

## PEDIAPOD DECEMBER 2023 TRANSCRIPT

### **Kari Nadeau**

My name is Dr. Kari Nadeau. I'm at the Harvard School of Public Health as the Chair of Environmental Health. I also run the climate change and global environment center, called Sea Change. And then finally I'm the John Rock Professor of Climate and Population Studies at Harvard. So I'm really excited about being here today with you.

### **Geoff Marsh**

You sound like a good choice to have guest edited this series on global climate change. Could you give us a sense of why you think now is the right time for Pediatric Research to have a collection on climate change?

### **Kari Nadeau**

I think now is a critical time. Children for the most part don't have a voice. UNICEF reported that a child born today will suffer from at least one climate change event in their lifetime. Not only that, children that are born in inequitably exposed communities have been exposed to the environment more than anyone and unfortunately that will compound itself over a child's lifetime. We need to make sure at this juncture, knowing that the climate literally is on fire and that it's our time as adults to act now, that as pediatricians, as healthcare providers, as parents, as guardians, as people that care about the future, we want to make sure that we can focus on children.

### **Geoff Marsh**

At first glance, you might think that climate change and pediatrics are quite disparate fields of science. Can you give us a sense of how exactly they're linked?

### **Kari Nadeau**

When we think about climate change, we have the opportunity to give anticipatory guidance. We have the opportunity to prevent worsening events, not only because we can reduce greenhouse gases and we can help reduce climate change as individuals and us as governments, as pediatricians, as healthcare providers. This is how we think- Pediatricians have anticipatory guidance for trauma, we have anticipatory guidance for vaccines, we have anticipatory guidance for what to expect when you're an adolescent. So that's just part of who we are and when you think about climate change, we have the opportunity to not only educate about climate change and things like heat stress and how that might affect the body of your baby or toddler or five year old, but we have the opportunity to educate about how bad heat stress is, let's say for children, which is associated with climate change, but we also can give handouts to say here's what you want to do if your baby is in a hot environment, here's what to do. There's all sorts of guidance that as pediatricians we can provide for flooding, for wildfires, for heat stress. So all of these things are really important and it's embedded in who we are as pediatricians.

**Geoff Marsh**

Would you say that climate change is particularly relevant within your area of expertise- allergies, asthma and immunology?

**Kari Nadeau**

Absolutely. I also practice, both in adults and in children. I see a lot of families with these issues. I do also see patients with autoimmune disease and cancer. So unfortunately wildfire smoke and air pollution don't really see any boundaries in terms of the globe or age but children are at a high chance of having diseases because of this. And we know from COVID that the immune system is such a critical nexus point by which we can understand biology, understand how we respond as the host to outside influences. That includes allergens, so when we get exposed to air pollution or wildfire smoke that lands on our skin, unfortunately there's already data showing that that activation disrupts the skin barrier and activates the allergic pathway and activates autoimmune disease. So there are now studies to show that if this happens, this is a response of our body to it. There's also other data to show that if you have a lot of air pollution in your lungs and that affects your blood and your immune system, you're not going to be able to fight viruses very well. So for children, when they get exposed to air pollution, get exposed to heat stress, get exposed to extreme cold that worsens their asthma, it dysregulates their immune system. And allergies affect at least 40% of the globe. In some regions of the world, sometimes 50% of the children have asthma.

**Geoff Marsh**

There is geographical variation in the effects of climate change. There has been this notion in the past that climate change is something that affects the developing world, the much hotter parts of the planet. Would you counter that and say that it's a global problem?

**Kari Nadeau**

Yes, it's a global problem. It's relevant to everyone and especially it's relevant to the younger age groups. But unfortunately those people that are under-resourced are more affected by it. They're at higher risk of having long term consequences. If you live in a place where drought is going to affect your crops and you're not going to be able to eat season to season, like in places in Sub-Saharan Africa, that's going to affect your family and your children. It's going to affect pregnant women and their nutrition. But everyone on the planet has been affected by climate change, whether it's directly or indirectly. Whether or not you were waiting on an IV bag in a hospital in Texas because the IV bag was coming from Puerto Rico where a hurricane hit, or you're directly affected by climate change because you have had a wildfire next door to your home in San Francisco. So there are really no boundaries. Dust storms in the Middle East for example circumnavigate the globe within three days. There are ways to go online and look at monitoring so that you are aware of what's happening in your environment but no one is immune.

**Geoff Marsh**

And as we've alluded to this area of research, this crossover between climate change and

pediatrics is quite new. What *do* we know? Are there any parts of this that are quite well established?

