

Cell Phone Dangers / Dr. Devra Davis, PhD, MPH
@ National Institute of Environmental Health Sciences (NIEHS)

Video: http://www.youtube.com/watch?v=wNNSztN7wJc&feature=player_embedded 1:01:40
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Cell Phone Exposure, Toxicology and Epidemiology - An Update
National Institute of Environmental Health Sciences
Devra Lee Davis, PhD, MPH
April 4, 2012

Dr. Linda Birnbaum: It is really my pleasure to introduce my friend, **Devra Davis**. [Aside:] Were you already starting to give your talk? [Laughter] ... You can understand Devra is extremely enthusiastic and very passionate about what she does.

[Posted on screen: *Learn how to protect yourself from cell phone radiation dangers at www.EHTrust.org*]

- Devra has her BS in physiological psychology and MA in sociology from the *University of Pittsburg*, and
- her PhD is in Science Studies at the *University of Chicago*, and a *Danforth Foundation* graduate fellow.
- And then she has her MPH [Master of Public Health] in epidemiology from the *Johns Hopkins University School of Public Health*, before it was the *Bloomberg Johns Hopkins School of Public Health* [April 20, 2001].
- She has authored more than 190 publications, and books, and journals ranging from the *Lancet* and *Journal of the American Medical Association* to *Scientific American* and *The New York Times*.
- And she blogs in *Freakonomics*, *Huffington Post* and elsewhere.
- Devra has been a *National Book Award* finalist for *When Smoke Ran Like Water*, which is a very powerful book, and I really recommend that if you have not looked at it.
- She founded the *Environmental Health Trust* in 2007, and continues to lead it.
- She lectures at *Georgetown*, *Harvard*, the *London School of Hygiene and Tropical Medicine*, as well as other places,
- And was founding director of the *Center for Environmental Oncology* at the *University of Pittsburg Cancer Center*, and Professor of Epidemiology at their *Graduate School of Public Health*.
- One of her very powerful books, which a little more recent than *When Smoke Ran Like Water*, is *The Secret History of the War on Cancer*. And it was a top pick by *Newsweek* and is forming the basis for National Cancer Policy revisions in South Africa, for example. And I've read that book relatively recently. If you ever believed in conspiracy, it's true, at least as far as, for example the... why it took over 50 years for the fact that smoking caused cancer to be accepted in Public Health circles.
- So Devra's career has spanned all areas of academia, public policy, and scientific research.
- Devra was the founding member of the *Board on Toxicology of the National Academy*, which is ongoing and provides some evaluations and guidance to us, as well as other parts of the government. **President Clinton** appointed her to the newly established *Chemical Safety and Hazard Identification Investigation Branch*.
- She's a former senior advisor to the Assistant Secretary of Health.
- And she has counseled leading officials in the U.S., the United Nations, *European Environmental Agency*, etc., etc., etc., and in fact, I first knew Devra when she was a member of the Board of Scientific Counselors of the *National Toxicology Program* back in the 80's.
- She was another, I would say, protégé of **David Ross**.

So, with no further ado... I'd like to hear all about *Cell Phone Exposure, Toxicology and Epidemiology*, Devra...

Dr. Devra Davis: It's really an honor to be here today, and I'm especially pleased and proud to be here with **Linda Birnbaum** as your director. I've been a fan of **Dr. Birnbaum** for many years, and it's wonderful to see what she's been able to do in difficult times. And I want to say again to all of you, "You are on the cutting edge of what needs to be done now to protect public health. And the reason why your work is so critically important is that the models and analysis that you do will allow us to figure out how to prevent harm, and not just prove that harm has happened."

So, I want to tell you how I came to be concerned about this issue. And I want to explain, as I said informally a few moments ago, like most of you in this room, when I first heard there could be a problem with cell phones, I just did not believe it. At the time, I had three phones, and I was kind of proud of my ability to keep up with all my grad students. Well, I began to look, and I learned that I was mistaken in my assumption that if there were a problem I would know about it, because after all I'd worked at some of the most important scientific institutions in the world.



This is some of what's going on today, and I think some of you may not be aware of this, but you will see here that there is a very aggressive campaign of marketing cell phones to children. And not just 5-year-olds as I show you here, but here's a *Baby iPhone Rattle Case*. You'll notice that the cell phone is directly over the child's gonads, and it's - yes - it's a case for a real *iPhone* for a real baby. They give them to babies in cribs.

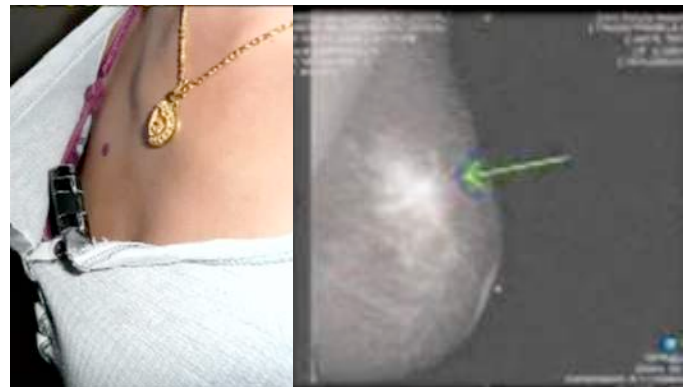


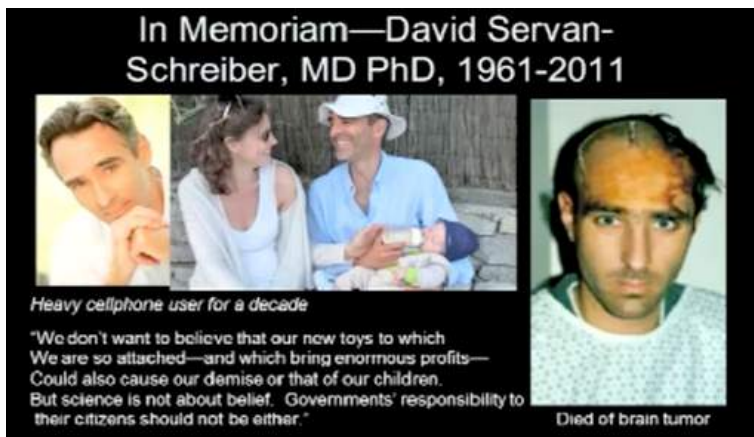
And here are some of the *Apps* for babies. Linda, last night I went and looked up some of these. You can actually play white noise to put the phone under the baby's head. You can teach the baby how to find its nose or its ears. And these *Apps* are actually real *Apps* for real phones handed to real babies.



Another problem that when I first heard about it that I was quite skeptical about was that people would actually put a cell phone in a bra. Some of you may know people who have done that. Anyone here know someone who puts a phone in their bra from time to time? Yeah. Okay. Well, let me show you - these are pretty astonishing images. This is a 39-year-old Chinese American vegetarian from California, and she had multiple primary tumors right under where her phone was stored, and this is here mammogram - multiple

primary tumors. Now, this is a case report that I'm writing up with her physicians, but this is quite extraordinary. She is not in a risk population for breast tumors at all. Breast tumors normally are not multiple primary. But you and I all know this could simply be a coincidence. However, the pattern of putting cell phones in the bra, putting cell phones in the hijab for the Muslim woman, and now there's a new device on television you may have seen where you can actually have the phone strapped to your head called a *GoJo* - it's a real hands-free unit - made me concerned about what we know about exposure to the phone. So, I'm going to briefly talk to you about that, but I want to also share with you the fact that my dear colleague, who wrote the preface to my current book, *Disconnect - The Truth About Cell Phone Radiation*, died of a glioblastoma multiforme just last year.





And he wrote in the preface to my book, "We don't want to believe that our new toys to which we are so attached - and which bring enormous profits - could also cause our demise or that of our children. But science is not about belief. Governments' responsibility to their citizens should not be either."

The irony of this is incredible. When he and I first met to discuss this in 2007, he tells the story that we were having dinner and he went to answer his phone, and held it next to his head, and I

apparently yelled at him, perhaps. I said, "How could you be doing this?" because you see, he had had a brain tumor at age 31, that was picked up incidental to an MRI. And this was now 16 years later. And he said, "What are you talking about? If there was any problem I'd know about it." So, I asked him 2 questions. I said, "Did you know that cell phones come with warnings?"

