Welcome to the Science Podcast for July 6th, 2018. I'm Sarah Crespi. This week, deputy news editor, Leslie Roberts, has a story on vaccine-derived polio, and an outbreak that threatens big plans to eradicate the virus from the planet. And online news editor, David Grimm, introduces us to America's first dogs. According to new evidence, they came over from Siberia, just like America's first people. And then the dogs disappeared entirely thousands of years later. First up, we have Leslie Roberts, deputy news editor for Science. She's here with a story on a polio outbreak in the Democratic Republic of Congo, and this outbreak highlights the bumpy road to eradication of polio. Hi Leslie.

Okay. So this is kind of a tricky tale to tell. Let's start with where polio is still endemic, where could one still catch the polio virus in the wild?

The wild virus is just in Afghanistan, Pakistan, and they're not sure, maybe Nigeria still.

There's now this polio outbreak happening in the DRC, the Democratic Republic of Congo, and this is not wild polio, this is something different. It's based on one of the weakened types of virus found in the polio oral vaccine. How is an oral vaccine causing infections in polio?

Okay. Well the oral vaccine is based on weakened live virus, and it's very safe, but in rare instances the live virus can revert and become able to paralyze again and actually spread person to person.

And when you say revert, you mean it picks up mutations so that it's suddenly dangerous again.

Right. It gets to be very close to the original virus, the original wild virus.

And there's something about the fact that the oral polio vaccine is being used in the DRC that generates this problem. Can you talk a little bit about that?

Yeah. See the oral polio vaccine is used in much of the world, you need it for eradication. We don't need it in the United States or in Europe, because polio is very low and just about everybody is immunized.

So they're getting a shot as a part of a course of children's vaccines?
02:35 SC: So why are they using the oral vaccine in all these other places, in these places where polio is still hanging on?

02:41 LR: Because they tend to hang on in very poor countries, and many of the children are not immunized. You'll have some parts of these countries where only 30% of children have routine immunization. So they need these campaigns with millions and millions of doses, and the oral polio vaccine is inexpensive, pennies a dose, easy to use because it's drops on the tongue, and it packs more punch than the inactivated one.

03:11 SC: Do you wanna talk a little bit about its ability to kind of spread itself as a vaccine into the population?

03:17 LR: Yeah, that is one of the big benefits of oral polio vaccine, is that the live virus replicates in the gut for a few days or a few weeks. During that time, it's excreted in the feces, and in places with especially poor sanitation, it can spread child to child, and then it actually gives immunity to those kids who weren't vaccinated.

03:41 SC: Is that how this vaccine-derived strain, or this vaccine's new strive infection, is coming back into the population? Is it because it's getting passed around?

03:50 LR: When children aren't vaccinated, when there's a big enough population, then the virus is able to keep spreading, child to child, for years. And as it does, it accumulates mutations, and that is what makes it revert to the dangerous form.

04:07 SC: So what is this reversion causing? What kind of problems is it causing in the DRC? How many infections have they seen?

04:13 LR: Well you don't see infections, you see cases, so, so far 29 children have been paralyzed. But the outbreak is actually much, much bigger, because for every child you see paralyzed, there are 100 or 200 more infected, and they're spreading the virus.

04:32 SC: Is this happening anywhere else, this reversion, in any the other parts of the world?

04:36 LR: Yes, it's happened in the past couple of years in about 10 countries. In the countries you would expect, such as Somalia or Pakistan with bad immunization. But there's a new strategy and they have all been stamped out really quickly. So what's different about the DRC is it's still spreading.

04:56 SC: Well, let's talk about this strategy, I mean this is something that public health officials have been worried about, the fact that this, basically the polio and the vaccine could be reactivated and cause infections. So what did they start out doing? How did they first strategize to defeat this problem?

