question was have I recommended changes to my children? No, I have not recommended changes to my children in the way that you…

Ryan Knutson: Changes like tell them to use the headset or anything like that or just you don't tell them to do anything?

John Bucher: I have not really addressed that issue with them.

The genetic toxicology findings in the report, I must say we, as I indicated in my remarks, are puzzling over them. We would like to see and in fact plan to repeat these results when we complete the exposure chamber facility that we are constructing currently to do some follow up studies on the cellphone study findings that we've made to date.

The patterns of damage in the brain, to the tissues in the brain of these animals were not particularly consistent with what we saw with the tumor outcomes and were not consistent even within a particular animal across the brain. So we have some questions.

We looked quite a bit into the technical aspects as other studies were carried out and we can't really identify any particular reasons for these findings that would've been explained from the standpoint of a technical artifacts. So at this point we really just don't feel like we understand enough about the results to be able to place a huge degree of confidence in the findings.

Operator: Thank you. We can go next to Lauren Neergaard with Associated Press. Please go ahead. Your line is open.

Lauren Neergaard: Hi. Thank you. So I have a couple of questions about what takeaway messages we can actually glean from this. The findings were so different in rats vs. mice. Are we even studying the right animal model here? Does it tell you something to go forward with that takes this into a realm that is more applicable to current human use?

John Bucher: So the rat and mice in these studies were actually exposed to different frequencies of radio frequency radiation.

In the studies leading up to this large two year study, we performed some simulation exposures of animals to try to understand the types of radio frequency radiation that might be highest in this respect, to being absorbed by a particular animal, and found that the 900 MHz frequency was absorbed more readily by rats and the 1900 MHz frequency was absorbed more readily by mice. There's still a question as to whether frequency in and of itself and the changes in frequency could alter the outcome in these animal studies.

So the fact that rats and mice seem to be responding somewhat differently can't necessarily be determined from the study that we did. Rodents are

generally considered to be reasonably good surrogates for toxicology and cancer studies for humans.

The issue is studying something that at best might be a weak carcinogen, which I think everybody would kept classified radio frequency radiation if in fact it is a carcinogen. That would require large numbers of animals and exposure set ups, and things that would be very, very difficult to accomplish. So we think that the technical aspects and just the simple ability of exposing animals to a situation that might reveal a radio frequency radiation induced damage, or in fact cancers, really requires that we use rodents at this time.

Lauren Neergaard: Okay. Thank you.

Operator: We can go next to Denise Grady with New York Times. Please go ahead. Your line is open.

Denise Grady: Hi. Thanks for answering this. Just wondering in the reports, how many individual studies do they actually encompass. If it's even possible to give an estimate or sort of order of magnitude, how many animals are involved in these studies over this time period?

John Bucher: So the main studies involved rats and mice, male and female, that were exposed to either the GSM or the CDMA radio frequency radiation. The total number of animals was approximately 3,000.

Denise Grady: Okay. Thanks.

Operator: Thank you. As a reminder, if you'd like to ask a question, please press the * and 1 on your touchtone telephone. We can go next to Todd Shields with Bloomberg News. Please go ahead. Your line is open.

Todd Shields: Thank you. I'm interested in the take away for people/for humans. Do people need to be afraid of their cellphones? What should we say to the man on the street?

John Bucher: So as I indicated before, the typical cellphone has radio frequency radiation emissions that are very, very, very, very much lower than what we studied. We studied, as I indicated, the maximum that one could achieve during a call in a poor connection situation and we studied it over nine hours a day for over two years.

So this is a situation obviously that people are not going to be encountering when utilizing cellphones but again, it's a situation that allows us to express potential biological events or find potential biological events if one is going to occur.

So I think that the message is that typical cellphone use is not going to be involved, is not going to be directly related to the kind of exposures that we use in these studies.

Operator: Thank you. We can go next to Erin Ross with Axios. Please go ahead. Your line is open.