Here's an example: this is the fine print warnings that comes with your *iPhone 4*, and in case you can't read that this is what it says at the bottom, "May exceed the FCC exposure guidelines for body-worn operation if positioned less than 15 mm (5/8 inch) from the body (e.g. when carrying the *iPhone* in your pocket). How many of you here have *iPhones*? How many of you know that you're not supposed to put it in your pocket? Right. This is a problem. Why are these fine print warnings - I asked him if he knew about that.

And then I asked him a second question. I said, "Did you know that you cannot get insurance for health damages from cell phones if you're a cell phone manufacturer? You cannot get secondary insurance." So, those two questions are important questions, and I don't have the answers, but I want to show you now some of the science of what we understand.

We know without any question that microwave radiation from cell phones has positive impacts. It's being used in medicine now and was approved by the FDA last month to treat brain tumors and hepatocellular carcinoma [cancer of the liver] - last month for brain tumors / last year for liver cancer - cell phone-like radiation. It stops bleeding / it is being used to enhance the uptake of drugs into the brain, because it is known to relax the blood-brain barrier. Now, I know that another talk going on in the Institute right now has to do with LOX/COX pathways and epilepsy and the blood-brain barrier. Think about all the epileptics we have in this country, and the fact that cell phone radiation could be playing a role in weakening the blood-brain barrier.

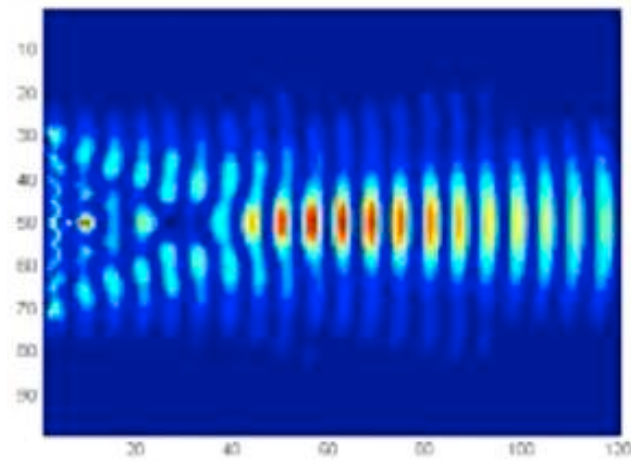
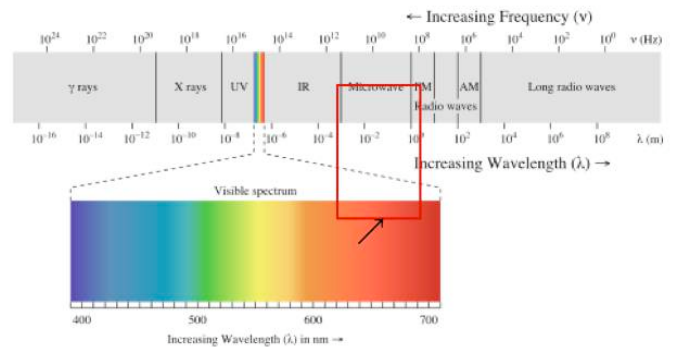
Now, negative impacts of cell phone radiation are less widely understood and appreciated, and I'm going to briefly cover some of the data today, because there is so much of it. And I want to say that I'm working with some of the best and brightest experts around the world today, some of whose data I will be showing you / people like **Igor Bagayev** from the *National Cancer Institute of Slovakia*, formerly with the *Karolinska Institute* and the *Soviet Academy of Sciences*; people like **Alvaro de Salles** of the *University of Porto Alegre* in Brazil; people like **Om Gandhi** at the *University of Utah*; people like **Lukas Margaritis** and **Adamantia Fragopoulou** at the *University of Athens*. We are working together on various aspects with the support from *Environmental Health Trust* to develop more information about both the positive and the negative uses of cell phone radiation. And today I'm going to go through just some of the highlights.

The exposure data I'm going to show you come from work developed by an industry institute funded in Switzerland headed by **Niels Kuster**. And I'm going to show you some data recently provided through Professor Kuster and **Andreas Christ**. We know that there's been a tremendous change in cell phones over the years. You can remember when it was the shoe phone - the big box shoe phone. The original mobile phone you see over here. It's really quite something...



It was more like a luggable phone than a mobile phone. Alright? But the interesting thing is that it's the Scandinavian countries that have the longest use and the most data, and I'll hopefully get to that in a moment.

Now, just to set the context, the electromagnetic spectrum goes all the way from the things that drive our radios to the ones that are in outer space that are clearly very damaging: x-rays, gamma rays, UV. The microwave spectrum right here includes cell phones, microwave ovens, cordless phones and Wi-Fi. The difference is this: they all use a similar frequency, namely the frequency of about 800 megahertz to 2400 megahertz, or .8 gigahertz to 2.4 gigahertz. The power of a microwave oven is 1000 watts. That can boil a cup of water in a minute. The power of a cell phone is much less than 1 watt, and it was thought for a long time that therefore it had no biological impact. That is not the case. The biological impact of cell phone radiation is not related to its power. It's not related to its power. It is, in fact, quite weak. It is related to its erratic nature of the signal and its ability to disrupt resonance and interfere with DNA repair. And I'm going to show you some of the reasons why scientists believe that that is the most plausible theory for understanding the wide array of health impacts that pulsed digital signals from cell phones can have today.

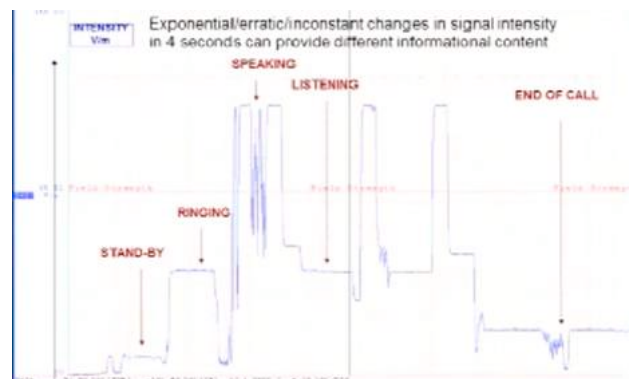


This is a really important illustration, and this was developed by the Greek researchers showing the complexity of the signal. Signals have frequency, or pace. They have amplitude, or power. They have the pulse, or the beats. They have intensity, polarity, and information content. And the information content on the signals may be the most important. We don't know, but we do know that whenever you're analyzing information about cell phone radiation, you need to know all of these things. And that's an example of how complex this is. This does not fit easily into the conventional paradigm of toxicology with *the greater the dose, the greater the response*. It is the intermittence, the erratic nature of the signal that may be most important

biologically. So, that a very weak signal, but a very weak signal that goes... [a tapping and vibrating given as example] might be more damaging than one that is a steady, regular signal. Think about how you, if you're trying to sleep, can sleep when there's a nice patter of rain. But if the thunder comes and shocks you it disrupts your sleep. Well, we are in a natural state of homeostasis and resonance. And things that disturb our resonance may be more biologically important.

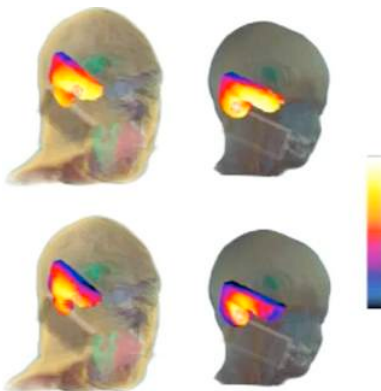
Just to give you an idea of the complexity of a signal, look at all the things that take place in variation of intensity over a 4-second phone call. This was developed by **Professor Margaritis** at the *University of Athens*. This is showing you the tremendous variation that we get over one call. So, when we're looking to try to mimic cell phone radiation in vivo this is really very difficult, because we want to avoid thermal effects, and we know that microwave radiation will induce heat. It's used for that in higher doses, or higher levels are used in medicine for that purpose exactly. Signal characteristics may be much more important than total dose.

That is to say, the total dose or the average of the dose may not be the issue so much as the characteristics of the signal - again, its erratic nature.