**Kari Nadeau**

I think the major questions that have been answered are, for example, that each degree that increases either in centigrade or Fahrenheit, we know how much that's going to worsen your asthma, or how much it's going to worsen your likelihood of having heat stroke, for babies especially. Now, we need to understand that more but we know that heat stress is bad, that it induces inflammation, that it induces asthma, that it induces other diseases too and that you can die from heat stress. We know flooding is bad, we know it carries diseases, it carries bacteria and children especially can be more sensitive to those fungi and bacteria than adults. We know climate change is associated with vector-borne diseases. We know malaria is on the rise, we know Dengue is on the rise and that those affect children. Tick-borne diseases are on the rise too and that's really unfortunate. And again, this is really due to global warming and the changes in our environment. We know that because of the increase in global warming, there's more pollen and that's dangerous because that increases allergies and asthma. So these are the things we really know for children are not good. We also know pollution is very bad for children, wildfire smoke is very bad for their lungs, for their immune system, for their developing heart, they get increases in blood pressure. A lot of people have studied this so we know a lot about the bad things that happen. We need to focus on solutions now and see to what extent solutions can help.

**Geoff Marsh**

Let's discuss that. Where do you think the major gaps in our knowledge of those solutions are?

**Kari Nadeau**

I think the gap is in making sure that we understand what solutions are being implemented. When a bus goes from a diesel bus to an electric bus in the schoolyard, to what extent before and after does that help someone's asthma? So those are the types of solutions that are being implemented now that we could just test. There's also now conversions of wood stoves or gas stoves to electric stoves. Indoor air pollution is very dangerous. We spend 90% of our lives indoors, especially children in schools, and they're spending a lot of time in places where they could be exposed to gas stoves and we need to know what happens when electric stoves are put in and to what extent their health gets better. So these are the types of things that need to be studied because solutions are being implemented now. We also want to make sure that there's no unintended consequences of these solutions. If you're going to be putting in an air filter into a school, make sure that it works, right? And then by measuring the health outcome and seeing whether or not children are improving in their breathing, which is very easily monitored, you could say, in this age group it didn't work as well as this age group, or in this school it didn't work as well as in that school because they had a different geography. The other thing that's a big gap is the compounding effects over someone's lifetime. We need to have more studies where we're following children over their lifetime to see to what extent the solutions work well, or not.

**Geoff Marsh**

And are we, in your opinion, fully equipped to answer these questions and fill in these gaps? And if not, is it new methodologies we need or is it new technologies? If you had a magic wand to speed up the advance of climate change and pediatric research, how would you do it? What do we need?

**Kari Nadeau**

Great question. In a way we need to broadly educate more people as to what the tools are and how accessible they are. So in general in the climate change mantra as well as discussions globally in policy and governance, we have all the technologies, we have the money, actually, to be able to reduce climate change and global warming. We need to have the political willpower, and to be able to create that political will and that good citizenship, we as pediatricians and as researchers can try to provide the science towards helping policymakers know that their decisions are good or bad. And to me, we use children as the measurement tool because children are our future. So I think yes, the tools are there and we have the technology. I would say that people should get very knowledgeable about artificial intelligence, about machine learning, about satellite communications, about making sure that they understand that if their research is going to focus on a solution, have it be community based, community driven. The solutions have to be hyperlocal, and to me, the solutions need to always be studying how they're affecting children as well as other vulnerable populations because if we didn't help those populations, then our solutions really didn't work.

**Geoff Marsh**

And presumably understanding climate change's impacts on children and infants and tackling those problems is going to necessarily be a multidisciplinary struggle. So who do you think pediatric researchers should be aiming to team up with?

**Kari Nadeau**

I think there's a lot of wonderful researchers that want to team up with pediatricians. I know in my own experience it's been very welcoming. From epidemiologists, to data scientists, to business people and economists who are able to understand the benefit-to-cost ratios. For every dollar that we put into renewable energy, for example, we get at least \$6 out in terms of improving health for children. That's a business directive and a good deal that we should all know about. We also work with government and policymakers. We need to make sure that we work with our senators and representatives more. So to me, it's a multidisciplinary team from A to Z. You get your researchers together from different aspects, we need that. We also need ecologists and biologists- people that understand the planet because biodiversity is important here, too. We know a lot about how biodiversity is important for our general health and especially for children. Mental health and climate change issues is a big topic and I want to make sure we emphasize that today so that's a big gap of research that I hope people can work on. I think that overall there's a lot of hope and promise and we need to deliver on it. We do have the tools and the technology and different disciplines need to work together. We can no

longer be in our towers or our fishbowls anymore. We need to work across disciplines and that will best frame our questions and our solutions.