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**RAJESH:** My name is Rajesh. I am one of the co-founders of ClimateX, which is some of the groups who are sponsoring this event. We are really, really happy to have a wonderful cast of speakers, who will be talking to us about how to turn some of the work that we have all done in the field into advocacy, especially three kinds of advocacy. One is a citizen advocacy, which Nathan and Audrey will be talking about. Then there is legal advocacy, which is Chris. And advocacy by creating market solutions, which will be Ory. So I'm going to get out-- to prove that I'm not Donald Trump, I'll stop talking now and give it over to Chris, who is going to talk a little bit about how he, as an MIT chemical engineer, became a lawyer and is now going after the bad guys.

**CHRIS NIDEL:** So as Rajesh said, my name is Chris. I'm an attorney in DC. I do mostly environmental work. I do some other pharmaceutical work, but my background's in chemical engineering. So I got a master's degree from MIT in chemical engineering, and I use that background to evaluate chemical exposures, to evaluate pharmaceutical exposures, to review-- and review of epidemiology, and toxicology, and related scientific subjects to the cases that I bring. And as part of that, I use the whole spectrum of scientific data.

Some of that is very high tech, lab-based, mathematical modeling, obviously, you know, EPA type sampling. But then I also use-- at sort of the other end of the spectrum is more citizen science type data. We'll start by talking about a few examples starting with photography, but people don't think of photography as being data. But the same standards apply in court, whether it's a sample taken by an expert with multiple degrees to a picture taken by someone on the street corner. And so, I think photography is a good starting point to talk about how to get things admitted into court, and how you can use these types of information, data, to advocate for your cause-- to prove a case whether it's to oppose a permit, or to oppose an expansion of a facility, or to generate some finding of liability on behalf of your client.

So we're going to see if I can do this with my phone, and it seems like it's working. The important thing, when you start talking about scientific evidence, I get all kinds of questions

where someone will say, you know, we're looking to fight this issue. We want to go to court, and we want our data to be good in court. So we want data that's the best. We want it to be good in court.

And the reality there's no golden rule for what's admissible in court. You can have-- I had a case in Massachusetts outside Boston, a PCB case where the EPA had done hundreds and thousands of sampling testing-- where they had sampled the ground for PCBs, and it was all EPA sampling. It was not part of litigation. It wasn't done by me or my experts, and despite the fact that it was EPA sampling done by EPA methods and protocols, the defendant still challenged the data. I mean, they say, well, it's not reliable because it was EPA. So there's no answer that says, well, if you do a, b, and c, and dot all the I's in there, that it will be admitted.

And I think, to the other point is, if you haven't done a, b, and c, you still may get your data in front of the jury or in front of the judge, depending on the assessment of essentially these factors, which the first thing is whether the data is reliable and repeatable. So for example, I had a case, that I'll give you a couple examples from, that involved sampling for bacteria. It was a chicken house that had discharges going to the waters of the US. It was a Clean Water Act case, and there was a question about whether there was bacteria as well as some nutrients in the water-- so phosphorous and nitrogen-- that were polluting the waterways.

And questions that become relevant are is a person wearing gloves, is there sterile procedures used, are the containers that they're going to take a sample of the water from-- are they sterile to begin with? Obviously, if there's any question about those things, it calls into question the reliability and repeatability of the data. So that's the first real prong.

The second prong, and this is pretty loaded, is whether it's fit for the intended purpose. So if you're trying to prove, for example, the presence of benzene in somebody's drinking water, and you have a certain test that detects benzene, and maybe it gives it a number. If the question for the jury is whether there was benzene in the water, there may be a different standard than if the question is was there enough benzene in the water for the last 15 years to give my client leukemia?

And so, there becomes this question about what is the purpose that you're offering the evidence for, which then relates this third point, which is given your purpose, is it going to assist the jury? So if that information, to whatever degree it falls in that scientific rigor spectrum, how is that going to help the jury understand? So maybe we have a test that shows

the presence of benzene, but we don't trust the number. But we have an expert that does groundwater modeling that can say, well, we have a number that shows the presence of benzene. On top of that, we have an expert that modeled out the groundwater for the last 15 years and can show the fluctuations in those concentrations over the last 15 years-- the combination of which gives you the juror or the judge confidence that there was, in fact, benzene in the water, and it was within a certain range that, I might argue, caused a person to get sick.