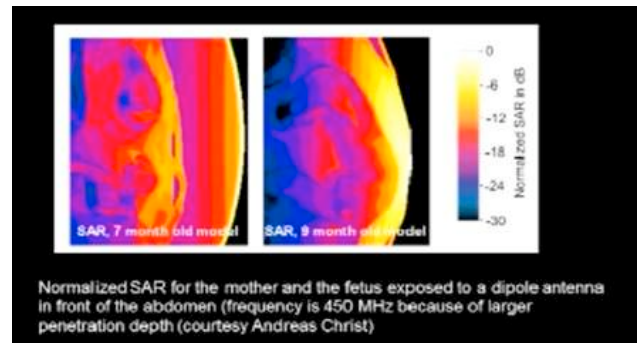
So we are, in fact, conducting an experiment right now on all of you. And I'd like to ask you - sorry I didn't do this before - to please turn off your cell phones - not silence them, but turn them off right now. There are some people in this room who will be more comfortable if you do that, just as a courtesy to them. We are, in fact, conducting an experiment right now with 5.5 billion cell phones. And as **Dr. Birnbaum** said in her introduction, the reason I am, in fact, talking to you about this issue today is, because like most of you, I thought there was nothing to it, really. And I really thought I would know if there was anything important. And I realize that although I didn't recognize it at the time, I could be just as arrogant as other people, and I was wrong. I was quite wrong, and now I'm going to show you *why*. But think about this: if we go through with cell phones, what we have just gone through with tobacco, and asbestos, and vinyl chloride, and bisphenol A, and obesogens, and other things that we're now identifying, what this will mean for our planet. It's something of grave concern.

We do not have definitive human evidence on some issues, but we have evidence on others. And I'm going to briefly discuss what some of that evidence is. The one thing we know is this: cell phone absorption - and these

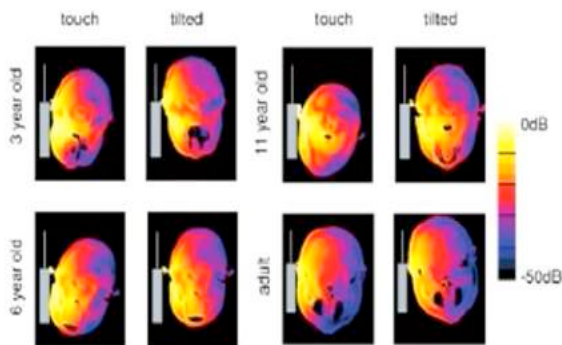


are pictures not of heat, but of the distribution of microwave energy into the head. The standard that is used for all of the cell phones in the world today - all of the 5.5 billion cell phones today - set based on a guy who was at the 90th percentile of military recruits in 1997. Alright? **Standard Anthropomorphic Manikin** called **SAM**, for short. This is the difference in exposure to the young brain, and again, this is not heat; this is simply exposure of radio frequency energy into the brain. Now these data were, again, provided by our colleagues in **Niels Kuster** and **Andreas Christ**, and have been published.

But these have not been, and I want to share them with you. This is showing exposure into the fetus. This is a seven month old / a nine-month old. Alright? You see the exposures? Phone out of dark coming in, and you see the exposure gets pretty much through during pregnancy, if a phone is held right over the abdomen. That is why, by the way, the **Blackberry** comes with a very clear warning: *Do not keep near the pregnant abdomen, and don't keep near the abdomen of teenagers*. Of course, when someone goes from age 19 to 20, I'm not sure what the presumption is there. But that is what the advice is with the **Smart Phones**: *Don't keep near the pregnant abdomen*.



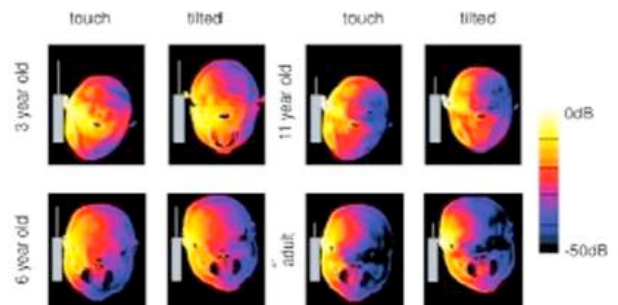
SAR Distribution in the Head Models at 900MHz



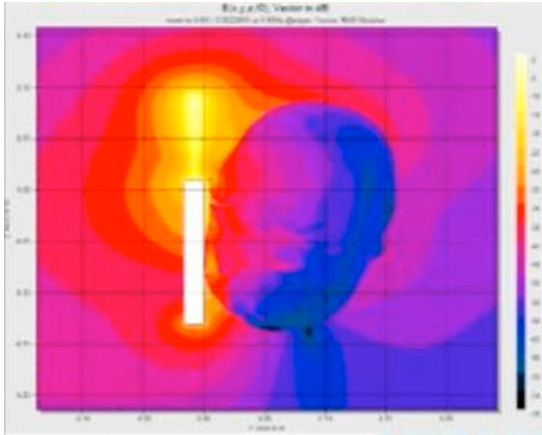
This is now / these are data from the same group showing distributions of radio frequency energy / microwave radiation into the head of a three-year-old and a six-year-old looking at 900 MHz at the tilted and at the touch position. Alright? You can see that the exposure gets pretty much through the brains. Remember the ads I showed you at the beginning.

This is the 1800 MHz, and the distribution is slightly different. It's actually greater with the 900 than - but you see that you're getting complete exposure. That is because the skull of a child is thinner; their brains contain more fluid; they will more readily absorb microwave energy. So, who is most at risk?

SAR Distribution in the Head Models at 1800MHz

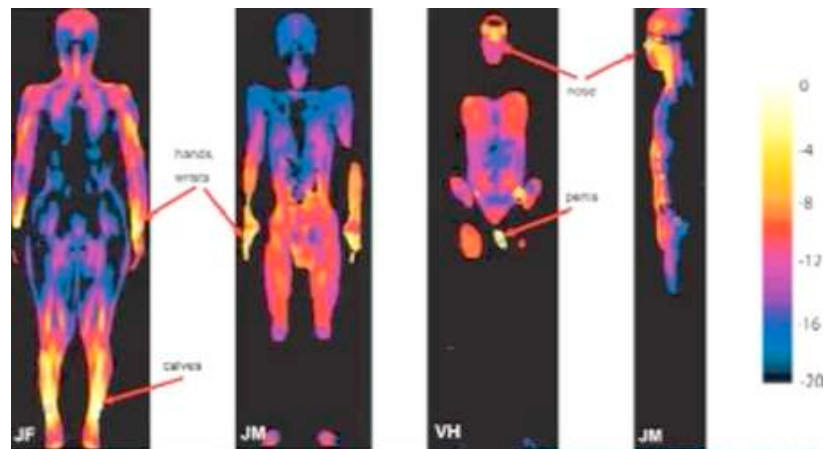


Well, we're doing a project right now at the *University of Porto Alegre* where we're going to be modeling exposure into the head of a one-year-old, a two-year-old, and a three-year-old. And when I told my colleagues I wanted to know the answers to that, they said, "Why?" And when I showed them the ads in the United States and the fact that there are several hundred *Apps* that people are downloading to give their babies for their phones, they were quite surprised. But that is, in fact, what we're dealing with. It's a public health fiasco for methodological reasons. We will have no control group. In this generation of young people there will be no control group.



These are some other studies we're doing now at Porto Alegre. This is developed by **Claudio Hernandez**. And again, looking at the complexity of the signal and the absorption into the brain. This is a movie, which I'm not going to be able to run on this computer, but basically we can model how the plume gets into the brain. And the thing you need to realize is this: if you hold a phone next to your body or your brain, because the antenna of the phone is symmetrical, half of the exposure gets directly into your brain or your body. And of course, your skull and your hip have bone, so you don't absorb as much there. But your breast, or your chest, or your gonads will absorb much more, because there is nothing / no density to protect it there.

