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Head of Research Design for the $25m US Gov Study on Cellphones Provides Additional Analyses and Discusses Implications With Scientists from the Israeli Institute of Advanced Studies at Hebrew University

Scientific Briefing on the NTP Study on the Carcinogenicity of Radiofrequency Radiation

YouTube link https://youtu.be/rM3_Qdv1hFE

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[transcript begins]

[Michal Linial]

Good morning to everybody. And good afternoon to those that are in Jerusalem. It's really… let me just introduce myself, very briefly. I'm the Director of the Israel Institute for Advanced Studies at the Hebrew University in Jerusalem. This is one of the quite important institutions in Israel in terms of academic and excellence in research and science—so science and more. So it will be interesting to discuss it, if we have time for that. But really, I'm very happy to host this press briefing on the issue of mobile phone and its implication and, more importantly, really to support—and I'll just say in one word—the support and encouragement of this… of building a thinking team in our place. We will be convening an expert international symposium on non-ionizing radiation and health to kind of encourage a scientific dialog on—maybe the best way to say it is—what we do know and what we *should* know. So I think this is really the topic of this briefing as well. Let me just mention, if I may in two minutes, that Devra Davis approached me about a year ago with this idea of having us as a really national institute to host something that can be of importance, scientifically initially and maybe on policy in a later stage. And of course, I brought this idea to the academic committee of the Institute, which, by the way, checks tens of applications of that kind, and we were very happy to kind of encourage and basically a little bit of even supporting this thinking team that I just mentioned, that will happen actually in the coming January. I can say exactly on the 23rd to 27th of January 2017. I can just say just a little bit about why we are in this game at all. As a Director I'm saying and also as a citizen of Israel, I think this is very important not only in the global aspect of this important issue but actually there is an Israeli angle to this that we would like to explore. And Devra Davis, that maybe just very briefly I'll introduce, is a Visiting Professor of Medicine in the Hebrew University in Jerusalem, is a perfect person to lead this kind of a thinking team. She is—I'll just say to you

that maybe are not familiar—she is a former member Scientific Board of the Counselors for the U.S. National Toxicology Program with new findings on the study of microwave radiation we are discussing today. So that's really the context. And of course, Dr. Davis is also the author of several books and on the truth about cellphone radiation. And she has an award-winning book. So all this bringing us to team with Devra and many other experts—that I won't mention their names—in Israel to really build up a dialog, a very open dialog, in an open atmosphere, as we do in all other topics that we are covering. And just to let you (inaudible, 3:42), what we are looking, often, is really not just one thinking but actually to bring the science on the stage and to make, in a very special atmosphere and supporting atmosphere, to discuss troubling issues such as economics, inequality. We just had a meeting on future of big data in biomedical research. So this specific topic that we are discussing is very important for us and also, needless to say, to the world's children and the future. So this is kind of a very brief breakdown(??). Just to sum up, I would just say that we just ended a few months of discussing what's the limit of completability(??, 4:29) in combination of computer scientists, philosophers, and so on. Our most recent talk, outreach talk to the public, was entitled "From Aristotle to the iPhone." So now we have to close the loop and address the hidden health consequences of our growing reliance on this wireless device. And I think by that maybe I'll switch back to you to organize this very important meeting. Thank you so much.

[Meg Sears]

Now we're very privileged today to have Dr. Melnick join us. He led the design of the National Toxicology Program within the National Institutes of Environmental Health and Science in the U.S. He led the design of this rodent study. So he will discuss how the study was carefully developed to test for carcinogenic effect from cellphone radiation. And along the way they find other effects as well. Dr. Melnick was a Senior Toxicologist and Director of Special Programs in the Environmental Toxicology Program at the time of the design of this. And he has since retired. But Dr. Melnick, I look forward to your words today. Thank you for joining us.