05:12 LR: Well, the first idea, when they found out that the vaccine virus could actually do this, was World Health Assembly said, "Okay. If we're gonna eradicate polio, we eventually have to stop
using oral polio vaccine." And nobody knew exactly what kind of shape that would take, but in 2016, they tried the new strategy. Instead of stopping all OPV, they would take out one of the components.

05:41 SC: Type II.

05:41 LR: Type II.

05:42 SC: So, they were still giving oral polio vaccine, but they were only giving two types, and Type II was taken out. But Type II is the one that's popped up in the Democratic Republic of Congo.

05:52 LR: Right.

05:53 SC: But how can you help people fight this if you can't give them the Type II vaccine?

05:58 LR: You have to give them a specially formulated new vaccine, that is only effective against Type II, and use it very, very carefully in a very small area, no less, no more than you need to boost immunity, and that's the plan they're testing.

06:15 SC: So how does this outbreak of vaccine-derived polio compare with what's left of the wild-type, the wild virus?

06:23 LR: Well, there are more cases now in the DRC than there are anywhere else in the world.

06:28 SC: Of any kind?

06:30 LR: Yes. The cases in the endemic countries are really dwindling.

06:35 SC: So if the plan is to eradicate polio from the planet, how does this vaccine-derived outbreak affect the livelihood of that happening any time soon?

06:44 LR: If they can get it under control, if they can use this new vaccine that works against Type II, then everything should go according to plan maybe a little more slowly. But if they can't get it under control and it starts to spread across Africa, it's gonna set things back for years.

07:03 SC: Okay. Thank you so much, Leslie.

07:05 LR: You're welcome.

07:05 SC: Leslie Roberts is a deputy news editor for Science. You can read her story on vaccine-derived polio at sciencemag.org/news. Stay tuned for an interview with David Grimm on America's first dogs. How did they get here, and where did they go?

[music]
07:25 SC: This week's episode is brought to you in part by LifeProof Backpacks. Whatever the action, whatever the destination, no matter the weather, LifeProof Backpacks keep you optimized, organized, prepared, and protected. Check them out at lifeproof.com/sciencemag and receive 15% off any pack. LifeProof Backpacks are made with water-repellent Cordura fabric, to shed rain during those showery afternoons in the summer. Special tech pockets are sealed against the elements and lined with soft fabric, so phones and other small devices stay safe. Select Backpacks also have an ingenious side access laptop pocket, ideal when you're going through long airport security lines. Speaking of security, most LifeProof Backpacks are equipped with a super secret stash pocket, for when you need to hide away a passport or some cash. And they're all outfitted with front tie-downs to hold oversized stuff on the outside of the bag. With four sizes, there's a LifeProof Backpack for any outing. Grab the Quito 18 liter for day trips. Up your carrying capacity with the Squamish 20 liter. Go with the go with 22 liter for tons of pockets, or max out on space with the Squamish XL 32 liter. Get your LifeProof Backpack now at a 15% discount by going to lifeproof.com/sciencemag. LifeProof Backpacks. Carry on.

[music]

08:50 SC: Who were America's first dogs? Were they domesticated from local wolves? Did they come across with America's first people, or did they come later? Online news editor, David Grimm is here with new evidence that clears up some questions about early American dogs, but doesn't tell us where they went. Hi, Dave.

09:10 David Grimm: Hey, Sarah.

09:11 SC: Hope I didn't ruin your story for you.

09:12 DG: No. You know I love talking about dogs.

[chuckle]

09:15 SC: So this is actually data from multiple papers. One on dates from very old dog burials, and another on tracing genetic ancestry of America's first dogs. Let's talk a little bit in general about what we knew about early dogs in America before this new data surfaced.

09:31 DG: Yeah. In fact, we actually have to talk about what we know about early people as well.

09:34 SC: Okay, good.

09:34 DG: So we don't exactly know when people first came to the Americas, but we think it was probably around 16,000 years ago. This is a time when there was a land bridge between Siberia and North America.

