Tracking Canine Enteric Coronavirus in the UK

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Alan Radford. He's a professor of veterinary health informatics at the University of Liverpool. We'll be discussing an enteric coronavirus in dogs and how it was discovered. Welcome, Dr. Radford.

[Alan Radford] Hi Sarah, nice to speak to you.

[Sarah Gregory] Describe the problem with tracking diseases in companion animals.

[Alan Radford] I think I can summarize that up quite quickly by saying a lack of data (we'll probably talk about it a bit as we go through). But historically, there has been no population-level data on companion animal diseases in the UK where I work or anywhere in the world, for that matter, that I'm aware of. So, lack of data.

[Sarah Gregory] So is there a reason why there's no national notifiable system or data?

[Alan Radford] I have my theory. It's my own personal theory. If you look at other animal populations, like food animals (cows and sheep, for example), there is a very well-developed system in most countries for tracking disease. Those national systems are managed now by the World Trade Organization and the OIE, and they were set up originally at the end of World War II as a way of managing trade in animals. And if you think about that time in life, I'm not quite old enough to have been around then, but at that point, at the end of World War II, animal trade would have been driven by food animals, not by what we now call companion animals. So, the systems were built and have evolved to survey disease of food animals and companion animals have been left behind, essentially. What we're trying to do with our research is find novel ways to fill that gap.

[Sarah Gregory] So, tracking was really done to keep the food supply chain going and not for any animal/humanitarian reasons or for any concern about zoonosis?

[Alan Radford] I suspect it was a combination of things. Essentially, at the end of World War II there was a real desire to stop that happening again. And one of the major ways it was felt that we could avoid world conflict was food trade. And what that required was a clear set of rules about how to trade and when a country could legitimately not trade with another country. So, in the context of animal diseases, it was okay to say, "I am not trading with you because you have a particular disease that I don't have."

[Sarah Gregory] Ah, I see.

[Alan Radford] That's how these systems were set up. The idea was that animal trade would happen unless there was a specific documentable reason that trade shouldn't happen. And that was generally done through presence of disease. So, foot-and-mouth disease is a classic example. If the UK has foot-and-mouth, and we don't at the moment, but if we did then the USA could say to us, "We are not having your cows because you have foot-and-mouth disease in the UK and we don't."

[Sarah Gregory] I see. Okay.

[Alan Radford] So, it's all that rules the trade.

[Sarah Gregory] So how did you become involved in this particular study that you're an author on?

[Alan Radford] So this particularly, we've been trying to fill this gap in health data for, well about 12 years now. And we have a lot of data. We're using it to look at all sorts of diseases in companion

animals, but then we were phoned up by a local practitioner, essentially, a lady called Dr. Danielle Greenberg who is a coauthor on this paper. And she told us that she thought she was seeing, she thought, she wasn't sure, but she thought she was seeing more dogs in her local practice, which is just outside Liverpool, more dogs with acute vomiting than she would normally see. And she wanted to know whether we could prove that or otherwise. So that was the very beginning of it. We get those questions from time to time. You see that in the literature in the veterinary press from time to time. "I think there's an outbreak in my area," and there's been no way to prove it. What we felt with Danielle is that we could use our data to try and prove, or otherwise, whether there was an outbreak of acute mass vomiting in dogs in urban northwest of England. That was the very first fact we had.

[Sarah Gregory] Okay. So you lack data and a national system, so what kind of surveillance did you use to track this illness?

[Alan Radford] So, the way we set up our network, small animal veterinary surveillance network, is we collect data from two sources. Firstly, from vets in practice, from about 10 to15 percent of the vets in the UK send us their electronic health data for free, out of the goodness of their hearts, and we have that as a data source. The other place we get data is from commercial diagnostic laboratories that are dealing with companion animal samples. And again, most of the big ones send us their test results, anonymized test results, again for free. So they're the two main data sources that we had access to for our research and that we were able to apply very quickly and in real time for this particular question.

[Sarah Gregory] Okay. So, describe your multidisciplinary approach and how that was useful.

[Alan Radford] Yeah, it's easy getting data--to get hold of large data sets. The challenge is about analyzing them. And we're very lucky in south metro Liverpool to have access to not a big team ,but a broad range of disciplines. We have vets who were seeing sick animals, it's really important that we understand ecological questions that our data is talking about. We have data scientists, both computer scientists and veterinary epidemiologists. We have also microbiologists who can bring samples into laboratories here and sequence them. So, it's that package, really, that goes right the way from the vet all the way through to a sequence from a sample. And that means we can respond very quickly to a particular problem like this.