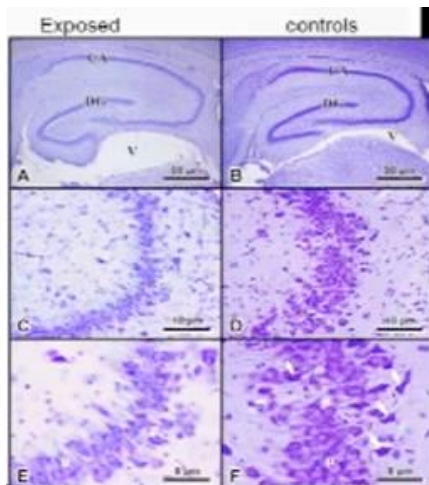
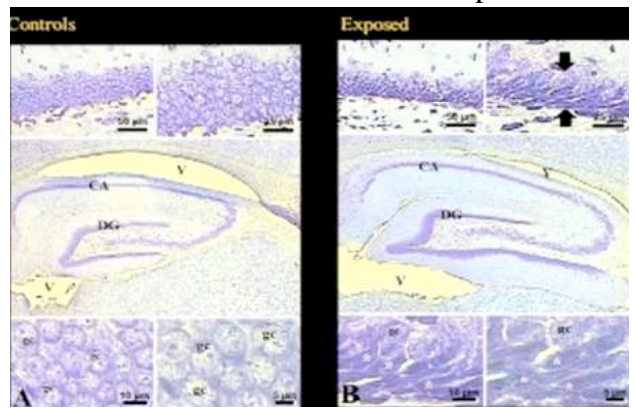
This is workplace exposures to radio microwave radiation where there's general exposures. And the important point of this work published by **Gosselin** et al. is that the penis gets the highest exposure - not surprisingly - it does not have bone or density to protect it. And yet standards are not set. OSHA does not actually have any standards at this point. They defer to a complex inner-agency process, and the bottom line is that we're really not relying on what scientific information exists to protect our workers today from this issue.



Now, the toxicology of radio frequency radiation recently the IARC reviewed over 900 studies for the pending monograph. Most of these were done outside of the United States, and they looked at impacts on cellular structure or cellular function at a wide range of organisms, some in vitro toxicology in animal and human cells, and some clinical observations. I'm going to just present a very brief overview of some of those data. I also, before doing that want to tell you that an analysis that has been done of the results by **Henry Lai**, who did some of the most important work in this field almost 20 years ago, has found that if you want to predict the outcome of a study, you just need to see who has sponsored it, and the probability that a study will find a no-effect can be predicted based on its sponsorship in part, that in terms of industry studies, the percent of studies that are finding nothing is about 2 to 3 times higher. Independently funded studies have twice the chance of finding a positive result. Now you know, what is this telling us?

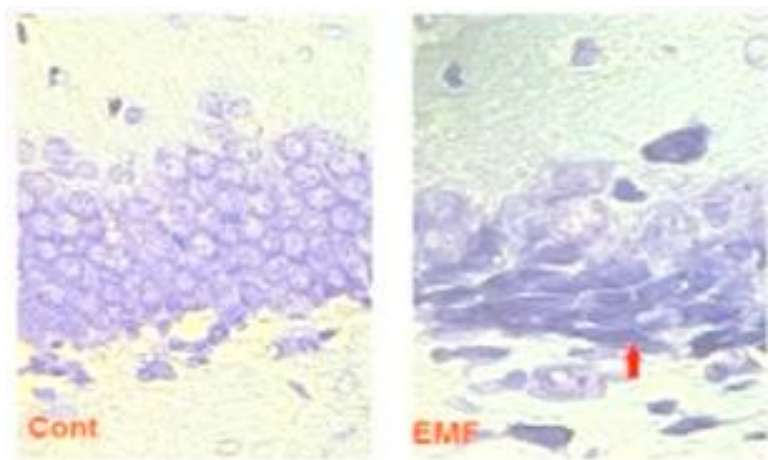
There are legitimate scientific complexities to this field. One example is this: if you're studying a signal, as I just showed you at the beginning, it's not one thing, it's a complex set of parameters you need to look into. And if you study continuous exposure, continuous exposure might actually have a lot of benefits - continuous, steady exposure. It's the erratic exposure that may be much more complex. And a lot of the studies that have different results use different qualities and characteristic signals. And I'm going to show you in a moment - use different cells. And there are resistant cells, and there are susceptible cells in humans and in animals.

Here's a series of studies that have been done by colleagues in Turkey. Now, *Environmental Health Trust* convened an international conference in Istanbul last year where we had brought together experts from about a dozen countries to present some of their work. And one piece from that conference was done by **Professor Suleyman Kaplan** on the effects of radio frequency radiation on the cell number of hippocampus and cerebellum looking at very wonderful stereological techniques. And I'll be happy to show you / get the entire set of slides of - Michael and others who are here might be interested to see them. But this work was published in *Brain Research* - a very high impact, high regarded journal - showing effects of the prenatal exposure on the dentate gyrus of rats. And here are some of / the underlying research question was: *Does electromagnetic radiation inhibit or effect the formation and differentiation of neural stem cells during embryonic development in the hippocampus?* So, the exposure was prenatal exposure, and the results were pretty stunning. Significantly decreased hippocampus granular cell number in the dentate gyrus of newborn rats, fewer cells in exposed compared to controls. And well, again, I will make these available to you in more detail. Hopefully, we will with *Environmental Health Trust* on our website we will make the talk available, within a week or so, to all of you, who are not able to look at it in more detail now.



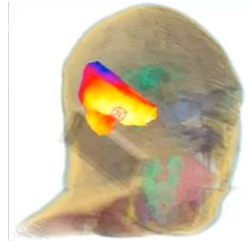
This is another example of pyramidal cell loss, again showing a real difference in exposed and controls, a significantly fewer brain cells in prenatally exposed rats. Now, think about this as we talk about all the studies that are ongoing about autism today. Think about this as we talk about the studies of / in the Gulf, and we're trying to study public health impacts - we have got to include questions about cell phone use. And the question cannot be, "Do you use a cell phone?" because everybody uses a cell phone. The questions have to be, "How do you use a cell phone? Where do you keep it? How many hours or minutes do you use it? Do you use a headset? Do you use a speaker phone?" And I hope by the end of my talk today, all of you will be using a headset or a speakerphone, and understand that the distance really is important here.

Granular cell loss might be caused by the inhibition of granule cell neurogenesis in the dentate gyrus. And the exposures in this particular study were prenatal. They also did another set of exposures where they started them early in life, as well. But again, a significant effect, and you can see it here. The cells literally, there are many, significantly fewer cells. And they did a stereological analysis, as well. So, you're getting fewer cells forming, an effect on neurogenesis. Now, fast forward and think about this potential effect for neurodegenerative diseases in the elderly.



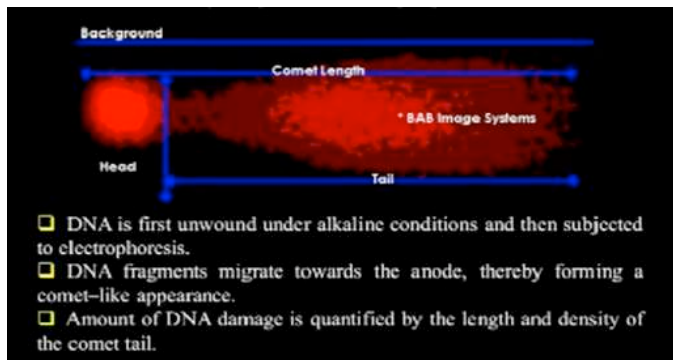
Another set of studies on microwave radiation from mobile phones has been done by **Nesrin Seyhan** at *Gazi University* in Ankara. **Professor Seyhan** has been working in this field for more than 30 years, and is one of the most distinguished researchers in this work. And her team has produced a number of studies, both using human cells as well as experimental cells. I'm going to show you just a few of these. They took DNA from hair root exposed to cell phone radiation, and looked at protein changes in and changes in that DNA. They also studied

rabbits, looking at the New Zealand rabbit pregnancy. The hair root study found significant damage in exposed compared to non-exposed hair roots. This would be, Michael, a very easy study to do - very easy. And it could be fun, again thinking about... Linda, we were talking about trying to think of something to do with his kids in the summer... Hair root, of course, is the first target of mobile phone radiation. You see it right here. Alright? And they took it, of course, from this area. It's, by the way, not too pleasant to have hair root taken out, but for science most people are willing to do that.