[Ron Melnick]

Okay. Thank you, Meg. And thank you for inviting me to participate in this conference. The cellphone radiation was nominated to the NTP—the National Toxicology Program—by the Food and Drug Administration. I became the primary focus point for the design of those studies. And the first phase we wanted to test the hypothesis that cellphone radiation could not cause an adverse effect. That's the null hypothesis. If we find one, then that becomes a hazard identification. When effects are identified, we also want to provide data that could characterize the dose-response relationship for any toxic or carcinogenic effects. And these studies are conducted in rats and mice. At the time that the nomination came in, there was very little known about possible long-term exposure effects to cellphone radiation. We were aware of ongoing animal studies, but we felt that they did not provide an adequate challenge to the null hypothesis. Those studies, for example, included two hours per day of exposure in animals that were restrained. So since power levels are limited by thermal effects of radiation, we extended the daily exposures to animals, and we wanted a system in which they would be free-roaming.

So we tested the feasibility of exposing animals in reverberation chambers. These are, essentially, rooms that look like big microwave ovens. But there was a number of criteria that we had to establish before initiating the animal studies. We had to be sure that the field strengths were uniform in the chambers. We wanted to be sure that the absorption of the energy would be to all organs, and not have an over-exposure to the tail. We established a number of criteria that were met; they were validated. Our chambers were built. And we selected two modulations: GSM and CDMA. And for rats the frequency was 900 megahertz, and in mice 1,900 megahertz. But there's a number of complications in building a chamber. For example, we had to have built special chokes for water delivery; since animals are exposed for a good part of the day, we had to enable them to obtain water *ad libitum*. We wanted… we had to have a door that would not allow the (inaudible, 8:31) of the electromagnetic energy (inaudible, 8:33) inside the chambers environmental controls for temperature, humidity, ventilation, noise, and lighting. So there were three experimental phases to these studies. The first phase was what we called the "Thermal Pilot Study." We wanted to determine the effects of various power levels of modulated cellphone radiofrequency radiation on body-temperature, body-weight, and survivals of rats and mice. We used rats and mice of different ages and weight, including pregnant rats, because we wanted to establish an exposure level in which body-temperature would be maintained, not (inaudible, 9:14) a body-temperature rise of more than one degree Centigrade. Once that part of the study was done, this helps us set an upper limit for the specific absorption rate. We then did a short prechronic study to be sure that animals exposed for several weeks would survive, and we wanted to see if there were any toxic effects, and determine then an appropriate exposure level for a chronic study. The chronic study then was designed to evaluate chronic toxicity and carcinogenicity of both the modulated GSM and CDMA radiation. And the specific absorption levels—this is the dose—(inaudible) a control, 1.5, 3, and 6 watts per kilogram. This would be in rats and mice, including pregnant rats. Today I can talk about the rat data to a limited extent, because there are still ongoing efforts. But the rats were exposed from Gestation Day 5. And the offspring were exposed up until approximately 110 weeks of age. The exposures were on for 10 minutes, off for 10 minutes, and these exposures lasted for 18 hours a day, 7 days per week. Again, as I mentioned before, because we're limited by the power that can be delivered, we extended the time to obtain a dosimetry and challenge the null hypothesis. What we observed in these studies are increases in gliomas and schwannomas of the heart, but there were also hyperplasias. There was a significant trend for gliomas in the CDMA-exposed rats. There were also gliomas observed with the GSM exposure. None were observed in the control. There were also glial hyperplasias observed in only exposed rats. The glial hyperplasias are focal proliferative lesions, which, as they grow larger, can convert into a tumor. In the female rats, there were no significant effects on the glial population of cells, however, there were incidences of gliomas in female rats as well as glial hyperplasias. In the heart, we observed an increase in schwannomas. The increase was a positive trend with both GSM modulation as well as with CDMA modulation. The level of schwannoma incidence was significantly increased in the highest exposure group with CDMA. In addition to the schwannomas, there were Schwann cell hyperplasias observed in only the exposure group and none in the controls. In the female rats, again there was no significant effect but there were schwannomas observed with CDMA as well as Schwann cell hyperplasias. One other effect that hasn't been really reported in the literature is that there