Erin Ross: Hi. I was curious if you have any new ideas as to why there might be differences between the response in male and female rats since this first was published in 2014?

John Bucher: Yes, actually we have, in looking at these reports as a whole. The responses did seem to be more severe, if you will, in male rats than female rats. And in what we call our pilot study phase where we were looking at levels of radiation that increased the body temperature of animals over 1°C, we found that the larger the animal in general, the great absorption of energy from the radio frequency radiation and the higher the body temperatures.

As rodents grow, and rats and particularly male and female rats grow at different rates, male rats achieve a body weight that's several hundred grams higher than the female rats generally. So we think that if any of the groups of animals, either male or female rats or male or female mice, were to show an effect, we would've expected it in the male rats.

Operator: Thank you. We can go next to Charlie Schmidt with Science Insider. Please go ahead. Your line is open.

Charlie Schmidt: Sure. I wonder if you can speak specifically to the dose response. Were the effects that you were seeing in the highest exposure ranges, did you see any kind of threshold below it there was no effect?

John Bucher: We did not see a threshold in our particular studies. The malignant schwannomas occurred with a dose response.

There were several other biological effects that occurred with those response and there were a number of statistically significant changes that occurred in tumor incidences for a variety of tumors that we did not see a dose response and we believe that in fact this sort of diminishes the confidence that we have in these findings.

So those responses are one of the particularly important aspects of deciding whether there was some evidence of carcinogenic activity, or in fact was equivocal evidence or was an uncertain finding.

Michael Wyde: This is Michael Wyde. I just wanted to expand on John's comment. In the lesions for the heart, the schwannomas, we also saw a statically significant trend with increasing exposure and also we saw statistical significance pair-wise at the highest exposures to 6 watts per kilogram and again, in those control animals we actually saw none of these lesions, which indicated that this was a very rare lesion in these animals.

Operator: Thank you. We can go next to Susan Wagner with NBC News. Please go ahead. Your line is open.

Susan Wagner: Hi. Yes. Thanks for taking my question. I'd like to go back to the difference between the male rats and the female rates. Is there any way we can extrapolate that to humans, to me and women?

John Bucher: At this time we don't have any ideas that would really allow that to be done. No, I'm sorry.

Susan Wagner: Do you have any understanding of the difference between that in terms of their hearts? What's the difference between a male rat's heart and a female rat's heart?

John Bucher: So there are obviously differences in the endocrine system and the way hearts age and respond to various stressors but in this case, we think that since the females were also showing strange, if you will, unusual patterns of cardiomyopathy which is a naturally occurring age-related degenerative condition in the hearts of rats, we did see with the radio frequency

radiation, we saw increases in sort of a different pattern of this disease. We did see it in males and females but again, I think that the tumors were showing up in males likely due to the fact that they were simply absorbing more of the radio frequency radiation than the females. That's as good an explanation as we have at this point.

Susan Wagner: Thank you.

Operator: Thank you. We do have a follow up question from Ryan Knutson with the Wall Street Journal. Please go ahead. Your line is open.

Ryan Knutson: Thank you. I was hoping you could talk a little bit about some of the other biological observations such as the birth rate being lower in the exposed group and then sort of more broadly, it seems like these results are sort of somewhat mixed. What do you think this says about just sort of the simple notion that there can be biological effects from this type of RF exposure even if it's unclear what that actually means for people's health?

John Bucher: In the reports, when you read those reports, I think you'll see a fairly large number of indications that there are in fact biological effects.

The birth weights were lower generally in rats in the perinatal portion of the study, meaning at birth and during early life/lactation and this was pretty much in an exposure related manner. We don't know whether this is a direct effect yet on what they call rat pups or this is an indirect effect perhaps related to the way the moms/the mothers, the dams of rats actually cared for those animals during lactation.

We don't have any idea really of - because of the configuration of the chambers, we weren't able to actually observe the behavior of those

animals during the exposure period, so there could be effects related to the maternal behavior that were somewhat different in the chambers or there may be other effects. We don't really know.