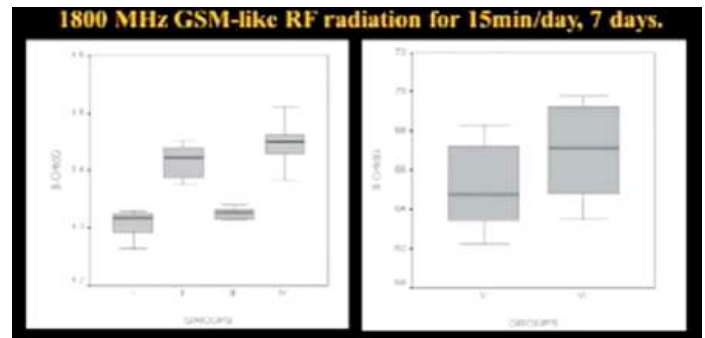
DNA breaks were observed in the hair root cells in human subjects exposed to 15 minutes and 30 minutes of radiofrequency radiation. I think most of us in this room have used our phones much more than that sometimes in a single call. I certainly did for many years. And so did **David Servan-Schreiber** until 2007.

They looked at eight subjects and they took 6 to 7 hair roots from the exposed area within a 60 mm square. And they did comet assay work, and this is just showing you a very, I think, pretty version of what the comet assay

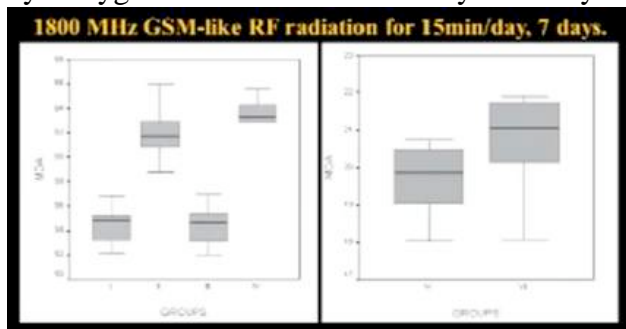


is. You basically are measuring the unraveling of the DNA. And the longer the tail, the greater the impact. And now, the comet assay can be scored automatically. When it was first developed by **Liam Singh** in 1994, it was all manual, and there were a lot of questions about the quality of the work. But basically DNA fragments with a charged current going over gel electrophoresis migrate to the anode, and form what looks kind of like a comet. And the amount of the DNA damage can be quantified by the length and the density of the tail. I'm going to show you a little bit more of the work we're doing on that.

With respect to the pregnancy outcomes, they looked at newborn and infant rabbits. And they looked and found evidence of DNA strand break - double and single strand break - chromosomal abnormalities, apoptosis, cellular stress, neurological degeneration, and free radical formation. And using GSM signals - that's there are different signal types within cell phones, and we won't get into that today, but there are. They generated power with a spectrum analyzer, and using that looked then at the brain of the resulting animals. They looked at non-pregnant adults and pregnant adults, and they looked at the newborns, and they looked at the exposed and the unexposed newborns, looking at DNA base modification and oxidative stress parameters. And the results were pretty dramatic.

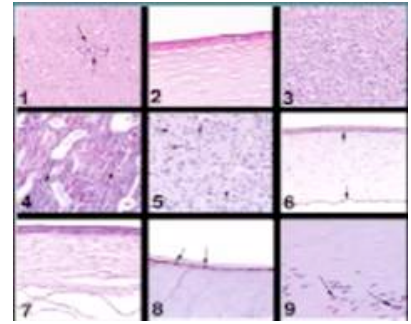


8-hydroxyguanine... you can see / you can figure out. These are the controls. These are the exposed. 8-hydroxyguanine... 15 minutes a day for 7 days.



And this is at 1800 GSM. And this was at MDA level. Also, significantly increased from controls to exposed. Of course, this is rabbits. And its relevance to humans we have to pursue, but it would seem to me that this is evidence per se that there is a biological impact. And they are using a rather unsophisticated version of exposure here. So, something more sophisticated you think may get more robust results.

There's an increase in DNA base modifications and free radical modifications / free radical formations in the brain of the adult rabbits and newborns with this exposure. They looked at histopathological analysis; I'm going to show you now, looking at the brain, the eye, the liver, the lung, the spleen, and the kidney. And effects are shown here in gliosis in the brain, epithelial degeneration, apoptotic cells in the cornea, cornea degeneration, apoptotic changes in the lens. Again, this is / I'm picking here the cream of the work that **Nesrin Seyhan** and her team have done at *Gazi University*.



And there is a lot of work that has gone on. They have been supported by NATO; they have been supported by some of the top institutions in science in the world, and yet it's not widely understood, and hasn't been really integrated into what we understand about this issue in the United States today in science. So, they've really confirmed apoptotic cells in much of the tissue that they've examined, and significantly increased apoptosis in exposed newborns compared to unexposed.

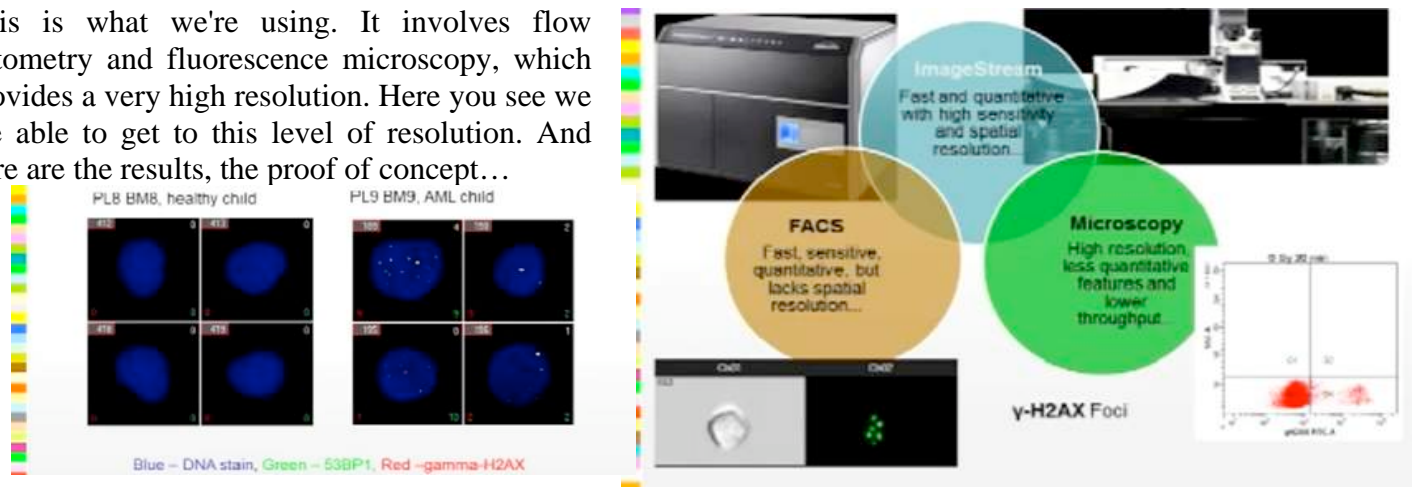
As a result of this work, others have concluded and published in *Environmental Health Perspectives* in 2003, that there is evidence of impact from cell phone radiation at levels that cell phones occur at today. That's the important thing. As you know in toxicology, we traditionally use the maximum tolerated dose. We go through high doses, but in the long run if we're having an effect on brain reserve - I don't know about you, but I want to hold on to all my brain cells - and effect on brain reserve, I think, is a very worrisome indication. And because of that, this is a quote from *EHP* from **Salford** in 2003, as he writes: *We cannot exclude that after some decades of often daily use, a whole generation of users may suffer negative effects maybe already in their middle age.*

We are seeing earlier age of diagnosis of a number of neurodegenerative diseases today. There could be many, many different factors involved. But certainly one of them that needs to be examined is the possibility that cell phone radiation is playing a role, and has to be integrated better into our epidemiologic studies of workers, whether they're in the Gulf or elsewhere.

Now, I want to show you some of the work we're currently doing with *Environmental Health Trust* with our colleagues at the *National Cancer Institute of Slovakia*, and at the *Medical University of Vienna*. **Alexandra Markova** and **Igor Belyaev** are studying the effects on hematopoietic stem cells, because they have previously shown that you can inhibit double strand break repair in primary human lymphocytes. That's been shown. You can inhibit repair. And Belyaev and his team believe that the inhibition of repair may be the critical mechanism here, that cell phone radiation may be an epigenetic carcinogen, if you will, in so far as it inhibits repair. And there's an imbalance between cellular repair systems and DNA damage. Looking at human mesenchymal stem cells and lymphocytes, they appear to be more sensitive to EMF exposure than fibroblasts. And most of the negative studies - and there are a lot of them - on RF exposure and cell cultures have used fibroblasts. And that may be why those results are negative.