So with that being said, let's see. Oh, do I have-- is it going to be? Do I not know what I'm doing? OK.

So here's a simple example. So I represent-- there's a lot of people in DC. There's probably a lot of people in a lot of different cities. It's not glamorous by any stretch, but there are a lot of people that live in subsidized housing in this country that is sub, sub, sub standard. So there are people that, whether it's the state or its HUD, the federal government, are paying for them. In a city like DC, they're paying, you know, \$1,500 a month for a mother and her child to live in conditions that are unhealthy for both the mother and for the child, and that the government's paying the bill for, and somebody is profiting from at the expense of these people living in there and at the expense of the government.

And so, this is an easy example, where someone takes a picture. I picked a picture of this as, you know, water coming through the ceiling of this apartment where you have mold. We are currently-- I don't know why we're losing our picture. Oh, there we go. So we represent-- in some cases, we represent the government on what's called the whistle blower lawsuit, where we're representing the government against these landlords for collecting money from the government, representing that these are habitable healthy places that they're getting paid a significant amount of money for-- for people to come, and get sick, and end up at the emergency room with asthma attacks when they can't breathe anymore, because they've been living in these conditions.

I could have-- there was a horrible situation. And again, it's sort of a simplified approach to data, but in one of these apartments, you go in there, and there were so many bugs. I mean, you couldn't-- it was the craziest thing. But the picture is worth a thousand words, and there becomes a question, like there would be with any data, as to who took the picture? When was it? Can they certify that it was in the apartment?

That's at issue. And at the time-- and, you know, that they didn't-- it wasn't a bunch of plastic cockroaches that they put, but it was in fact a bunch of bugs crawling around. Oh, and this, the farmer trenched the ditch. So the purpose here would be to show visible evidence of mold as opposed to the farmer trenching the ditch, which we'll get to.

So you're going to have a witness that comes in and says, yeah, I took that picture. I took it three months ago. I remember because it was two weeks after the water was dripping from the ceiling, and here's the mold. Again, if we were trying to prove a housing code violation, the picture is probably sufficient. If we're trying to prove that somebody has asthma attack two weeks later was caused by this mold, that's where you get into some more sophisticated sampling and having an industrial hygienist come in and do some testing.

So this is another type of litigation that I've been involved in. For those people that aren't aware, a good bit of our sewage sludge, human waste, that we generate goes from the sewage treatment plants, gets collected as solids, and then gets sent to farms. In this case, it was a quote unquote, tree farm, but it's sent to farms that grow crops. And they put human waste on crops-- the argument being that it's treated. The treating is relatively minimal, and they essentially put lime in with the fecal material. And they then use it as fertilizer.

So as you can imagine it's full of pharmaceuticals-- it's full of industrial chemicals, because the local industries all contribute to the sewer system. There's hospital waste in there, so there is viruses, pathogens, all these things that you would expect in human feces-- exist in there. And in this case, this was a 1,300-acre forest that they spread this stuff in, and my client lived in the middle of the forest. She ended up with pulmonary fibrosis with her lungs that were getting scarred from repeated inflammation from breathing in these proteins and stuff. And so, this was one of her pictures of what was going on. Again, like, not what we necessarily think of with respect to data, but it creates a compelling picture, and you still have that same standard of getting it admitted for the court.

This is a picture from the case that I referenced a little bit ago. This is a poultry operation that we have there that we had access on public property. The water keeper, or the local river keeper, had access on public property to this drainage ditch, and this is where we get into sort of a combined use of different media or data. The water keeper is able to come to this ditch on public property and take water samples, which she did, I think, 12 or 14 times.

So she took water samples, which showed high levels of bacteria-- fecal coliform, and E. coli,

as well as high levels of nutrients going through the ditch, across the highway, and then eventually out into the waters of the US. And what this photo actually is is this is a photo from Google Earth. It's just a Google Earth satellite photo.

Another point of issue was, at the top corner there, there was a pile of some unknown material. And we'll see a close up in a later picture that sort of shows some of what was going on on the farm. And then you have the pictures of the chicken houses. And then you have what's also a cattle operation in the bottom right there that I'm going to show you another picture of it.