was also a toxic lesion in the heart; it was a right ventricle degeneration. This was observed with both male and female rats and was significant at all exposure groups except for the female rats at the 1.5 watts per kilogram. So what's the message from all of this? We tested the hypothesis that cellphone radiation could not cause health effects, and we feel that that hypothesis has now been disproved, because these results clearly show that cellphone radiation can cause adverse health effects. The finding of increases in gliomas and schwannomas of the heart in rats exposed to the radiofrequency radiation provides consistency with the epidemiological reports of increases in gliomas and acoustic neuromas—which are tumors of Schwann cells—among humans exposed to cellphone radiation—those were the findings that provided the basis for the IARC evaluation of 2011—because the same cells that became cancerous in rats are the cells that have been reported to develop into tumors in epidemiological studies. And there have been some comments made about the NTP study that I can address at this point, very quickly. One comment was made that the study had low statistical power and that might lead to a false positive. I'm not sure if that was a misstatement by the reviewer, because low statistical power means there's a high probability of accepting the null-effect hypothesis even when a true effect may exist. That is, there's a greater chance for a false negative, rather than a false positive, if there's low statistical power. There has also been comments made about the reduced survival among controls. So I looked at this data a little more carefully. In the 6 watts per kilogram group exposed to CDMA radiation, there was not a significant difference from controls. There was a slight greater reduction in survival in the controls after Week 95(??, 15:32). However, the first incidence of schwannoma of the heart was seen at Week 70. So that that difference in survival really should have enabled some controls to have developed these lesions if in fact these lesions would have shown up in the control animals. And hyperplasia, which is part of the continuum of proliferative lesions that can develop into cancers, was not seen in controls. And this might have been expected in early-death animals, because the first brain hyperplasia in a CDM[sic]-rat occurred at 58 weeks. So not seeing hyperplasias in early-death animals confirms to me the finding of the glial tumor response in rats. And lastly, there is claims made that these were low incidence of tumors at high power levels for long daily exposures. Well, the doses were not really that high. The doses ranged from 1.5 to 6 watts per kilogram. And in the United States, the FCC has a limit for cellphones of 1.6 watts per kilogram. So in terms of the dose received, it's not high like people think of chemical toxicity studies. And the incidence of tumors is not the measurement of risk alone. Risk is determined from both the dosimetry—which is the absorbed power times time—versus the tumor response. So because of the large number of cellphone users worldwide, even a small increase in risk at exposure intensities that may be close to what humans experience could result in a large number of people developing a RF radiation-induced tumor with long-term exposure. Thank you.

[Meg Sears]

Thank you very much, Dr. Melnick. That certainly clarified a lot for me, and I hope for the people online as well. And Dr. Davis is… I've had the privilege of knowing and working with her for a year. She's one of the most brilliant people I know. She's the President of the Environmental Health Trust—a non-profit science and policy think-tank focusing on wireless

radiation. She is the Founding Director of the Board on Environmental Studies in Toxicology of the U.S. National Research Council, and Founding Director for the Center of Environmental Oncology at the University of Pittsburgh Cancer Institute. She's a former Senior Advisor to the Assistant Secretary for Health in the Department of Health and Human Services in the United States. And she's a member of the National Toxicology Board of Scientific Counselors. So Dr. Davis, thank you very much for all of your hard work. And I'll turn it over to you.

[Devra Davis]