09:46 SC: Beringia.
09:46 DG: Beringia, right. So people could have travelled across. And we know that after a time, that these people, when they were in the Americas, had dogs. If you look at archeological sites that had been excavated over the past few decades, researchers have found evidence of dogs being buried in Native American sites, sometimes as old as 8,000 or older. So there's this weird gap, so we know people came over around 16,000 years ago, we know there were dogs here about 8,000 years ago, but we don't know a lot about what happened in between.

10:17 SC: Right. So did the dogs come with the people? Were they here already?

10:21 DG: Exactly.

10:21 SC: Very unlikely?

10:22 DG: Exactly.

10:23 SC: Okay. And there's even some reports from early European settlers that said there were dogs here.

10:29 DG: Right, exactly. So you know when European settlers first started coming over, there's some accounts that when they met the Native Americans, they had these dogs. A lot of them described these dogs as being very wolf-like. They encountered them in the forest, they would shoot them. So we know that the Native Americans had dogs and that they were an important part of their society.

10:46 SC: So what's the archeological evidence that you talk about in your story?

10:49 DG: Well, so the archeological evidence is helping us refine these timelines a little bit. So there was a couple sites in Illinois, where we already know, we've known for a few decades, that there were dogs buried there, and they were buried individually. And it was thought, based on previous dating, which wasn't of the dogs themselves, but sort of surrounding material, that these dogs were about 8,500 or so years old. But when researchers went back and re-dated the dogs and actually dated the dogs directly, they found that these dogs are actually closer to 10,000 years old. So not only are these the oldest dogs we know of in all of the Americas, but actually these are the oldest individual dog burials in the entire world.

11:24 SC: Everyone should know the caveat that it's individual dog burials.

11:27 DG: That's right, so there are older burials of dogs with people, but in terms of dogs being buried by themselves. And so, what this does is it tells us that by 10,000 years ago, even way into the middle of North America, we already have, not only dogs, but people burying their dogs, which suggests there was maybe some sort of sentimental relationship going on there. So that helps us a little bit figure out, okay, well there were dogs here earlier than we thought.

11:50 SC: Still not 16,000 years ago?
11:50 DG: Still not 16,000 years ago.

11:52 SC: But let's go to the genetic evidence now.

11:54 DG: Right. Okay. So what the genetic evidence tells us is actually really interesting. What researchers did was they took a lot of these ancient bones, they got DNA from them, and then they compared that to the DNA of modern dogs. And what they found was that these dogs in the Americas, what they call the pre-contact dogs, so these dogs that existed before European colonizers came over, they're all related to each other. They all form this special group that has its own genetic signature that's different from dogs anywhere else in the world. Also, that they're not related to North American wolves, so that nixes this idea that dogs were domesticated independently in the Americas. What the DNA also suggests is that these dogs may have arisen in Siberia around 16,000 years ago, they're closely related to an Arctic dog population there. And so all this tells us is that American dogs, they're sort of unique, they have their own story. They could have originated in Siberia about 16,000 years ago, but when you combine the archeological evidence with the DNA evidence, it suggests that there was this gap, where people came over first, maybe about 16,000 years ago, but dogs may have not come over until thousands of years after that.

13:01 SC: What might be the reason for that delay?

13:04 DG: Well, we don't know when dogs first came into being. So there's a lot of controversy about this, and it could be as recently as 15,000-16,000 years ago when dogs first came into being.

13:12 SC: There weren't any to come over with people.

13:13 DG: So maybe there weren't any dogs, that's one possibility. The other possibility is that there were dogs, but maybe just these small pockets of dogs, and they really hadn't taken over as being very important. So when people first started coming over, they didn't have dogs or they felt they didn't need dogs. Another possibility is that dogs did come over 16,000 years ago with people, we just don't have the evidence for that yet.

13:33 SC: Right. I do wanna point out that there are dogs that we consider very old in the Americas. So for example in Peru, they have these hairless dogs that have been pictured with Inca, in Incan art. What about those dogs?