So again, this is Google Earth. We went to trial in this case. We got these pictures admitted from Google Earth. And one of the things that we saw-- and I was deposing the defendants-- is that the property had poultry operation that was run by-- well, that was owned by Purdue-- run by their quote, unquote, family farmer. And we believe that that was discharging into that drainage ditch and out to where we sampled. There was also the cattle operation, which had probably some impact on the water.

But what was interesting was-- as part of the Clean Water Act lawsuit, we had to notify them that we were planning to sue them. And at some point, what you see on the aerial photo-- as you can see, you know, tiny there, but basically the cattle were then moved from the cattle grazing area down in the far right-- if we the looked on the previous photo, where you see all the cattle markings from them in the two lower right fields-- to a feeder that's up in the top there. So you can see the cows parked around some hay bales or a feeder with a bunch of hay on there to create the impression that the cows weren't just over to the far right. They were more by this ditch even though-- and that's just something we randomly picked up on Google Earth.

So when I'm in deposition with them, and I ask them, well, where do the cows hang out-- and they tell me, oh, they hang out all over the place. And you can see, and there was a whole series of photos, as you can imagine, from Google Earth that show that, consistent with the markings in these areas, that the cows and their feeders mostly are in here, some in here, and pretty rarely up in there. And so, this is the aerial photograph. So this is the pile that was at the top of that drainage ditch. This is the ditch that was in question.

And so, we had the Google Earth photos, and then we also had aerial photos that the water keeper was able to get a flight and take some of their own photos. And here you had a pile

which was sort of unknown, what it was, but it was pretty clear from these photos that the farmer had dug trenches to drain what was in those piles-- the runoff, the water that was accumulating there, into the farm runoff-- into the ditches that then, ultimately, went out to where we sampled. Then it ultimately went out to the waters of the US.

So again, what's the purpose of this photo? What's the purpose of the previous photo? If the purpose is to show where the cows are, if the purpose is to show where they are in a given date given the image date from Google Earth, if the purpose here is to show that the farmer had indeed-- that there was drainage coming from this pile, which turned out to be-- it was actually sewage sludge. Unrelated case, but the farmer was also stockpiling sewage sludge. So it's material that's rich in nutrients as well as probably bacteria and pathogens.

And he had trenched this, so is their drainage? What's the material? Did he intend to drain this material into the ditch? Those questions, I think, it's certainly is relevant, and fit for that purpose, and would be helpful to the jury.

So this is the sampling point, and this became an issue for a couple of reasons. One is whether she was trespassing. Two is how she took the samples, as far as her sterile technique. Getting to the lab data that we use, we had, I think, it was 14 or 12 samples. And she went through, she wore gloves, she used sealed containers from the lab. She kept them cold. She had a chain of custody from the sampling point to the lab.

And so, all of the questions where you say, well, do we need to hire a consultant? Do we need to pay somebody a lot of money to come in from another state and take a sample, or is it sufficient to have somebody that's got sort of the requisite training that would otherwise disqualify the sample? So if she didn't know about sterile technique, or if she hadn't worn sterile gloves, or protected the integrity of the sampling containers, those would be things that would call into question the reliability of the results. But the court ended up admitting the sample results-- didn't question the results-- because she was able to answer questions on her cross-exam that she had done all of the things that would otherwise disqualify those results.

And so, there was some question about whether there was flow that the defendant said that there wasn't ever flow-- that there was barely ever water here. And so, these pictures, obviously came into play for that. This is at that public access point, and obviously that was helpful for that purpose. I just put this picture in here. I think Nathan-- I don't know if Nathan

has an interest.

Some of the work that I do on fracking-- and I do a lot of work with the folks down in Texas and the people in Pennsylvania. And so, it's difficult to see in this example. I just quickly pulled it off YouTube, but with FLIR camera, it's not unlike, in some sense, a standard photograph, which we've seen some examples of, but it's an \$80,000 piece of equipment. But with such a camera, you can see emissions from this equipment that you can't see with the naked eye. And so, there's a piece of equipment here, and you can see all this billowing out of there, which is primarily volatile organic chemicals-- things like benzene, and toluene, and you name it from these storage tanks.

And so, when you look at-- whether you're looking at climate change impacts, or whether you're looking at health and environmental impacts, or all of the above, you know, you have these tanks. You walk up close to them. You can smell them. But they are vented to the atmosphere. They're not being regulated. And you have people-- typically with respect to fracking, you have people that are living in conjunction with them in close proximity.