At this point, probably one of the stronger effects that we saw in this study was a decrease actually in age-related nephropathy, which was a degenerative kidney disease that rats typically get and typically you see that in males more so than females. In fact in this study, if you remember back to the May 2016 report, one of the findings that we also report - again, the same study - were that the control male rats lived a shorter amount of time than the exposed animals. We found that in carrying out the complete evaluation of these animals, that the condition of chronic progressive nephropathy was decreased in an exposure related manner across the radio frequency radiation exposure level.

Clearly, this is also in evidence in a positive sense with respect to the radio frequency radiation that there are biological effects of exposures to this test agent.

Operator: Thank you. We can go next to Seth Borenstein with The Associated Press. Please go ahead. Your line is open.

Seth Borenstein: Yes. Actually, my question was to follow up on that. In terms of if you weigh now both the increase in the heart schwannoma but the higher survival rate of the radiated rats, can you weight those two against each other? In the long term it looks like the radiated rats lived longer, so wouldn't that be a better thing than -? I guess how can you explain this to people that hey, there are more tumors but the radiated ones also lived longer? What should people take home from that?

John Bucher: So there's two levels of that question. One is the specific aspect of the living longer on the tumor incidence and I will say that we did survival adjusted statistical evaluations in our study so that in fact the increases in heart tumors were not fully due to the fact that the animals lived longer. They actually did have an increase, statistically significant increase.

But I would say also that we don't always - in a variety of different chemical evaluations/chemical assessments we've seen both positive and negative effects with respect to an ultimate effect of the chemical on animals' physiology and biology, so it's not necessarily unexpected. I recognize that it's a difficult message to get across but - in fact, that is the case in this situation.

Michael Wyde: This is Michael Wyde. So when you look at the survival, I think what you're asking is how a survival might impact the development of a tumor.

So when we look at the schwannoma specifically, these don't only appear at the very end of the study. We've started to see towards the end of the study this occurred before we had more significant loss of animals in the control groups. So as opposed to what we looked at in the brain, these were very late occurring tumors.

So if the animals were living longer, it's possible that the length of time that they lived might contribute to the fact that they had a longer time to develop the tumor. But for the heart, we believe that this occurred earlier on in that stage, so we believe that this is not necessarily specifically related to the survival of the animals.

Seth Borenstein: I guess what I'm getting at is so for the average person, if you say you may get - and granted you're not saying these extrapolate to humans but

you may get a heart tumor but you may live longer, the average person would say, "I'd take the heart tumor and live longer." I guess that's what I'm trying to understand. Are you saying that this is necessarily a better thing?

John Bucher: So what we're doing is we're actually simply reporting the findings that we have in these studies. I mentioned earlier that these studies were done using exposure levels that are unlikely to be encountered by a human. So the extrapolation of these findings to potential for risk for human health is something that requires a number of different steps that go beyond the particular realm that we're studying here, that we're reporting here. So I don't think that that question is particularly answerable at the moment.

Seth Borenstein: Thank you.

Operator: We can go next to Brenda Goodman with WebMD. Please go ahead. Your line is open.

Brenda Goodman: Hi. Thanks. I was going to ask about the lower survival rates too. That's a puzzling one. Do you have any thoughts about why?

John Bucher: Well, there are really two proposals and that is the one that this is a chance effect and I think that there may be some truth to that.

There also is a potential that this is a real biological effect due to the known use of microwave therapies in what's called microwave diathermy to treat tissue injuries and reduce levels of inflammation. In the chronic progressive nephropathy in our male rats, one of the key features is an inflammatory reaction and in almost all of the organ systems that we

evaluated, this inflammation was in fact occurring at a lower level than in control animals that hadn't received the microwave radiation.

So again, it's a complicated situation here. We're seeing both positive and negative effects in these animals.