And thank you, Meg. It's a pleasure to work with you, as well, at Prevent Cancer Now, which is doing important work in giving people information about environmental health hazards. I want to thank all of you for listening to us today, as we talk about a very important issue for ourselves and our children. Let me just clarify some of the things that Dr. Melnick said. When we talk about GSM phones, those are the frequencies that are used by AT&T and T-Mobile. And when we talk about CDMA, that's used by Sprint, Verizon, and U.S. Cellular in the United States. The rest of the world… most of the world is using GSM phones. So basically, what this study did was to evaluate these currently used technologies and see whether or not they had an effect on the chance that tumors would develop. And as Dr. Melnick just said, even if there was a *small* increased risk, because *billions* of people are using phones today, the impact of this small risk will be huge because there is so much use of these phones. And many countries, like Australia and the United States, today actually have more phones than people. And by the way, this study was not just about cellphones. It was about the kind of radiation—the microwave radiation—that they emit, and many other devices are emitting this radiation today, including tablets, which are being used in increasing numbers by infants and toddlers. So there is, for example, the iPad teething rattle case and the iPhone teething rattle case, which the American Academy of Pediatrics and others are not in favor of parents using. But most parents, until now, had no idea that they were handing their child a device that might increase the risk of cancer. So it's very important to understand that the kind of exposure we're dealing with here is of currently used phones and other devices that emit wireless radiation, a growing number of which are being used in schools with young children without awareness of the fact that they are two-way microwave radios that now have been shown, in the National Toxicology Program, to increase the risk of cancer, in animals, under very controlled studies. And I want to say that we agree with the American Cancer Society, and we're delighted to see the statement of Dr. Otis Brawley, who indicated that this is in fact a paradigm-changing study, because this study used twice the normal number of animals, it had three panels of reviewers instead of the normal one, and it followed all of the criteria that have been established over many years by the National Toxicology Program, which is the premier testing program of its kind in the world. And those results need to be taken very seriously, as a consequence. And as many of you know, this study adds to the burden of proof that was established in 2011 when the International Agency for Research on Cancer reviewed all of the data up to *that* time and concluded that based on information as of May 29th, 2011 cellphone and wireless radiation should be called a, quote, "possible human carcinogen." We agree with our colleagues, Lennart Hardell of Sweden and Vini Khurana of Australia, that these new findings certainly indicate that cellphones and other wireless radiation should be re-classified as a "probable human carcinogen" if not a definite

human carcinogen. I was delighted to meet recently with the Federal Communications Commission senior members of the Chairman's office, who informed Environmental Health Trust that they are waiting for the federal health agencies to advise them on how to handle this issue. And now that they have this information, we can expect that they will proceed to take steps accordingly. I just want to comment on a few of the epidemiologic findings that are important to understand in the context of what the National Toxicology Program found. As Dr. Melnick indicated, this partial report noted an increase in malignant tumors of the brain—gliomas—and a schwannoma of the heart—a malignant tumor of the nerve sheath of the heart. Now these are relatively rare tumors in animals and humans, relatively rare. *But* they are lethal. And for humans they are often life-shortening, without any question, and life-changing beyond doubt. And what we know is that there are epidemiologic studies which have looked at people who have used cellphones, and when you take people who have used cellphones heavily and matched them to others who do not have brain cancer and compare the amount of cellphone use of the people who have brain cancer with those who do not have brain cancer, what you find is that the heaviest cellphone users have a significantly greater risk of developing brain cancer. And as a matter of fact, in the French national study which was published *after* the International Agency for Research on Cancer reviewed the epidemiologic data in 2011, that French national study in 2014 found a significant increase in malignant gliomas and a greater increase with the longest hours of making phone calls. Now that's a very important finding, because it's one of several studies all of which have shown the same thing. So we can say that every study that has good data and uses a case-control design finds that those who use cellphones the longest have the greatest risk of this glioma. And this is parallel to the findings now in animals, of the National Toxicology Program, which according to the criteria for saying whether or not something is a *cause* of something in humans, we now have animal data showing that this tumor is increased in animals, and we have information that it's also increased in humans, under controlled conditions. Now I want to address the lack of an epidemic of brain cancer now, which some people have said is proof of safety. And I want to explain that it is not proof of safety. What we know is the following. If you look at the pattern of smoking in the U.S., when the peak rate of smoking occurred—which was in the 1950s for men—there was not that big a rate of lung cancer deaths at that time. In fact, the peak rate of lung cancer deaths did not occur until 40 years later. So we had 70 per cent of the population smoking heavily, and we did not see an increase in men in lung cancer deaths until 40 years later. Our use and the users of cellphones have changed very recently. So of course we're not going to see a huge increase in the population patterns of brain cancer at this time. But the absence of that epidemic is not proof of safety of cellphones. And we are in fact seeing increases in the most aggressive forms of brain cancer, according to a report from the Central Brain Tumor Registry of the United States, which needs to be carefully examined. But their report on cancers in young adults did show an increase in that type of cancer. And the more aggressive brain cancers appear to be increasing. And that Registry, unlike the United States SEER Program, covers almost the entire U.S. population and has very well ascertained data. So we would be foolish to ignore these signs. And I think it's important to understand that this is a strong study from the National Toxicology Program. And as Dr. Melnick said, because it studied twice the normal number of animals, the power to find an effect was greater than the usual study, *but* the probability of finding a positive effect is greater when you have large numbers.