[Sarah Gregory] Why don't you give us the highlights of your study now?

[Alan Radford] I think we were able to very quickly move from the question, "Is there an outbreak?" to "Yes, there is." I feel that's probably the biggest highlight. Practitioners see changes in their day-to-day consultations and wonder if there is an outbreak happening. But we were able to show, really very quickly, that there was an outbreak, and that it was a statistically significant outbreak. And that was probably the first time that we've been able to do that. So firstly, that there was an outbreak, a statistically significant outbreak, that would be a highlight. We were able to very quickly show that humans weren't involved, that was important. If you remember, for us, this was happening in March and April of 2020 when there was a pandemic happening in humans and we didn't want our message to be confused with that one. We certainly didn't want to get in the way of any of the messaging around COVID-19, for example. So, it's really important we were able to show that humans weren't involved and that we were able to show it was infectious, and that gave the clue of what to look for. We were able to show that none of the routinely looked for diseases was causing it. And the cherry on the cake was we were able to find a variant of a canine enteric coronavirus which was associated with cases. We can't say for sure it's the cause of the disease, but it is strongly associated with animals that had this severe acute vomiting.

[Sarah Gregory] So what methods did you use to carry out this study?

[Alan Radford] A full range, really, from what I'd call traditional field epidemiology, which was getting questionnaires and samples from animals with disease and without disease, so cases and controls. We were able to access a huge volume of data incredibly quickly, particularly the data from vets in practice. And finally, we were able to get samples submitted from cases and use them in what's called next-generation sequencing to identify this potential cause of a canine enteric coronavirus. So, quite the way from data science and epidemiology through to sequencing.

[Sarah Gregory] So, you mentioned that this canine enteric coronavirus is *not* the same as SARS-2 or COVID-19, right? You want to explain how it's different?

[Alan Radford] Yeah, it's a really, really important point of the messaging around what we found. We very early on were able to show this is a canine enteric coronavirus. We never call it coronavirus, it's always canine enteric coronavirus. The coronaviruses is a big family of viruses. They fall broadly into three types and SARS-coronavirus is in a completely separate type to canine enteric coronavirus. So, they are related, they're both coronaviruses, but they're very distantly-related coronaviruses. And there's no link between our outbreak and the pandemic that obviously the whole world has now been suffering. They're completely separate, they just happened to have occurred at approximately the same time, at least started at the same time.

[Sarah Gregory] Were there any specific reasons related to increased risk, such as seasonality, age, gender, or geographic location? And do you know why these things, if they did, why they had an impact?

[Alan Radford] I guess, with one year's data, it's difficult to be sure. See, it definitely had a seasonality. I mean, our outbreak started, we think, probably around November/December time of 2019 and finished around April time of 2020. And we've looked to see whether it's happened again this year. Veterinary practice is very different this winter to what it was last winter because of COVID, but we haven't seen any evidence were it occurring again. So, we don't know whether this will be an annual event, but we are still looking. In terms of age, enteric coronaviruses in dogs typically were associated with young animals previously, but this was affecting animals of all age groups. There was a geographical pattern, we did see the disease occurring in local geographical regions and we thought that was being driven purely because of it being infectious and so, a dog...likely to affect dogs that are near to it. But other than that, no, we weren't finding any strong associations to this particular disease.

[Sarah Gregory] What do you consider to be the most important aspect of your study?

[Alan Radford] That's a good question. I think I could probably answer that question differently on different days. But today, I think we were able to show that in a very efficient way, using data supplied collaboratively, from vets in practice, from owners, from diagnostic laboratories, in a very efficient way with a small multidisciplinary team, we can spot outbreaks really very efficiently. I think it's a very neat, efficient system which we hope was helpful in this outbreak and we certainly hope can be a model for studying companion animal disease, not just in the UK, but in other countries. Because, as we said right at the beginning, there's a lack of population health data for companion animals, not just in the UK, but as far as I'm aware, in every country. And we think this model is one that is very transferrable into other countries. We are actually working with a group at University of Minnesota to set up a similar system there. And so, if people in the States are interested, then I'd encourage them to look for CAVSNET, which is based at the University of Minnesota. That's C-A-V-S-N-E-T (CAVSNET).