Brenda Goodman: I know this is going to be difficult because there have been so many different studies but can you put these findings into context a little bit for us of other major cellphone studies like interphone? How do we assess all this information taken together? Are you telling us really we have to consider this as its own discrete piece of information?

John Bucher: No, actually I'm saying that this is part of a much larger set of information that has to be considered with respect to determining risk to human health.

The interphone studies and a number of other earlier epidemiology studies still have produced conflicting evidence as to whether there are increases in brain tumors as well as tumors called acoustic neuromas or vestibular schwannomas of the 8th cranial nerve in humans using cellphones in a very heavy rate. One of the things that we found most interesting about our findings was that the malignant schwannomas, even though they occurred in the heart and not in the head of these animals, were in fact schwannomas and schwannomas are the same type of tumor that's found on the acoustic nerve in humans in the earlier epidemiology studies.

So I'm not saying that our studies should be taken only in isolation in effect. I think that as I indicated in my remarks, we need to take into consideration the entirety of the epidemiology literature. You need to take into consideration the number of animal studies that have been done in the past and they number almost 20 now - animal studies of cellphone

radiation with the vast majority of them coming up negative with respect to cancer.

We have, in the report, pointed out a number of the technical difficulties with some of those earlier studies that actually led us to do the study we're reporting today because of what we felt were some technical improvements that we can make in the study designs. But again, I think that absolutely one needs to take into consideration all evidence before reaching conclusions about public health implications over a study.

Brenda Goodman: Thank you.

Operator: Thank you. We can go next to Laura Kelly with Washington Times. Please go ahead. Your line is open..

Laura Kelly: Hi. Thank you for taking my question. I wonder if it's possible you could talk maybe about this one surprising finding to you that you didn't expect?

John Bucher: Well, I think the surprising finding to me was the malignant schwannomas. I think that given the history of findings in these studies, we were surprised by this.

I was also surprised at the chronic progressive nephropathy decrease that we found and I think those two things sort of stand out.

Operator: Thank you. We can go next to Erin Ross with Axios. Please go ahead. Your line is open.

Erin Ross: Thank you. I haven't had a chance to look closely at the numbers in this because they did not newly posted like 12:45 but I remember in the 2016

report, one area of concern was that the controlled group in this particular strain of rats is prone to cancer that they found and some people criticized that the rates were extremely low. I was curious if the anonymously low rates in the control group were present also in this particular - in the 2018 update? Then I was also curious with regards to the nephropathy. You mentioned that there's a type of microwave therapy used in kidney inflammation. I was just wondering if you could repeat that hype that has been used in the past? I didn't get the full name when I was transcribing.

John Bucher: The therapy that's used is microwave diathermy.

Erin Ross: Could you spell that?

Michael Wyde: D-I-A-T-H-E-R-M-Y.

Erin Ross: Thank you.

John Bucher: So I'm not exactly sure I understand entirely the first part of your question. The [crosstalk]…

Erin Ross: [unintelligible] that the rates of cancer in the control group were lower than you would expect just by normal occurrences. I was curious if that was still true in the 2018 study.

John Bucher: The original report, I think what you're talking about is the fact that we saw no tumors in the control animals in the hearts or in the brains and this is not totally unexpected occurrence. These are rare tumors. We would see a tumor about one in every two or three studies that we would do and there were none that showed up in this particular study. So it's not that

unexpected that you would have to study and would not see these tumors in a control group.

Erin Ross: Thank you.

Operator: Thank you. We can go next to Joel Moskowitz with the University of California Berkeley. Please go ahead. Your line is open.