With small numbers, and relatively small numbers as in… you will find a probabily of a false *negative*—not a probability of a false positive. If you want to know how common diabetes is, do you ask 10 people or do you ask 1,000 people? And that's what we faced with here. The larger number of animals were studied than usual, it's still a relatively small number, so in fact we had a study that had a higher probability of a false negative and certainly no probability….

[Meg Sears]

Thank you very much, Amir Borenstein, for pointing out that you believe that 3G UMTS is similar to the CDMA that was used in the National Toxicology Program studies. During the studies they used two forms of modulation. So I would like to invite either or both of our panelists to comment on the meaning and the importance of these different types of modulation in this toxicology study.

[Ron Melnick]

I'll answer. This is Ron Melnick. The CDMA is a 3G development. And it is similar to UMTS.

[Devra Davis]

And I'll add, if I may, that the problem we face is this: we are studying these things *after* people have had exposure to them. Now, if cellphones were a drug, they would be illegal, because we have to test drugs *before* we expose millions of people to them. And we have no post-marketing surveillance for them either. And I think that's something we all need to think about now, in light of the National Toxicology Program findings. We absolutely need a program of surveillance. We need training and reseach, so that we can understand these things. And without that right now, here we are in United Stated investing in spreading this technology into schools, with the assumption that it's safe, when in fact we do not have data on safety. And that's, I think, a huge problem.

[Meg Sears]

Our next question is from Robbie Reven(??). Many have questioned the findings because of the differential effects by gender. Can you address this? We've actually learned a lot about gender differences suggesting that what one sees in the goose is not the same as the gander. So Dr. Melnick, could you talk about the differences between the males and the females and why we see effects more strongly in one than the other?

[Ron Melnick]

Well, this is not uncommon in NTP toxicity studies with chemicals. Obviously, the Program has not done a lot of studies with physical agents. But in addition to the difference in response we saw with the radiofrequency radiation, as I tried to point out, there were tumors—schwannomas as well as gliomas—in female rats. They didn't achieve statistical significance. But in addition, the historial control data for both of these tumors are lower in female rats than in male rats. So we don't understand the basis for the difference but it is a common occurrence. So, for example, the brain glioma historical control rate—this is the rate in untreated controls—is ten-fold less in female rats than in male rats. And that hasn't been determined, as far as I know, why that difference exists. So seeing a difference on an effect from radiation, it would not be unexpected. We might have expected to see both sexes with similar response, but a difference in response is just not explained at this time but it is a common occurrence in toxicity studies.

[Devra Davis]

Let me add that methylation patterns are different in men and women. And that has been established in a number of scientific investigations. And that refers to how the DNA interacts with other things in the environment. And men and women have different patterns of dealing with methylation. And that has an effect in their livers. So the fact that you might have differences between males and females, obviously without those differences we wouldn't have (inaudible, 32:28). And we know that there are many differences in the way males and females respond. For example, tobacco smoke—women develop lung cancer more easily than men, in response to tobacco. And we know that there are huge differences in the response to certain agents in the environment. So finding effects in one sex is not unusual, as Dr. Melnick said. And there may be biological basis to it: hormonal or other aspects of metabolism.

