Dr. Ellen Mallory:

We are very concerned about the health risks for farmers and for farm workers, because of where they work and where they live, they're exposed to more PFAS. If they're on a contaminated farm, then your general population.

Announcer:

In this episode of Sustainable Healthcare, we dig into a timely issue facing farmers, families, and food systems across Maine and beyond.

Tim Doak:

Welcome to Sustainable Healthcare. I'm your host, Tim Doak. Today we're talking about something that's been showing up in our soil, our water, and yes, even our food. Per- and polyfluoroalkyl substances are what most of us know as PFAS. Known as forever chemicals, PFAS are synthetic substances used in everything from nonstick pans to waterproof clothing to firefighting foam. They don't break down in nature and increasingly they're being found in places we never expected, including farmland.

Joining me today is Dr. Ellen Mallory, a researcher at the University of Maine, who is part of the university's PFAS Research Initiative. She studies how these chemicals move through soil, crops and livestock and what it means for our farming communities. Ellen, welcome to Sustainable Healthcare.

Dr. Ellen Mallory:

Thanks, Tim. Thanks for the opportunity to be here.

Tim Doak:

Well, it's great to have you. So let's jump right in and start with the basics. PFAS, it's a term we're hearing certainly a lot more of lately. Exactly what is it and how on earth does it end up in our food?

Dr. Ellen Mallory:

Yeah, right, good question. Well, you gave a bit of an introduction to what PFAS are. There are a group of chemicals, thousands and thousands. Depending on what definition you use, it can be from 7,000 to forty-some thousand, but they all have in common a carbon-fluorine bond, at least one, or by some definitions it has to have two. But that bond is really unique in that it's probably one of the strongest chemical bonds that exists, and it's what gives those chemicals their unique properties in terms of repelling oil, and grease, and water, and resisting heat. And that's why they've been used since the forties and a whole bunch of different products like you mentioned.

But the problem is that strong bond that gives them those unique properties is also what makes them a bit of a problem, because they're virtually indestructible, and because they don't break down, then they accumulate and persist in people and animals and in the environment, and that's why they're termed forever chemicals. We'll talk probably about how they're not always forever, but once they're in the environment, they travel mostly through water, but they can also travel through air, they've been measured in precipitation. And so what that means is that they've moved around the globe, so even though they're synthetic, purely human-made substances, they have been found in areas everywhere around the globe, even where humans don't even exist. So think Arctic or something like that.

Tim Doak:

Sure. So completely manmade. This is something not found at all in nature?

Dr. Ellen Mallory:

No.

Tim Doak:

That's interesting. So once it's in the system, it just stays? Or does it dissipate in some way over time?

Dr. Ellen Mallory:

Okay. Yeah, so because they don't break down, unless we humans intentionally destroy them. And you can do that, there are different technologies. I'm not really equipped to talk about them because some of them are complicated, but most of them involve high heat or high pressure, or something that is expensive at this point to do. And so there are a lot of promising technologies, but right now they're not really economically feasible. And your first question, I forgot to talk about how they get on farms, but I'll just say that one of the things that's unique about when they are on farms and they get there through again, air, water, application of soil amendments like composts and biosolids, once they're there, they're spread out over a really large area. And so while a technology that might work for water, let's say, where you can filter and then actually isolate the chemicals, and then you have them pretty concentrated and maybe you can destroy them, it's really hard to think about how you would do that at a farm scale. How do you get them out of soil? How do you get them out of that extensive of an area?

And so yeah, I'd say once they're created, they are there. I will say though, it is important to understand at the individual level, PFAS aren't necessarily forever, in the sense that we, humans and animals excrete PFAS through urine and milk. And so if we stop consuming or being exposed to PFAS, then the levels of PFAS in our body will go down. Same with animals, and that's actually a strategy of how to address PFAS contamination on a livestock farm.

Tim Doak:

So if we think specifically about food, what is the process or mechanism by which PFAS actually gets into the food product itself?

Dr. Ellen Mallory:

Yeah, that is a good question. Well, PFAS can enter onto a farm through a variety of means, groundwater, air, soil amendments. In Maine in particular, our issue has been the historical application of contaminated biosolids, and that would be wastewater, sludge and septage. So once it's on the farm in soil or water, plants will take it up through their roots, and then it makes its way into the part of the plant that is harvested. So let's say it's a tomato or green bean, or even wheat, but they also feed those plants to animals, and so animals can become contaminated and then PFAS can enter their milk or their meat, and then humans consume it from there.