Joel Moskowitz: Thank you. As I recall, the early toxicology studies on tobacco found a whole host of low incident tumors in various organs of the body and people just sort of ruled them out because of the belief that an agent wouldn't cause tumors in various organs. There was a US air force study conducted from 1980 - 1982 looking at very low intensity microwave radiation, 2,450 MHz at much lower exposures that you were using in this study from 0.15 watts per kilogram to 0.4 watts per kilogram and what they found looking at male rats was that 18% of the male rats exposed to this form of microwave radiation over a two year period developed cancer as compared to only 5% of the rats in the [unintelligible] exposed control group. This was called the Guy Study but it was actually published later on in bio electromagnetics and Chao was the first author on the paper, so this is a peer reviewed study. So the relative risks they reported of developing cancer across these different types of tumors in different organs in the wireless radiation exposure group compared to that [unintelligible] control group was 4.46 which was highly significant. If you were to look at your data from that standpoint of the proportion or the relative risk of developing any type of tumor in the rats and then also in the mice as compared to the [unintelligible] controls, what would you find?

John Bucher: So we have looked at that. The female rats and the male and female mice showed total tumor incidences across the groups that were about equal across the control and the exposed groups. There were slight elevations in the male rats in total tumors, total incidence of animals with tumors.

It's hard for us to actually interpret these findings because total incidences of tumors are generally driven by common tumors, not driven by these rare tumors that we've been reporting in this study, so we haven't really done the evaluation completely with respect to the point that you're raising.

I will say that the survival difference would magnify this issue related to total tumors, in that the control animals would be affected I think more so than the incidences where you have the particular incidence of a rare tumor. I think that would be more effective in this case. So we really have to dig into that in a little more detail to decide exactly how to answer that question.

Joel Moskowitz: Thank you.

Operator: Thank you. We can go next to Andrew Joseph with STAT. Please go ahead. Your line is open.

Andrew Joseph: Yes. Thanks so much. I'm sorry to harp on this again, but with the survival data, I know sort of the difference between the exposure and the control with male rats and I was just wondering if there was any noticeable difference either in female rats or in either sex of mice?

John Bucher: Well, there were slight differences. In general, if you look across the study, there was a slight increase in lifespan in the exposed animals compared to controls but these were not statistically significant differences.

Andrew Joseph: Got it. Thank you.

Operator: Thank you. We can go next to Charlie Schmidt with Science Insider. Please go ahead. Your line is open.

Charlie Schmidt: The other studies and [Audio Gap] describe it as the largest, most comprehensive animal study to date or what sort of magnitude of this study relative to its predecessors of the others that are ongoing? Assuming you want to answer that. [Laughter]

John Bucher: I can answer that from the standpoint of the typical study, and that is typically one would run studies - a cancer study has about 50 animals per dose group. We might run two dose groups in a control. You might run rats or mice and in this case we run 90 animals per exposure group including controls. We've done males and females rats and mice.

We started the exposure in utero in rats which is a whole other dimension. They have another dimension of exposure scenario because I don't know of any of the other studies that have used in utero exposure. I could be wrong on that.

Well, they were large studies, let's put it that way and technically, it's very demanding studies and in this case, because of the design of the exposure scenario, we were able to expose animals - free ranging animals, if you will - not held within a particular restraint device to allow the radio frequency radiation to be directed specifically at the head of the animal or

something else but these animals were exposed over their entire body for greater than nine hours a day for over two years, so this is an extensive study. We think that's an accurate characterization.

Michael Wyde: I would also expand that to say not only the size of the study itself as far as the number of animals and the scope of the study, not only was that large, but this also involved the development of a novel exposure system - the testing and the [unintelligible] of that system and the construction of a facility where we can expose the animals.

Charlie Schmidt: That's the one in Chicago?

John Bucher: That's correct.

Charlie Schmidt: Okay.

Operator: All right. We can go next to Todd Shields with Bloomberg News. Please go ahead. Your line is open. Todd Shields, your line is open. Please check your mute function.

Todd Shields: Hi. Yes. Mute function. My bad. I'm told by a reporter who knows more about this stuff than I do to ask was the increase in malignant schwannoma in rats statistically significant?

John Bucher: Yes, it was. By trend test in one case and pair-wise as well as trend in the other.