[Meg Sears]

Thank you very much, Dr. Davis. Just as a quick follow-up, the findings were not significant but we did see that the female rats developed more tumors in the exposed groups than in the control groups. So in these studies, they say that they're not significant at a 95 per cent level. Could you very briefly explain for our listeners what the implications are of the standards for significance, in this kind of study?

[Ron Melnick]

The 95 per cent significant level is kind of standard for toxicity/carcinogenicity studies. So that becomes the criteria established at the beginning of the study for significant (inaudible, 34:00), seeing that the chances that we're wrong are only 5 per cent. So it's a standard used in health effect studies.

[Devra Davis]

And let me add: it just means that there's 1 chance in 20 that your results could have occurred randomly. That's all it means. But the more important thing to understand here is it's an arbitrary number. In physics you use a 10 per cent significance number. So the fact that something is borderline significant could be hugely important in this case. And I think it *is* important, as you just noted, Dr. Sears, that we have tumors in females that are not significant but they're occurring in *all* of the exposed animals and *not one* of the control animals. It's very important to realize that these tumors of the heart and brain are rare, and not *one* of the control animals developed them. And when you look at a study, it's important to look at your current controls and not necessarily your historical controls, because the lighting, and the feeding, and the conditions of the animals are matched in this study. They were exposed to the exact identical conditions. And you may find other patterns in other studies, but these are the relevant controls. And in this study what they found is that no tumors of the heart or no tumors of the brain occurred in your control animals; and they did occur in the exposed animals. That's the important thing to understand here. And in some cases they did not achieve significance at the 1-in-20 level—the 0.05 level—but they did achieve significance at the 1-in-10 level. And I think that given what we are doing now with *billions* of people using these devices around the world, we would be foolish to ignore the implications of this study.

[Meg Sears]

We have a question from Lloyd Morgan, directed to Dr. Melnick. And Lloyd is asking about these remarkable reverberation chambers that were designed and built. And so Lloyd is asking: what's happening with these chambers now?

[Ron Melnick]

I don't know the status of the chambers, whether they are usable at this time or not, since the study ended—I'm not sure—it could have been at least a year ago. The plans and the designs are available—these were constructed by IT'IS in Zurich—that they can be replicated. I don't know if the current equipment is available at this time.

[Devra Davis]

I've been told that the equipment has been dismantled, that it was no longer usable. But more importantly, I've been told that this equipment and these chambers cost quite a bit to build. The total amount of the study was apparently $25 million. A substantial amount of that went for the building of these chambers. And now what I understand is that there are newer technologies to give uniform exposure, in appropriate manners, that is a lot less expensive than that. Now, the real question we have to ask is: what are the plans of the U.S. government to follow up on this study in light of these positive findings for a technology that's about to get replaced? We have 2G, 3G, we will soon have 4G and 5G. And while the newer technologies are weaker they may not be less important biologically, because it looks, from all of the studies so far, that it's not the power of these devices that influences their biological effect—it's the pulse

modulation. And the pulse may be much more important than the power. So even though the newer technologies will in fact be weaker in power, they will still be modulated in pulse; and that's what we have to pay attention to. And frankly, there ought to be much more research, starting now, on the newer technologies before we expose people to them in a widespread way.

[Ron Melnick]

At IT'IS they've also built small chambers that hold, I believe, four animals, so that small chambers can be used for any type of mechanistic follow-up studies that researchers are interested in pursuing.

[Meg Sears]

And by "mechanistic" you would mean biochemical follow up, things like…

[Ron Melnick]

Certainly.

[Meg Sears]

… DNA damage.

[Ron Melnick]

(inaudible, 38:57)

[Meg Sears]

While we're on this topic, there is one question regarding the finding of DNA damage that was reported in one of the… it has been reported in the press. Could you expand a little bit on what was found in terms of DNA damage and whether you looked for oxidative stress and other biomarkers as well?

[Ron Melnick]

The study was designed to include interim sacrifice for studying DNA-strand breaks in brain, looking for micronuclei in blood, I believe in the liver as well. There is a paper that has been submitted for publication, and I'd prefer not to go into details until the authors hear that their paper has been accepted. But all I can say at this point is it is not a negative.