Tim Doak:

And so how many crop cycles does it take, or do we even know yet, to deplete the PFAS from the soil?

Dr. Ellen Mallory:

That is a really good question because all the time we get people asking, "Well, why can't we just grow something to pull it out of the soil?" And I guess, one, we know that that isn't so effective because these fields that have been contaminated since the late eighties, early nineties, let's say a hay field where people are taking plants off every year, two or three times a year, we still have levels that are high enough to be an issue. Also, some of the studies that people have done on plan uptake in let's say, there was actually a really great study done in Northern Maine using hemp, and they found that for some PFAS, the shorter chains, smaller molecules, they do get a significant amount of uptake, and maybe in decades you could

deplete the PFAS. But for the longer chain, like the one that I've been mentioning, PFAS, bigger molecules, the rate of uptake is just not significant enough to deplete. So it would take centuries to actually deplete.

Tim Doak:

Oh, wow. So we've talked a little bit about farming, and I do want to touch on that a little more, but first I want to talk a little bit about healthcare. You and I had an earlier conversation about how PFAS shows up, not just in farming, but in many of the things that we use here in healthcare. The tools and supplies we use, I think a good example would be a heart catheter, typically contains PFAS. And healthcare like other industries really is working to tackle how our waste stream contributes to environmental problems. How do we even begin to address that?

Dr. Ellen Mallory:

Yeah, that's a tough one. I think as a society, the ultimate goal would be to turn off the tap. If we're dealing with a contaminant, let's stop producing it. Let's stop getting it out into the environment. But we also as a society have to have some discussions about value of these chemicals. And in certain uses, a human life is worth a lot. So I think the ultimate goal in, again, I'm an agronomist, not a medical practitioner, but the ultimate goal in medicine is to find sustainable alternatives where that's possible without risking lives, I guess. So there's definitely a systematic approach to trying to find sustainable alternatives, assessing the risk of whatever it is. How persistent is it? Does it bioaccumulate? How toxic is it? And then identifying where that chemical is being used.

I think right now, we really, like I said, there's so many thousands of them, we don't have a really good handle on where they are, where they're being used, things that you wouldn't even think about. Dental floss, for instance. It's like there they are. So getting a good documentation of where they're being used and what functions they're playing, and then identifying alternatives that could play similar functions and assessing the performance and hazards and economics of using those alternatives. We've done that for Mercury, for instance. And there are organizations like the Lowell Center for Sustainable Production that are looking specifically at, well, they have a publication on Mercury, and I think they're shifting to look at PFAS as well.

Tim Doak:

Okay. You do bring up a good point. We don't really even have a comprehensive inventory of where this is occurring within our supply chain today. And that presents a tremendous challenge as we think about how on earth are we even going to begin to quantify this and address it.

Dr. Ellen Mallory:

Yep.

Tim Doak:

Yeah, for sure. So you touched on health, and I really think that's a big one here. I know as a researcher focused on agronomy, you really are wanting to stay in your lane here, so I'm just going to point our listeners to the EPA's PFAS website for more information and specifics on human health effects. But if you do look at that info, you will see that it touches on things like reproductive health, developmental health, as well as various forms of cancer. So it's certainly very much a concern.

What concerns do your team tackle to respond to the threat of PFAS?

Dr. Ellen Mallory:

Sure. Thanks for that question. So, first I do have to say while it's outside our lane, we are very concerned about the health risks for farmers and for farm workers. And because this is a podcast for medical practitioners, it's worth talking about those unique risks that those people have because of where they work and where they live, they're exposed to more PFAS. If they're on a contaminated farm, then your general population. And so there are some guidances for medical providers from the National Academies of Sciences on how to work with patients who have had high exposure rates in Maine. I just want to give a shout out to Dr. Rachel Criswell, who's at the Reddington-Fairview General Hospital in Skowhegan, who's done a lot of work in this area and has found that people who are farming can have levels of PFAS contamination in their blood that are equivalent to people who work in factories where they are producing PFAS, and so at the high range of our exposure levels, so it's a huge concern.