[Sarah Gregory] Okay. Were there any challenges to doing this study? Obviously, there were since there was no national surveillance system, but you want to talk about that a little bit?

[Alan Radford] I think the challenges come down to time. We're researchers at Liverpool, that's our job. We teach vet students and science students and we do research. And so, when a situation like this comes along, in our case we had to split that around our day job. And that was very challenging. Very rewarding, really great to show that it was doable, but it required us to be very flexible with our time. We were lucky that we could do it. Maybe next time there's an outbreak, maybe we won't have the time to do it. That's a worry. But yeah, I'd say it's time. We have everything, we have everything we need to do this again. It's just time.

[Sarah Gregory] Because of the current pandemic, I think people are becoming more aware of what's called One Health and what that means related to wild and farm animals. How would you put companion animals into a One Health context?

[Alan Radford] It's interesting, isn't it? I think companion animals are often left out by many people. Again, maybe it's the historical context. People feel that we have very close contact to animals through our food—we eat them, that's not putting it too crudely. But increasingly, in certain parts of the world, there is now massive contact between humans and companion animals. And it's an area that perhaps we're only really beginning to address. You know, in the UK, I think it's about a third of households have a pet, mostly cats and dogs. And if you look at the interaction between people and their pets, it can be incredibly close. And we're seeing more examples, the more we look, we see more examples of infections that are passing from companion animals into humans, including things like antimicrobial resistance. I do think it's worth saying that companion animals are overall a force for good in people, but they do bring the potential for a negative impact on their owners and other humans that they interact with. And we're learning more and more about that now. But, we're probably a little bit behind in terms of our studies, compared to those who are looking at food animals.

[Sarah Gregory] What about the other direction? You mentioned people getting issues from their animals, but what about animals getting it from their people?

[Alan Radford] Animals getting from people....well, that's a really good example. I mean, there's lots out there from the typical areas of infection; I'll give you an infectious disease example in a moment. But think, we were just talking this morning actually about behavior problems in animals and how, you know, a lot of that is driven by how we keep, which of course is driven by the owner, not by the animal. People are very worried about things like separation anxiety, for example, coming out of COVID. But that brings me to a nice infectious disease example. Another project we've been working on with part of the CAVSNET team is looking at SARS coronavirus 2, the cause of COVID-19, and we have shown that cats and dogs aren't picking up infection from people. We've looked for antibodies in dogs and cats and you can find animals that test positive; that work's also been recently published. So, yes, infection will pass in both directions. In the case of SARS coronavirus 2, we believe it happens. We don't currently believe that it has any major impact on the pandemic, in that we think most...although it's likely there are some cats and dogs that have, and other animals, that have SARS coronavirus 2, we think the vast majority of people who get SARS coronavirus -2, unfortunately, will get it from other humans, not from animals. So, whilst it does happen, humans do infect....people do infect animals, sometimes, we think, in the case of COVID-19, it's not, thankfully, important to the pandemic itself.

[Sarah Gregory] How would you like to see your findings being used going forward? You mentioned a little while ago that you definitely would like to see further work on it. What do you want from this?

[Alan Radford] In this specific example, I think we would like to understand, perhaps bringing those two things together, we would like to understand more about coronavirus diversity in dogs and cats. You know, we found this canine enteric coronavirus variant, we've found evidence of SARS coronavirus 2, there are other well-known coronaviruses of, particularly cats, as well. We think, with the new technologies that are available through the sorts of science we have, we think there is a really good opportunity to look at coronavirus diversity in dogs and cats.

More generally, I think I would like people to read that paper and say, "We could do that in our country." I think I'd like people to ask what would happen if that outbreak had been in their country, could they have, how would they have dealt with it. And if the answer is as I suspect, it would be that they're not sure how they would've been able to approach it. Then perhaps they might consider using a similar system to CAVSNET to do it. There's a lot of good will up and down out in the veterinary profession, in veterinary practice and in diagnostic laboratories, to share data, it just needs the right champion in the particular country to bring that together.

[Sarah Gregory] So, specifically, what further studies would you like to see done on the lack of good surveillance or how data helps control outbreaks?

[Alan Radford] What further studies would I like to see done? I mean, we've talked about just cataloging surveillance activities in different countries. And I'm not aware of any other networks like ours, apart from in one or two countries that are trying to develop similar projects either to ours or to another system that exists in the UK called VetCompass. It would be nice to know which countries are trying to do something. One, so we can identify gaps, and two, so we can learn from each other. I think that would be a nice study to move this forward.