[Devra Davis]

The title of that paper is in the release from the National Toxicology Program on their partial finding report. And you can find that on our website at ehtrust.org. And in it, at the end, as Dr. Melnick indicated, there is the title of the paper that was submitted, and it indicates genotoxicity.

[Meg Sears]

We have a follow-up question. Is it the actual device—like the cellphone or the tablet—that's dangerous, or also is wi-fi, which is in so many homes and workplaces and schools and public spaces, is the wi-fi itself a hazard? Now, I realize this is a rather awkward question in that if you have wi-fi then you're going to be using the devices. So how you can… but nevertheless, just the wi-fi in and of itself, what level of hazard or risk would be attached to that?

[Ron Melnick]

The risk comes from the antenna which is located in the device. And the distance from the antenna determines the exposure intensity. This means that all devices are emitting and it's a distance to those devices—the antenna of those devices—which imparts the greatest exposure. There have been studies done to try to characterize what exposure would occur for an individual walking into a room or a coffee shop where people are on cellphones or on their computers, wi-fi connected. And all of these are contributing to an exposure but by far the highest exposure intensity was a result from the cellphone itself. But it depends on the particular situation. If you're in a school and the student in front of you or behind you is working with their computer or tablet, and your head may be closer to the tablet than the person who is working on it. So it's complex to characterize the exposures for all scenarios, but there are models being developed that do a pretty good job of working through all types of scenarios of what a person might experience in a classroom, or a coffee shop, or a library—wherever they may be—or even in their own home, depending on the devices that they have and how close they are to the antenna. Remember: the power intensity decreases with the square of the distance to the antenna.

[Devra Davis]

Environmental Health Trust has been working with colleagues at the University of Porto Alegre, Federal University of Brazil. And we have published a number of modeling investigations on this question of, number one, of the exposure of the child brain to cellphone radiation, but in addition recently, as part of the expert, invited seminar to the Pediatric Academic Societies, a number of scientists spoke about the risks to children. And we included modeling from Porto Alegre with Environmental Health Trust of a child… a six-year-old using a laptop, a tablet, as well as virtual reality, as well as an estimation on wi-fi. So what we know, as Dr. Melnick said, is that distance makes all the difference. But these devices now are being used in ways that were never anticipated when they were first tested for safety and designs for testing were

developed—almost 20 years ago today. The Israeli government has created a National Institute on Non-ionizing Radiation Safety. And the official recommendation of that Institute is that children avoid wi-fi in the younger ages and that schools should use wired, instead of wireless, in general. Now, that's a general recommendation. But the problem we face in Israel, as in all over the world, is that people are so enamored with the amazing things that wireless can do, that they're reluctant to address the fact that there may be risks. And just as one example, there are reports where, for example, a young man died of a seizure. He was found with his iPad on his chest and his phone nearby. And it's not clear whether or not there was a router right over his head or near him in his dorm—because routers are often located by IT professionals whose goal it is to achieve the maximum connectivity. In fact, there are people who are hypersensitive to these things. And they have great difficulties functioning in the world that is increasingly wi-fi. And there's growing recognition by medical experts that the phenomenon of hypersensitivity is real, yet we have, again in the United States, no serious research underway to address it nor efforts to design hardware and software that could minimize exposure. And just as one example, we have cordless phones—which also emit wi-fi radiation—and baby monitors—which also emit wi-fi radiation—and they are on 24/7. They could be programmed, as they are in Switzerland, to be voice-activated. That would save you money, because you'd be using less electricity to power them all the time. It would save your battery life when relevant. And it would reduce your exposure. So we need to have a serious conversation, a public conversation, about how and why we should be reducing exposures. And yes, wi-fi exposure is much less, on average, than cellphone exposure, but where routers are located and how you use devices makes a huge difference. Again the Israeli government advisory group says not to use a phone in a moving metal container, as in a train or a bus, because when you are in that train or bus and everybody else is using their phone, that signal is going to be pinging all over the place. Now, that advice is officially given but very few people understand it or understand the reasons for it, which is why we are thrilled to be working with the Israeli Institute for Advanced Study to come up with some practical solutions to this problem and to propose a research agenda that makes sense to move us forward in our understanding of the science.