You might have a swimming pool or a playground in somebody's side yard that's within a few hundred feet of some of these tanks. And so, again, what's the purpose? Is the purpose to show that, in fact, there are emissions? Is the purpose to show that the four-year-old is having breathing problems as a result of these emissions? From my perspective, if the purpose is to show emissions, you have someone testify.

Five minutes? That's perfect-- you know, what the FLIR camera does, how it does it, and what it shows-- which I think would validate that there are admissions. If the purpose was to show that somebody was having breathing problems or was getting cancer from that, you would probably also have, for example, some other grab samples, some air testing, that actually qualified or quantified the amounts of benzene, and toluene, and other things that are in the air that would then be corroborated with this visual evidence that says, in fact, there is something coming from the tank. And we're picking it up in the front yard of my client or the person that's complaining. So I think that this is an example. Unfortunately, it's out of the hands-- financially out of the hands of most people at this point, but it's a really powerful tool with respect to not just health but also climate change issues with methane leaks and other things.

This is an example outside Pittsburgh that I'm looking at right now. This is from modeling that

was done-- and this is cancer risk based on Coke emissions. And so, I'm looking at a case around a Coke plant outside Pittsburgh, where you have people that are living in the shadows of this huge Coke plant, one of the few remaining in Pittsburgh. And this is sort of the rigorous data that's looked at based on air emission data and modeling of those emissions, where you can see these huge cancer risks as a result of the emissions.

This is another thing that's going on in that same community, which is this is-- I think this is called-- I forget the name of this device, but it's one of these internet of things connected devices that looks at air quality. So is it is it lab-certified data? I mean, this example it said 200 high. The air quality is bad. Again, am I trying to show that half the neighborhood has asthma because of this, or am I trying to show that they have decreased the property values because their air quality is bad, or am I just trying to show that the Coke ovens are impacting the air quality locally? And then I have the other data, the previous data, where I have modeling to show the real nature and extent of risk and injury.

This is another similar device. These are guys that I've talked to about trying to use in some of my cases, where you could take for a couple hundred, \$200 or \$300. This one's called a uHoo, and you could distribute these throughout a neighborhood and show that, for example, the pattern of emissions. You could show that the emissions, or the air pollutants, are at the highest level near the facility and decay as you get farther out from the facility. What you might also try to show are things like the pattern of emissions.

So a lot of times, industries will-- you know, smart on their part-- will wait until between 2:00 and 5:00 in the morning to let things fly. And so, I have a case in Michigan where the refinery there is alleged, by the people living near it-- between 2:00 and 5:00 in the morning, they smell the rotten eggs. They smell the chemicals, and they wake up with difficulty breathing. And so, again, you put something like this inside your house or just outside your house. It's capturing data. And is the data being used to prove that you got lymphoma or leukemia from that, or is it being used to show that every night, at between 2:00 and 4:00, you get a spike? Whatever that number is, it may not be scientifically credible to the 0.00, but does it show that there is some pattern that-- or when the weather changes, that you get a shift, and that weather is consistent with winds blowing from the facility to your point of testing. So again, it really gets back to this question about what is it that you're intending to use the data for?

This is-- what do I have, like, two minutes? This is another example, when I gave a talk with Public Lab, that someone was doing in New York City, which I thought was really great-- was



that they were using-- they were giving low-income people that were in subsidized housing these connected thermometers. And they were collecting data from their homes, so that in the winter they could see where people were living in sub-- you know, in freezing-- or maybe not freezing but uninhabitable conditions in their homes that were not being properly-- so they're living in public housing or subsidized housing, and they're not being treated properly.

And so, it's really a simple-- you know, it's just a temperature test with a GPS tag that could show these homes-- and I guess a time tag as well, so time and temperature are essentially that we could do, for the most part, with our smartphones these days-- that set up legal arguments for these people to say that they're not being treated properly and that they need adequate housing. So to sort of bring this a little bit to a head, better doesn't always mean more, and sometimes more data, even if it's qualitative data, can be better to prove a certain point, depending on what that point is. And so, there's this balance, or tension, between quality and quantity of data that largely relates back to money.