Todd Shields: Okay, and if I could have a quick follow up. In the news release you say you caution against drawing/extrapolating to humans but then you also say the following, "We know however the tumors we saw on these studies are

similar to tumors previously reported in some studies of frequent cellphone users." So do they buttress these earlier reports of tumors in cellphone users and doesn't that say we should indeed draw a link to human cautions? I'm a little confused by the direction of that.

John Bucher: The association - I mean one of the things that drew our attention to this particular tumor type was the earlier reports of schwannomas and I indicated that.

There has been sort of an evolution I think in the way cellphones are used and in the technologies, I think that they're moving more and more towards lower power exposures, lower power exposures to humans. One of the big pushes is to prevent the rapid battery decline that happens in a high power situation from cellphone.

So I think the technologies are really moving us away from some of the exposures that would've been happening when they were moving from the 2G especially the 1G, the analog systems to the 2G/early 2G systems where there were fewer base stations or base towers and potentially higher phone powers being used at that time.

Todd Shields: Thank you.

Operator: We can go next to Ed Friedman with Friends of Merrymeeting Bay. Please go ahead. Your line is open.

Ed Friedman: Thank you. A few quick questions. You said that this is an unlikely exposure that these test animals have underwent. On the other hand, clearly there's a great deal of ambient exposure that people have beyond just being glued to a cellphone. Can you relate one to the other i.e. does

the period of exposure time with your test animals maybe compensate somewhat for the other exposures that people receive? Then the rats and mice, do you consumer them sort of equal opportunity test animals or are there plans to maybe look at the same exposures in both species and would you expect a difference? Then just lastly, any plans for looking at probably the most common wireless frequency 2.4 GHz or thereabouts? Thank you.

Michael Wyde: So in answer to your first question, we're kind of living in this wireless environment where we're exposed to wifi and cellphone radio frequency radiation and electromagnetic fields. The way that I understand it is that the exposure from the cell towers themselves is negligible unless you're very close or working on those particular towers. So primarily human exposure is through use of handsets that you use, the wireless communications technologies that we researched.

Ed Friedman: Okay. Thank you. Of course people have smart meters and tablets and all these other things that are fairly close.

Michael Wyde: Right. So that's one of the concerns and so our research, depending on what types of frequency use and modulation used, these studies would be [unintelligible] one of those technologies and again, we're not experts on the exposure side but it's my understanding from discussing with experts that the exposures are rather minimal from these other sources but again, these are sources of exposure and those need to be further investigated.

John Bucher: So I'd like to add to that. One of the things that you mentioned is that there are different frequencies used in different technologies and we acknowledge that. One of the things that I think will come to of these studies that's a great advantage to us is that we, through continuing some

of these molecular studies into the tissues of these animals and knowing what happens with the particular frequencies and modulations that we've used, we can design short term studies to be much more flexible and try to keep up with the changing technologies, by monitoring some of the molecular changes that we've seen in these studies, in newer studies, and hopefully we'll be able to do something about keeping up with the rapidly advancing technologies with respect to assuring cellphone safety in the future.

Ed Friedman: Okay. Thank you. That sort of gets to my question about the 2.4. What your future plans might be. I understood that the old reverberation chambers were destroyed. Maybe that's not true but I heard you say you're making some more. So are you thinking about moving ahead with follow ups based on what you've done?

John Bucher: Yes, we are. The reverberations chamber system that we used was large and not suited for the kind of small rapid studies that we need to do and it could not be modified to accommodate all of these various different technologies, so we're building a much, much smaller but a much more flexible system to be able to move forward with these studies.

Ed Friedman: Any timeline on that?

John Bucher: We're hoping to have the facility in place by late summer.

Ed Friedman: Thank you and thanks for your work.

John Bucher: Thank you.

Operator: Thank you. We can go next to Melissa Chalmers with Epic. Please go ahead. Your line is open.