And actually in Maine, a farming couple decided to leave their farm just because of the exposure risk. So it's huge, and there are some promising things. They're looking at a cholesterol drug, colorestermine, to remove PFAS from the blood, and there are other people working on looking at dust exposure and all of that on a farm. But for most of our work, what we're really focusing on is helping farmers understand and respond to contamination on their farms in terms of producing food. And so at the University of Maine Cooperative Extension, for instance, we are producing educational resources for farmers and for gardeners. We have fact sheets, and we have an email address that people can email us with their PFAS questions. We're also coordinating a network of, we call them agricultural service providers, so people who work directly with farmers on anything dealing with PFAS.

We have this network across the state that we meet monthly to make sure we're communicating with each other, coordinating our information, keeping up to date so that we're giving consistent information and guidance to people. And we also do some outreach events to raise awareness and give people the opportunity to ask questions. And then there's this whole area of research that's been prompted by the crisis in Maine, everything from crop uptake studies to animal depuration, that's where you excrete PFAS out of your system, to using biochar, and feed binders, and wild crafted foods like fiddleheads, or game and fish, testing technology, consumer response. There's a huge research response going on in the state that's pretty exciting.

Tim Doak:

So I'm interested in your research a little bit. Maine certainly is, it's a rural state, it's a state that depends on farming. And although we've seen a consolidation of things like potato farms in the northern part of the state where I'm from, we've actually seen overall a growth in the number of farms across the state. And I think most people would be surprised to know there's what, more than 7,000 farms now in the state of Maine?

Dr. Ellen Mallory:

Yeah.

Tim Doak:

It's a pretty impressive number. So your research is really helping folks that are engaged in farming activities. I'd like to know a little bit more about the research work that you're doing.

Dr. Ellen Mallory:

Sure, sure. Yeah, so the research that I'm working on specifically really focuses on forage crops or plants that are fed to dairy and other livestock animals. And part of the reason for that is that we've found that we, and when I say we, I'm talking about a huge network of people in the state doing all sorts of activities from the state CDC and Department of Ag. And anyway, but overall, we have found in the state that a particular PFAS called PFOS tends to be most prevalent across the farms that are contaminated, and that

works its way from the soil to plants and then plants into the animals, and it accumulates in the dairy animals and appears in the highest quantity of any of the PFAS in the milk. And we know that milk is really important, especially for children, so it's high exposure levels.

So that's our focus, really is on PFAS movement, and because I'm an agronomist, I'm talking about from soil to plants. And so we're looking at how different species of forage crops and different soil and plant factors might affect that uptake. How could we manage those forage crops in different ways that might minimize that uptake, that the amount that ends up in the plant? Can we apply biochar, for instance, to try to lock it up in the soil and not let the plant get at it? And so, yeah, then those questions, we are working in a team that then we have an animal scientist looking at ways to manage PFAS in the animal system. And we're also working with an environmental engineer who is looking at the manure side, actually, like how can you break this cycle? Let's not put it back out on the fields. And are there ways to isolate the PFAS out of the manure itself?

Tim Doak:

Wow, that's huge. So what's the situation right now for farmers here in Maine?

Dr. Ellen Mallory:

Yeah. Well, so I think that it sounds so dire, right? And there's been a lot of news about PFAS in Maine, and so that can give the impression that Maine, PFAS are everywhere on farms, and we're in big trouble. So the Department of Environmental Protection and Department of Ag Conservation and Forestry since 2022, 2023, started systematically testing sites where there have been licenses for sludge and septage so that they can find the areas that are of concern, where their levels are high. And so as of this spring, there were 90 farms that were identified. And that's 90 out of that 7,000, over 7,000 that you mentioned. Those 90 farms that have a soil test that is above the screening level that they've set for PFAS or a water test that's above Maine's interim drinking water standard, or both.

And so that's 90 farms, but I will say that only a handful of those have had to cease operation because of contamination. So there's a lot of ways of managing PFAS on a farm. Maybe just as simple as not using the fields that are most highly contaminated, or installing a water filter if you've got a groundwater contamination problem. But then we can also do things like altering what crops are grown because PFOS in particular tend to accumulate in the leafy portion of a plant and not in the fruit or grain. So grow tomatoes instead of lettuce, or harvest corn for grain, or snaplage, which is just the cob and grain and husk instead of the whole plant for silage and feed that.

So those are some of the ways to manage. And then there's a whole answer on all the assistance that's available for farmers in the state, from financial assistance to technical assistance. There's even land buyback program. So the state has a huge response program, and then also a couple of nonprofits have been trying to help fill gaps while they can, in terms of that kind of testing, and farmer wellness programs. And of course, I would be remiss if I didn't mention that there's also crisis support that farmers can tap into if stress levels are getting really high. And that those resources are available on extension publications and websites if that's needed.