So sort of to give you an example, this is that Coke facility in the top right. You can see part of it. And if we were to go and take samples throughout the neighborhood, they all cost money. If we were to take them with a PhD from the University of Pittsburgh, it would cost even more money. And so, the question becomes what is it that we are trying to prove? And if we're trying to prove that the levels of air pollutants are highest near the facility, and they decay as you get farther away, and that they spike at night, that that may be-- a certain level of data quality might be suitable for that versus trying to prove that someone's lung cancer or some other health issues were a result of that exposure.

And I guess the converse is it may, in times-- and I think this is a good example-- be better to have more data of an arguable lesser quality than to have rigorous sampling done on three houses but not to have that full spectrum that shows what's happening as you get farther and farther away, because you focused your time, effort, and ultimately your money on sampling those things that were located where you had one sick person and that's it. Then you get into a question-- OK, I've got a great number outside this person's house, but I'm not sure how it relates back to the facility, and I'm not sure how the facility is impacting everybody else in the neighborhood. And I think that is-- so I think this is my last slide.

Obviously, more money you pay for people with degrees, and consultants, and for lab testing-- you can save money with some of these techniques, citizen science, some of these taking your own samples with the appropriate training and technique-- using some of these

connected devices, using some photography and FLIR cameras. More money doesn't always mean better, but it tends to mean that you've got better numbers, more precise numbers, that are more reliable. But again, the question is what is your purpose?

If your purpose is to show you know that the source of the pollution is impacting the neighborhood in a broad sense, you can probably get by with some data of lesser rigor and that's lesser expense. If you're trying to prove someone's been exposed for how long at what level precisely to show that they got sick, obviously the standards are increased, and the level of scientific rigor is heightened as well. So I think that's it for me, and I'll pass-- I'll answer any questions. I'll receive applause.

The question was to what extent trespassing on people's land and drones-- it's a good question. Drones are, you know, for some people, maybe not so new, but as far as people like me, a newer thing. But, I mean, drones are a great-- I mean, huge. Like, the aerial photos that were taken with a full flight-- like, having to rent a plane and all that stuff, it could be done with drones very easily-- get even better quality pictures. Drones are a huge, huge benefit to the citizen science operation. I mean, they have drones that can also take air samples and things like that, so the ability to get data cheaply, and efficiently, and effectively is a big thing.

As far as trespassing goes, in my opinion, you never want to trespass. You never want to represent someone who's going to have somebody else saying, well, you trespassed. By the same token, I have had cases where people trespass on the land, and took a sample, and went home. And as a lawyer, I have an obligation to disclose the fact that they took a sample-- the result of that sampling. And aside from any allegations or claims of criminal trespass, if the data is reliable-- if they can't impugn what the person did-- that they somehow adulterated the sample, then the sample should be admissible for the purpose of showing what the sample shows, right? So there could be a dispute about whether there's some criminal trespass, which I think largely there's no impact from, but in general, the answer is if you can do it with a drone, and you can take pictures, if you can get a court order to get a sample on the property, that's a much better way to do it than trespassing.

A lot of people don't understand the first thing you have to do is make a good case to the judge. So judges stand between you and the jury as far as scientific evidence-- as far as any evidence, right. And so, you first have to make a good argument to the judge that the data is reliable, fit for its intended purpose, and that it will assist the jury. What a jury will believe is oftentimes different than what a judge will believe, so something like a FLIR camera that

shows visually the stream of pollution coming off may be very compelling to a jury even if I'm talking about leukemia.

It may not be very compelling to a judge if I'm talking about leukemia, because it doesn't give you a number. It just tells you that there's stuff coming off, and I have an expert that says that stuff is this stuff that may cause leukemia. But it's still not 20 parts per billion of benzene, and that's ultimately what I need to show according to most judges, right. So I think, again, it's a very wide spectrum. It would vary hugely from judge to judge, and there's not any one answer.

I can tell you, that as far as epidemiology goes, generally, what courts require-- if I want to show that an exposure caused my client's leukemia, for example, I would need to have a study that showed a greater than two-fold increased risk. So I have more than a doubling of the risk to a 95% confidence interval. So to eliminate the no risk and to be at least a doubling at that confidence interval, and that essentially goes to this argument that it's more probably than not caused by the exposure. Does that makes sense? OK.