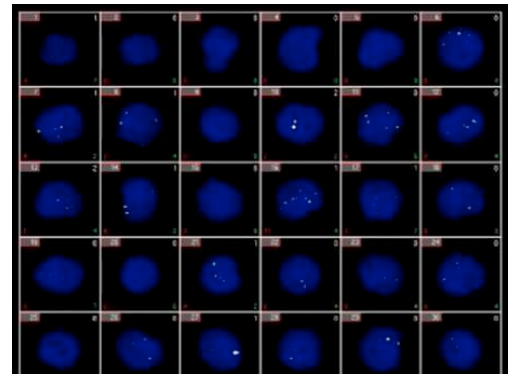
So, our question that we are currently asking is: *Does radiofrequency invitro exposure induce double strand breaks in umbilical cord blood and in stem cells?* So, we've taken cells from bone marrow and blood of leukemic patients and healthy donors. And we're looking at co-localization of proteins, and we are finding that the significant increase in CD34+ stem/progenitor cells in the leukemic patients compared to healthy controls. So, looking at that, there is an imbalance in repair. And the imbalance in repair may be what's going on here. And I suggest this here, because you are the people who could do the work that needs to be done now to try to clarify whether or not this is what's going on. We do not have any experimental data yet regarding possible effects on hematopoietic stem cells. And we're hoping to generate some.

This is what we're using. It involves flow cytometry and fluorescence microscopy, which provides a very high resolution. Here you see we are able to get to this level of resolution. And here are the results, the proof of concept...



DNA repair foci in hematopoietic stem cells CD35+ from bone marrow, and you see a significant increase in expression here in those with leukemia. And in the healthy donors you see none.

Now, this is very preliminary results I'm going to show you, but we have a wide array of responses from our RF exposed cells. And we're hoping to be able to clarify what this all is telling us, but we think that the use of cancer cells in culture to test the impact of RF will be very, very important. And for now, cancer patients just like everybody else should be aware of the fact that cell phones should not be held directly on the body, just like the fine print warnings that nobody reads tells us.



What we are thinking of, and now I share with you the work that I'm developing theoretically with **Belyaev** and others, is that we can characterize the damage as to two major types of damage. There's damage to cell function - that is the ability to form free radicals to use melatonin to repair, to impede repair. Things that interfere with repair are affecting cell function, and not necessarily affecting cell structure at all. And there is some evidence of damage to structure, as well. The common assay, gap junction inhibition, disrupting resonance or spin, and most importantly weakening the blood-brain barrier. So again, think about epilepsy / think about diabetes, where we know that there are problems with the blood-brain barrier because of pre-existing disease states. If cell phone radiation is having that effect, then all the animal studies that you're doing right now I would strongly suggest you need to have your technicians have their cell phones off when they're taking care of the animals, particularly as people tend to wear these things like jewelry, and can be in close proximity. Now, of course, it just depends on what other sources of exposure exist in the laboratories. This, I think, is a very important thing to take into account in all of the studies we're doing right now.

Why then do we have so many negative results, because we do? As I said, often they're using a constant signal, and not an intermittent one, or they're not using the same kind of information-carrying waves. They're relying on resistance cells rather than susceptible cells, so for example, adult lymphocytes are resistant, while neural stem cells are susceptible. And certain cells - younger cells - tend to be more sensitive. All of these things are things that will become clearer when the *NTP* study is completed, which I know is underway right now. And when more resources are applied to studying this problem. We really need more resources, given that there are so many of us now using these devices, it's very important that we get better science underlying our understanding of the potential biological impact that these devices may be having on our lives.

Now, certainly the United States is unique in the world today in encouraging infants and toddlers to use cell phones. And I know when I say that to people, that's why Linda encouraged me to show you those pictures, which I showed you at the beginning. People can't believe that they actually would be doing this, but in fact,

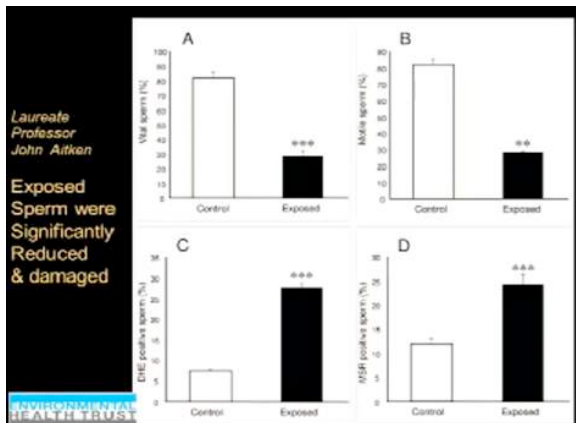
people are using phones, somewhat like pacifiers. And on the case for the baby *iPhone* rattle, it says, "Protect your phone from drool and dribble." The case is intended to protect the phone.

So, this is some of the future work that we are hoping to carry out now, and you can see, I'm sorry, I apologize for the size of this slide, but we have actually done the invitro work at this point. We have exposed cells, and we are now replicating the results. But the thing that needs to be done that will be very important is this: we want to take cells and expose them to melatonin, vitamin C, to promoters and to things that may be scavengers or repair damage. And I think this will be very important for public health purposes. If we can show, for example, that melatonin prevents damage or enhances repair, then that has a great deal of implications. And that is consistent with some anecdotal reports, and consistent with some invitro work that's already been done, but hasn't been replicated recently. So, this is where we are in the process right now. We have teams set up / we're doing this, but we do not at this point we're still raising funds for that work in Europe.

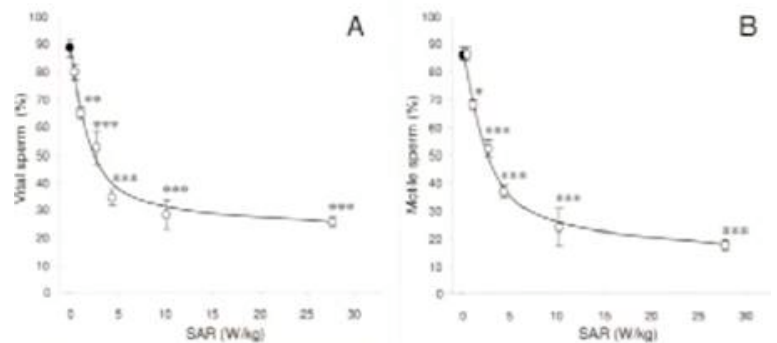
Future Work : tumor demotion and tumor promotion--Chemo-protective and Synergies



Now, I wanted to just show you a little bit about sperm, because it's something that's not widely appreciated in this country. I'm showing you now a summary of what's been done in 7 different laboratories around the world, most notably Australia - the *Cleveland Clinic*. They've taken samples of sperm from men and put them in two different test tubes: cell phone exposed and not exposed. And you can see here fairly robust results in terms of



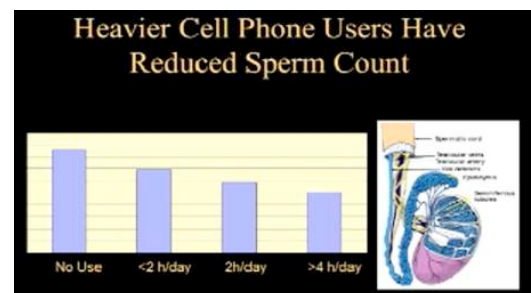
virality and motility - exposed sperm... die about three times faster, and they have three times more damage to their mitochondrial DNA, as measured here. And this is work from **Sir John Aitken's** laboratory at *Cambridge*, trained... who directs the *National Center for Research* on this in Australia. This is other work from the Aitken group showing a very



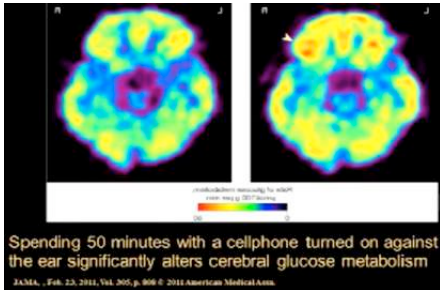
significant effect on reduced motility and vitality of sperm. And interestingly, a very much greater effect at lower doses / lower levels of absorption of radiofrequency microwave radiation. Alright? Really important. It's one of the reasons why that warning is on the *iPhone* - not to keep the phone in your pocket. This is work from the *Cleveland Clinic* where

Professor Agarwal, who's written more than 400 articles, noticed that men coming into his fertility clinic who were having problems, tended to carry a lot of devices on their hips. I wore a lot of devices on my hips for years. So did **David Servan-Schreiber**. It's convenient. Now, if I have it on my hip, I have it on airplane mode.