[Meg Sears]

This question is for Dr. Melnick. It's from Theodora. She is saying that people keep saying the exposures are too high to compare it to humans. Can you explain in layperson terms an answer to this question—how this exposure to the rats is applicable to understanding impacts in humans—and how this relates to our international regulations that are based on thermal effects?

[Ron Melnick]

First of all with respect to the thermal effects, as I mentioned, we did a thermal pilot study at selected exposures that were not… that did not increase body-temperature—to the extent that we could measure it. In terms of the high power, you must recognize that the limit by the U.S.

FCC is 1.6 watts per kilogram, and the exposures that were used in this study ranged from 1.5 to 6 watts per kilogram. Compare this to a chemical toxicity or carcinogenicity study, where the exposures—because of the small numbers of animals used—can be an order or even two orders of magnitude—10 or 100 times—greater, such that an effect observed can be converted to risk by characterizing the relationship between exposure and tumor response. So in this case, that same type of information can be obtained from this study, because we know what the absorbed power is, we have the time of exposure, and we have the tumor response. And from that kind of information, it is possible to create dose-response models that will provide estimates of risk. Remember: not everybody uses a cellphone in the same way or for the same amount of time. Some people only use headsets, some people hold it next to their head, some people talk for a few minutes a day, some people speak for hours. But it should be possible, from a characterization of that relationship between exposure—which would be exposure and time of use—to the tumor response, to estimate human cancer risk. And I'm not sure if that's in lay terms, but there are complex issues in terms of characterizing dose-response relationships. And that would be something that would be done by the regulatory agencies.

[Devra Davis]

Let me try to add one thing here. We take these animals—which, after all, only live a little more than two-and-a-half to three years—and in their (inaudible, 50:11) lifetime we expose them to as much cellphone radiation as an adult… as a human would get in their lifetime—assuming the human lives, by the way, to about 70. That's how the exposure is set. And as Dr. Melnick just said, they did great efforts to make sure that the levels of exposure here were not thermal. There was no measurable change in temperature in these animals. And that is clearly evidence—as the American Cancer Society has said—that you are getting an effect… an important biological effect at levels that do not induce heat. The amount of exposure to the animals was, in fact, relatively high, because you had to give them this exposure in just two years what you would give a human over their lifetime now. And we see this, by the way, starting with infants and toddlers now with their apps. You have babies at three months, with an iPad bouncy chair, that can play with the iPad in a bouncy chair, so that they can swipe before they can sit up, walk, or talk. And that's increasingly common, again with parents not understanding this. And that is why the Israelis and many other countries—the Indians, people in Belgium as well—have all advised that this is not an appropriate exposure for children. It just is not. And so we know from this that the exposures used were not thermal, they did approximate what a human can get nowadays, and we are seeing cancer—and as Dr. Melnick said before—and serious heart lesions. And in Israel as well, there's research showing calcification of the heart with exposure to a different type of non-ionizing radiation. Finally, let me say that the lowest exposure level in this study is equal to the level that the iPhone reported to the FCC for the iPhone 5 and 6: 1.59 watts per kilogram.

[Ron Melnick]

Could I just add one point? The animals in this study were exposed for two years; that is not full lifetime. And in this study, as I mentioned, there were hyperplasias in the Schwann cells as well

as hyperplasias in the glial cells in the brain; and that if this study had proceeded for a longer period of time—because a two-year animal is equivalent to about a 60- or 65-year-old human—it is likely that some of those hyperplasias would have progressed on to a tumor. So I think the hyperplasia and tumor response needs to be taken into consideration. And it was unfortunate that the study only lasted two years. Regulatory agencies, at this point, are saying if you are concerned there are precautionary measures that you can take. I think that message has to change to strong recommendations being made by agencies for precautionary measures, especially for children.

[end of recording]

[end of transcript]