[Sarah Gregory] What's the main way that veterinary health protects dogs and cats from diseases?

[Alan Radford] I would answer that the same way as I would for humans, and I think one of the main ways is through vaccination. We know about a lot of diseases in dogs and cats, and we're very lucky that many of them have vaccines. And those vaccines generally are very well used in most countries where companion animals are commonly kept. So, I think certainly vaccination is a big part of preventative health. And the other thing that's perhaps a little bit different between dogs and cats and humans is...well, it's very different...is neutering. Neutering is a big part of veterinary practice and it's done for a whole variety of reasons, obviously to control populations, but it also has a variety of health benefits which I think people do value and it's some of the reasons why they get their animals neutered. So, I'd say vaccination and neutering, one like humans and one very unlike humans.

[Sarah Gregory] And as pet owners, what can we do ourselves to best protect our pets from getting diseases?

[Alan Radford] Use your vet, I think is really important. I think owners these days are generally very aware of how to care for their pets and of diseases in their pets. But clearly, the veterinary practitioner will know more and may know things about diseases in the local area. So, I'd really encourage people, if they've got questions, to go to the vet. I'd encourage people to have the vaccines or if they're not sure, at least to talk to their vet about vaccines and why they should get them and what are the disadvantages if they don't get them. I guess the same following on from the previous question, they might discuss with their vet about whether it's worth having their animal neutered, what are the health benefits of neutering and what are the negative sides of neutering? But I think a good regular conversation with a vet in practice is a really vital way of keeping pets healthy.

[Sarah Gregory] So tell us about your job and what you enjoy most about it, and what is veterinary health informatics?

[Alan Radford] I love my job, really. It's different every day. I think I can tell you, I think we know each other well enough, I'm 52, and I've been working at University of Liverpool since I was 24. In the prior time, before then, I was a student there when I was 18. So, I've been at Liverpool a long time. But my job changes pretty much every day, and that's exciting. We're lucky as researchers. We can take our job the way we think it needs to go. We can follow the science. And that's what I've been lucky to be able to do. And that's seen me go from projects using test tubes and growing viruses when I did my PhD, which I'm still involved with, but now to doing big data science with databases with hundreds of millions of bits of data in. So, very varied.

Health informatics, you get a lot of different definitions for health informatics. But the one I like is about using big data for health. So, it's about collecting big data, understanding the strengths and weaknesses of it, and applying it to health problems so that you can improve health. And of course, veterinary health informatics is doing that in the animal domain. It's worth mentioning that, although I call myself a veterinary health informatician, a lot of what we do does have impact on human health, too. It's because animal health can impact human health. So, a very varied job. I do really enjoy the...a university life because, whilst I get older, the students don't and their enthusiasm, their motivation, their questions, their drive keep us all fresh every day. So, I'd say it's those two things, the students that we have and the variety.

[Sarah Gregory] So, do you have any special interests or hobbies you're pursuing during this pandemic?

[Alan Radford] Homeschooling, surviving...we have a youngish family and I think the pandemic has posed challenges to all of us. But perhaps particularly to younger children. And so, trying to—in my own sometimes confused way—trying to help them through this has taken a lot of time. I am just starting to build a garden room and that's going to be my next challenge. So, I'd say those two things— homeschooling and parenting in a pandemic and building a garden room.

[Sarah Gregory] What's a garden room?

[Alan Radford] Oh, it's getting quite common over here. It's a shed for--box is a better word--but a very well insulated, strongly built shed that you can use all year round as an office or as a gym or something like that.

[Sarah Gregory] Oh, okay. It's not like a greenhouse for plants, then.

[Alan Radford] No, no. It's for people, not plants. There might be the odd plant in it, but it's for people, not plants.

[Sarah Gregory] Okay. Very nice. Well thank you for taking the time to talk with me today, Dr. Radford.

[Alan Radford] Sarah, it's been a pleasure. Thanks for your interest.

[Sarah Gregory] And thanks for joining me out there. You can read the February 2021 article, Outbreak of Severe Vomiting in Dogs Associated with a Canine Enteric Coronavirus, United Kingdom, online at cdc.gov/eid.

I'm Sarah Gregory for *Emerging Infectious Diseases*.

[Announcer] For the most accurate health information, visit cdc.gov or call 1-800-CDC-INFO.