This is what they reported in the men: Those who kept phones on in their pockets or on their hip for 4 hours a day had about 40 to 50% of the sperm count of those who reported very little use. Now, you would get almost no man that would report no use of the phone. But this was published in 2008.



This study on Wi-Fi interfering with sperm production from a laptop, I think is a flawed study, but I want to show it to you anyhow, because the reason I think it's flawed is they literally took a laptop and put it on Petri dishes. Now, the laptop generates heat, and we know heat is not a good thing for sperm. So, I'm not sure whether we can attribute / what we can attribute this to, but they had a significant increase in DNA fragmentation and damage in this study that was published. And the ironic thing is that laptops are really not supposed to be put on your lap. You must / you should use a book or something. And again, the inverse square law applies, so just this much will give you a lot of protection. It's just that a lot of people don't know what the fine print warnings say with these devices.



I believe you may have seen these data from **Nora Volkow**, and I've flipped them so that you can see them more easily, because the eye goes to this side for the / this is the exposed brain [right] - this is the unexposed [left]. And this is the PET scan showing a significant increase in glucose metabolism in the brain. Well, as you may be aware, there's another name for Alzheimer's - it's called *diabetes of the brain* - because Alzheimer's causes an increase in glucose metabolism in the brain. Nobody knows what this really means. It's a significant increase in glucose metabolism in the brain, produced by just having a cell phone next to the head - that was all. That was what was reported in *JAMA*. This might potentially be a good thing for some things. But the long time implications of what this shows I think is something we need to take very seriously. Fifty minutes of exposure of a cell phone, where the person having the phone next to their head did not know whether it was turned on or not. Simply, the phone every few seconds looks for a signal from a tower, and that - as you remember I showed you with the change in exposure intensity - that change resulted in a significant increase in glucose metabolism in the brain.

And again, all you have to do to protect yourself is to hold your phone here. You don't have to throw it across the room. But when you have it right next to your head, as those of us getting older have to do, because we can't hear it otherwise, then half of that signal is getting into your body. The way to solve that is just to hold it here. Use a speakerphone / use a headset, while we continue to understand the significance of this work. And I understand that **Dr. Volkow** is continuing this work, and it will be very important to see those results.

You may not be aware about the **Blackberry warning**, so I just want to tell you that if you have a pacemaker, *Blackberry* says, "Keep it 20 centimeters from the pacemaker". Of course, your heart *is* your pacemaker. And it says, "Do not carry it in your breast pocket". Most people are not aware that there are only two spots for mandated testing for all of the 5.5 billion phones in the world today. One is with a 6 mm spacer next to the head, and the other is at the hip in a holster. Phones are never tested in the shirt or pants pocket. And if they were, according to studies published by a fellow who worked for the industry for 30 years, **Professor Gandhi**, phones in the shirt or pants pocket emit 4 to 8 times higher specific absorption than those held here at the head or the hip. In other words, you get much greater absorption when the phone is in your pants or shirt pocket. So, I want to leave you with this quote... [Shows on screen]

*The world is not dangerous because of those who do harm,
but because of those who look at it without doing anything.*

~ Albert Einstein ~

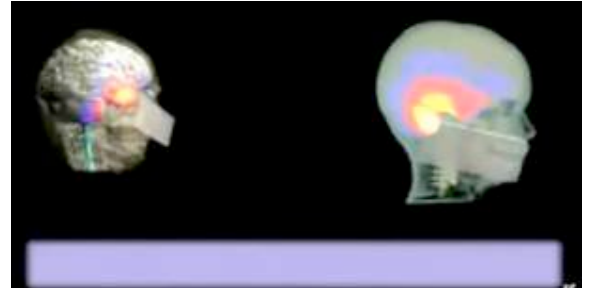
And I have other things we can talk about. And I'm sorry we had a little technical delay at the beginning, but the reality is we have information here that suggests that we have a big problem. And we need to figure out how to study it better, and how to develop responsible public policies, while we continue to do that. So, I come to you as someone who is a big fan of this institute and a big supporter of what you have all done. And I recognize that this isn't easy. This is not an easy topic to work on, not least of which because funds have not been available. And secondarily, I would venture to say that very few of you have ever had any training in electrical engineering. I certainly did not. All that I'm sharing with you today I learned from my colleagues, who are some of the best in the world. And I think that is a fundamental failure of our educational system. But for now, we need a training program, we need to expand the research, and we need to figure out sensible policies that can be

carried out to encourage people to use a cell phone with a speakerphone / with a headset. And I want to just show you what we did in Jackson Hole, Wyoming...

[Awareness video entitled: *Ski Champion Practices Safe Phone* - showing a girl skiing and riding a bike...]

Sarina Scott: That's me, **Sarina Scott**. When I ski or ride my bike, I always wear my helmet. Whenever I talk on my cell phone I use a speakerphone or a headset for the same reason - to protect my brain. Cell phones really are small microwave radios. Young adult brains are still developing and are much more susceptible to radiation.

Dr. Devra Davis: Take a look at the difference of the absorption there. Okay? This ran in the Jackson Hole movie theaters over 200 times, because *Jackson Hole Community Foundation* supports what we're doing at *Environmental Health Trust*. The town council unanimously passed a cell phone safety awareness declaration: *Just Be Aware*. And I'm going to share that with you in a moment...



[Back to the awareness video...]

Sarina Scott: I'm not going to stop using my cell phone, but I want to use it safely, so that nothing gets in the way of my fun. [Cell phone rings] Oh, I'll text them back.

[Screen reads: PROTECT YOURSELF NOW! www.EnvironmentalHealthTrust.org]

Devra Davis: So, that's one thing that we're doing to reach the public. And another is... working with the mayor, and I don't see that in... Nathan, I don't see that in here. So, let me... here it is. Let's see if we can bring this up. The mayor of Jackson Hole...

[Audio shown playing on screen]

Mayor Mark Barron: Hi, this is **Mayor Mark Barron**. The town of Jackson recently initiated *The Cell Phone Safety Awareness Campaign* to promote safe cell phone use in our schools. But we want everyone to be safe. We understand that when it comes to how we use our cell phones, *it's better to be safe than sorry*. The *World Health Organization* says, "The radiation from cell phones can be a possible cause of cancer". It's easy to be safe with your phone. Keep it away from your head and your body. Use a headset or speakerphone. And if you're not driving, then text. For more information, go to www.environmentalhealthtrust.org Remember, *distance is your friend*. Keep your phone away from your head.

Dr. Devra Davis: That's the mayor of Jackson, Wyoming - Republican mayor of Jackson, Wyoming. So, we're working to get the message out that people need to be safe, not sorry. And in the meantime, I'm delighted to talk with you about what some of the scientific work is that we need to continue to do. Alright? Thank you.

[Applause - **Linda Birnbaum** talking in background]

Janine Santos: Hi, I'm Janine Santos. My question is, "Is there any effort to look at?" There's a lot of changes going on, it looks like, with the cells, but is there any effort to look at changes in metabolism, because you have a lot of changes in oxidatives. You know, you have oxidative metabolism. There's changes associated to mitochondria function, which is my main area of interest. And we know that oxidative... the cell is a signaling environment, as well. So, you change that / you will change the metabolism of that cell, and on that note you have the gap junctions that also seem to be altered. And at least in radiation studies, there's a lot of data on / by a standard of facts. So that the cells, they are like very far away that through gap junctions get affected, because things are diffusing from one cell to the other. So, is there any effort to look at it in a more not DNA - I like DNA, too; I'm very fond of mitochondria DNA in metabolisms particularly - but I think in a more comprehensive way of looking, how exactly are the cells functioning in a broader view of / what is that kind of radiation doing to signaling, passing on to the next cells? Does the same by standard effect occurs with these type of radiation? I assume there is nothing much known, but...