Melissa Chalmers: Hi. Thank you. You mentioned about the exposure in rats and mice not being typical for regular exposure people have during the day. I was just a little concerned about that just because there are many people that don't realize that they are increasing their exposures by doing things like making a cellphone call from inside a metal building or their basement or in a moving car. Then on top of that, there are a great many people who don't know what the distances that these phones need to be from their body or their head and they don't look in their user manual and they exceed the safety code recommendation for their phone. So I just didn't want people going away with thinking that they're not usually actually getting to these levels that would've been experienced in your study.

John Bucher: Well, we've tried to indicate what those levels are so that the community can evaluate this information and put it in the context of everyday use. I think that when we started these studies, there were not great measurements in the literature of sort of the ambient exposure level and we're hoping that we actually believe that some of that work is being done. So we'll have more of a database on which to put these studies into context moving forward.

Melissa Chalmers: Okay. Thanks. I was just concerned because there were a couple of people from the media that had called in and were trying to get a firm answer as to whether or not it's safe or not and how this relates to the world and most people don't realize what they phones are doing. They've never measured them or done anything with them to know. So with my experience with helping people who are having problems with this

technology, often nobody realizes the exposures were as high as they were until afterwards. So thank you very much.

Operator: Thank you. We can go next to Louis Slesin with Microwave News. Please go ahead. Your line is open.

Louis Slesin: Thank you very much. A quick question about the length of the exposure. Originally the study was going to be a lifetime study and at the last minute it was a scientific two-year study exposure study. I'm wondering whether there are any trends that you now wished you could've followed through the lifetime or you think you've learned as much as you could from the two-year exposure?

John Bucher: Well actually, I don't think with respect to the rat study we could've gone much longer. The control animals were, as I indicated and even though from the earlier report, were not living as long as the exposed animals so to carry the exposures out further would actually make the statistical adjustments for survival more difficult to do. So from that standpoint, I don't think that that would've helped any. I will say from a technical standpoint it's very difficult, not only from a statistical standpoint but from a technical standpoint, to just keep chambers going of that size for a very small number of animals.

Louis Slesin: For the mice?

John Bucher: I'm sorry. For the mice. Mice generally don't live quite as long as rats so we're actually - well, I can't answer that question. I can't tell you what would've happened had we taken the mice study out to the end of their natural lifespan. We didn't do that.

Louis Slesin: My question is are there any trends that you saw that you wish you - I'm not asking you to predict what would happen but were there trends there that you might have liked to follow through on?

John Bucher: No, I don't think so. If you look at the mouse report that we've put out and send us some ideas if you have some. That would help us interpret these studies. [Laughter]

Louis Slesin: Thank you.

Operator: Thank you. We have time for one more question. We can go next to Jeneen Internali with Consumer Reports. Please go ahead. Your line is open.

Jeneen Internali: Thank you so much and apologies if this is repetitive. Also excuse me, I have a touch of flu. I believe you said in response to an earlier question that your understanding is exposure is really like the big risk from exposure comes through handsets and devices that you're using closely. I was wondering if there's any real concerns about 5G, something that's been raised in the media about how as we move to 5G, there'll be more base stations required in places that are - in closer proximity to where people live. It sounds like maybe that's not necessarily a thing to worry about. I wanted to make sure I understood that correctly.

John Bucher: Well, first of all, I wanted to state that you indicated that there might be a risk, high risk if you will. I'm not sure if that's what you meant associated with cellphone use at this time and I don't think that's a proper characterization. I don't think this is a high risk situation at all but I will say that there's a sort of a tradeoff in moving to the 5G networks. You're going to be decreasing the distance between a cellphone or smartphone of

some sort and the station to which it's sending its signal, so it's going to be running at a lower power. So although I know that people are not happy with the proliferation of these antennas in their neighborhood, it does in fact decrease the power that it takes the phone to connect to a base tower so it's a tradeoff.

Jeneen Internali: Thank you and I didn't meant to imply that the risk was high. Only that people have expressed concerns that there would be an elevated risk in response to 5G so apologies if I misspoke but thank you.

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