Tim Doak:

So what can individual farmers, or maybe even home gardeners, do if they're concerned not just for the product that they're growing or tending, but also their own exposure to PFAS?

Dr. Ellen Mallory:

Well, I think this area causes a lot of worry, a lot of stress. So taking a very systematic approach, thinking through why do you think there might be a reason for concern? Is there? So some ways to look at that then are, well, has there been contamination identified in your area in the water source near you? And we

have a whole guide on how to investigate risk on farms. Extension does, there's a publication that people could look at, but we also have a publication and extension on understanding PFAS and your home garden that walks through these steps as well.

So if you feel like you have reasonable reasons to be concerned, then testing is the next step. And testing is expensive, and for soil, can be complicated, and interpreting the test results can be a little daunting, I'd say. The first time I saw a test result, I was like, "What is this?" So for most people, it probably makes sense to hire somebody to help them with that testing piece of it. And then if you do find that you have an issue, then reaching out to extension or to state agencies is pretty much the next step. And in some cases, there is assistance that's available. And I'll just say the CDC has been really great in terms of these kind of health questions. If you have a concern about can I eat such and such out of my garden, or my chickens eggs, or whatever, they field those questions and are really helpful.

Tim Doak:

So lots of resources, but clearly the extension is an important conduit for that information.

Dr. Ellen Mallory:

Yeah. If we can't get you the answer, we can get you to the people who you need to talk to.

Tim Doak:

Sure. So Maine, I think, is regarded pretty widely as a leader in PFAS tracking. Do you agree with that? And although we may not have all the answers, should we be concerned or encouraged by the progress we've made to date?

Dr. Ellen Mallory:

Yeah. Well, I would say encouraged, of course.

Tim Doak:

Right.

Dr. Ellen Mallory:

And yes, I do think that we are seen as a leader. I'm on a couple national groups, and people often say, "Wow, what you guys are doing in Maine is so far ahead." There's some circumstances that led to that that are somewhat unique, I guess. But for instance, we have the only action level to guide whether milk and meat are safer consumption from relative to PFAS, again, that one chemical. No other state has that. So this question of how much is too much? A lot of people are just kind of stymied because, well, we could test, but then we get the results back, and I mean ...

Tim Doak:

How do you interpret that?

Dr. Ellen Mallory:

How do you interpret it, right? So the CDC established those guidelines, again, for milk and meat. And that has really helped the efforts in Maine to identify sites that are of concern. And so I guess I say we should be encouraged by Maine's actions, because I think on the one hand, we could say Maine has this problem, we're associated with this problem. But on the other hand, we can say we've gone further than any other state in actually identifying areas that are unsafe, but the vast majority of farms and sites are safe. So I think that's a really important message to put out there.

Tim Doak:

Sure. Ellen, this has really been a meaningful conversation, but before we wrap, any final thoughts?

Dr. Ellen Mallory:

I think, just along that line, I think we in Maine, should feel really proud of the work we've done to address the PFAS crisis. It's still huge, and for individual farms, it's devastating. It can be. But I think because Maine is a small state and we have really close connections, one of the things I've been most impressed by is how we've been able to work together, bring all of our available resources to the issue. And so we have collaborations, farmers first who have been working with folks to do the initial research that has led to some of these action levels being established. The CDC, the Department of Ag, Conservation and Forestry, the Department of Environmental Protection, the university, the non-profits, it's really, like yesterday we did a sampling, and I'd say pretty much we had representatives of all of those groups out there in the field together. And I think it's only by working together like that, that will really address this problem and we've gone a long ways towards that.

Tim Doak:

Important work, and we're very thankful you're helping to lead that. Thanks so much for being our guest today.

Dr. Ellen Mallory:

Thanks for having me.

Tim Doak:

Sure. For our listeners, we'll link to the PFAS Research Initiative and the EPA's PFAS Health page on our website. Until next time, I'm Tim Doak asking you to think sustainably.

Announcer:

Thank you for listening to this episode of Sustainable Healthcare. Please join us next time for a new episode. There are several ways you can tune in, on our website at northernlighthealth.org/healthyhappywise. We are also on Apple, YouTube and Spotify, which makes it easy for you to listen on the go on your favorite app.