Dr. Devra Davis: Wow! That's a really, really good question, and I don't know the answer, but I'm going to ask people who may know the answer. And I think, Michael, that may be something that you could look into, as you get farther along with your chronic studies. I really appreciate the question, and I think it would be great to have people like you thinking about how we could try to address it. [To another with a question:] Yes.

Rick Woychik: With the increasing interest...

Dr. Birnbaum: Rick, identify yourself.

Rick Woychik [Deputy Director, NIEHS]: Oh, Rick Woychik... With the increasing interest in increasing the number of bars for cell phone reception, there has been an increasing effort to put cell phone towers all over the place, and the annex of buildings. And so, what are you telling the general public about cell phone towers and exposure to towers?

Dr. Devra Davis: Alright. That's a really, really difficult question, so here's what I say: There's a lot of wireless radiation in the world today - garage door openers, baby monitors, microwave ovens. There's only one device that you hold directly next to your brain or body, and that's a cell phone. If you want to have a good cell phone signal you'll put a tower in every house. I'm being ironic when I say that. That's not a good idea. The location of towers is a very challenging issue. Okay? Towers in Austria - the standards for emissions from towers are about 1,000 times less than ours / lower than ours. And they have decent reception - I go there often. Okay? So, the challenge is: How do we design these towers so that they emit as low as possible and still work? And there are designs that can be done. We are not / we are behind on that in this country. And so, therefore, we need a massive program of monitoring and measurement, which we do not have. We need a sensible siting policy, which we do not have. And the *1996 Telecommunications Act* specifically prohibits any locality from objecting to the location of a tower on health concerns. And that was passed in my administration, because we didn't know any better. Alright? I had no idea, and most of the people in the senior leadership positions did not realize that there were health issues. We now understand that there are.

So, with all of these things - *distance is your friend* - towers should be sited tallest place where the fewest people will be directly exposed within a hundred meters. But in New York City that's just about impossible right now. So, I'm sorry to say I'm not an expert on the issue, but in fact, if you want to have really good reception you've got to have towers. You just need to have them in the right place. And we have them sometimes in the wrong place. One example: If you are a worker and you're assigned to go and repair a tower, the tower has to be turned off for you to go work on it. And in fact, we know if you're working on a real / a tower, the power can be so much that it can have a real serious effect. But if you are living in a high-rise building in New York City, somebody could put a booster tower right outside your bedroom window where you would be getting substantial exposure, and you would not be able to do anything about it. So, we really need a national policy and examination of these issues.

The Institute of Medicine in 2008, issued a report from a workshop that they held that recommended that we do research in this area, and somehow the mandate, I mean for the funding, has never come through. And I don't think I need to tell you about the funding dilemma that you face right now for a lot of these issues. So, in the meantime, what localities can do is use the force of good will that they have to be sensible. And I think frankly the country that seems to be doing the best job on this is Israel. Whatever you may think about Israel today, they understand radar, they understand microwaves, and they understand cell phones. And the Israeli government on March 1st, passed the first reading of a law that said *all cell phones must come with warning labels*, and warnings that say that *the Health Ministry of Israel has determined that cell phones can increase the risk of cancer, and children should be especially careful*. It must be on all advertisements for phones. But in addition, Israel has established a *National Institute of Cell Phone Research and Safety*, and they have established policies to reduce direct population exposure. Now, there's a lot of conflict within the country about what this will mean, but I think that they're a very sophisticated nation when it comes to using these things. And we would do well to

take some advice from those countries that have more experience than we do with these things, and not to assume that because we don't have clear evidence now, everything is fine.

Dr. Linda Birnbaum: Devra, can you just address the issue of cordless phones.

Dr. Devra Davis: Oh, yes.

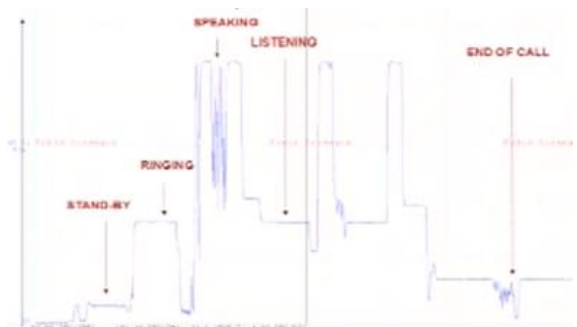
Dr. Linda Birnbaum: Not cell phones.

Dr. Devra Davis: A cordless phone is like a mini base station in your home that emits microwave radiation 24/7. Now, you should not have a cordless phone directly next to your head where you're sleeping. There is a cordless phone made by *Siemens* called *ECO DECT*, which is only on when it rings. Our phones are designed to be on all the time. And so, the Israelis, again - and you can find information on this on our website, which will be / we're revamping it, so we'll make sure it gets highlighted properly - the Israelis advise that you not use cordless phones in your home for 2 different reasons. The first is security, as you know when you have a power outage you do not have your phone - it's gone - it requires electricity to work. But the second reason is that cordless phones emit radiation 24/7. Now again, you don't / the cordless phone is not held next your head all the time, but when you do bring it next to your head you are getting another source of exposure. And studies done by the team for the *World Health Organization* that completed *Interphone* concluded that recently a third of your exposure to wireless radiation comes from cordless phones - a third of all your exposure.

Larry Burke: Devra, hi. I'm Larry Burke. I'm a radiologist specializing in MRI, magnetic resonance imaging, and I just want to mention one thing first, before I give my question, is that anyone who wants to see where their towers are in their neighborhood can go to www.antennasearch.com and you can put your zip code in and it'll put up every tower in your surrounding area. It's quite enlightening to see that.

My question is: I understand when you're talking on your phone keep it away from your head. The issue of having it on your body when you're not talking on it, you might want to elaborate a little bit more, because / about what's being put out by the phone and why that would be a risk.

Dr. Devra Davis: Well, thank you for the question... Just let me show you this again to see the variation in exposure here. [Silence while looking it up on the computer] When you have the phone and you're on the phone and calling, it will give you this variation in exposure from a single call, but it's constantly searching for a signal. And when you are in a car and you have a phone next to your head, as you're moving from one cell tower to another the phone will naturally go to MAX power, as it goes from one tower range to another. So, the worst possible exposure you can get in terms of MAX power is when you're in a car with the phone next to your head. That is why you should have *Blue Tooth* enabled cars where you can, and if you can't, you can go to *Radio Shack* and other places, and get a poor man's version, which I have for my old Ford jalopy that plugs into your cigarette lighter...



I think there's a proposal to band using cell phones while driving. And I think there are a lot of reasons that that will be taken seriously, and unlikely to succeed, because so many businesses now depend on cell phones for business purposes. But certainly with the liability issues that businesses are going to face; I'm now talking to a number of major, major health insurance agencies, and life insurance agencies that are starting to see the statistics. And they are certainly for their employees we're working on advisories, because they face liability. If you are an employer and you have your employees use a cell phone, you have to provide them a way to use it safely, particularly when driving, but in general to use it safely. And so, driving is one of the worst exposures that you can get.

And you're correct about antennasearch.com, but it doesn't tell you about your neighbor and what they might have right next to you, especially if you live in an apartment or a very high-density area. And we really need a more national conversation about these issues, because - look - holding a phone next to your head is not going to kill most of you. There are a small segment of the population - and we don't know how large they are - who are very sensitive to this radiation, and they have serious problems. You know, if you take a flashlight, Carl, and you flash it in somebody's eyes, most people are perfectly fine, but a small number may have a reaction to it even going into a seizure. So, we know that, and it's just light. It's not / it has no real power. We know that there will be responses - neurological responses - that we don't fully understand. So, that's why it's better to be safe than sorry. And that's why we're working now; we have a whole campaign with the schools of Jackson Hole, Wyoming. We're working with the superintendent, the *Board of Health*. And right now we have a contest underway where the kids are making *YouTube* videos and posters to promote *Safe Phone*. And we have our motto: ***Practice Safe Phone***.

Dr. Linda Birnbaum: Well, Devra, I want to thank you very much for being here. She'll be here the rest of the day. I think she's got a number of meetings, but I'm sure if you have a question, you can come on up and she'll be happy to answer. But thank y'all for coming. [Applause]