13:44 DG: Yeah, it's really interesting. So there's these dogs that, according to artistic accounts, have been around for 3,000 or more years, dating back to the Aztecs and maybe even before then. And yet, when the researchers sequenced the DNA of these dogs, they found no traces of these pre-contact dogs, which means that these dogs are probably not descended from pre-contact dogs, or maybe if they were at some point, their genomes got so... With the mating with European dogs and other dogs, that the genetic signature of these very early dogs has been lost.

14:15 SC: And that goes for Labradors, Chihuahuas, all the dogs we think of as American, they actually came over with Europeans?
14:22 DG: Yeah. In fact, if you really wanna get as close as you can get to one of these pre-contact dogs, you can look at a Siberian husky and Alaskan malamute. Some of these Arctic breeds which actually are the most closely related. They're still pretty distantly related, but of all the dogs we know of today, they are the most closely related to the pre-contact dogs.

14:40 SC: Except for a tumor. [laughter]

14:44 DG: The grossest part of one of these studies was the canine transmissible venereal tumor, I may be getting those words mixed up a little bit. But basically, this is this tumor that grows on the genitals of dogs. It's been around for thousands of years. What's really interesting about it is that the first tumor, it spread from dog to dog via mating, but the very first tumor to grow on a dog actually has the genome of that dog.


15:09 DG: Well, yeah, so we don't know. So the very first dog that had this tumor, that tumor kept that dog's genome and over thousands of years, it still retained that dog's genome. And what the researchers found was that this genome, it's not the same as the pre-contact dog genome, but it's very closely related. And what we do know is that there is no genetic signature of these pre-contact dogs anywhere in modern dogs except for in this tumor it seems somewhat related. So the only vestige of these pre-contact dogs we have, is in this possibly 8,000-year-old tumor that's been passed from dog to dog over the eons.

15:43 SC: Okay, Dave. I just wanna circle back to this disappearance. Where do researchers think they went? What happened to America's first dogs?

15:50 DG: Right. So this is the big mystery. We apparently had lots of these pre-contact dogs, definitely in the North America. Not so sure about South America. Then the Europeans come, and within a few hundred years the genetic signature of these dogs is completely gone, and so the question is, "What happened?" And that's really open for speculation, but the prevailing theories seemed to be that just as when European humans came over and they made contact with the native Americans and they transmitted diseases to them that the native Americans weren't immune to, and very similar situation could have happened with the dogs, where you had these European dogs coming over with diseases that the American dogs had never encountered and they were just wiped out. It's also possible that these colonizers didn't like native American dogs, that they shot them, that they killed them, whatever. We really don't know, but what we do know is for whatever reason, this was a population of dogs that existed, and at least genetically, has now vanished.

16:42 SC: Okay, Dave. Anything else you wanna tell us about on the site this week?

16:46 DG: Yeah Sarah, we've got a story about the first image of a newborn planet being born. Also, a story about horse dentistry, and what may be actually the first evidence of horse dentistry dating back about 3,000 years from Mongolia. For Science, inside of our policy blog, we've got a story about a controversial transparency plan at the US Environmental Protection Agency. Also a story about how Science candidates are faring in the upcoming US election. So be sure to check out
all these stories on the site.

**17:19 SC:** Thanks, Dave.

**17:19 DG:** Thanks Sarah.

**17:20 SC:** David Grimm is the online news editor for Science. You can find links to his story and more at sciencemag.org/news.

**17:28 SC:** And that concludes this edition of the Science podcast. If you have any comments or suggestions for the show, write to us at sciencepodcast@aaas.org. You can subscribe to the show on iTunes, Stitcher, many other places, or listen to us on the Science site. While you're there, you can read about the research and news stories discussed in the episode. That's sciencemag.org/podcasts. This show is produced by Sarah Crespi and edited by Podigy. Jeffrey Cook composed the music. On behalf of Science magazine and its publisher, AAAS, thanks for joining us.