Animal Exposure and Human Plague

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

[Sarah Gregory] Hi, I'm Sarah Gregory, and today I'm talking with Dr. Alison Hinckley, a CDC epidemiologist in Colorado. We'll be discussing plague in animals and people.

Welcome Dr. Hinckley.

[Alison Hinckley] Thank you, Sarah. It's great to talk today.

[Sarah Gregory] We usually think of plague as something from medieval times, but the plague still exists around the world, doesn't it?

[Alison Hinckley] Yes. I think most often people think of the historical outbreak known as Black Death when hearing the word "plague." But the truth is there have been at least three major plague pandemics that we know about. The first one occurred in the 6th century—that's the Justinian plague. The second one that most people have heard about—the Black Death—occurred in the 14th century. And we're now in the times of the modern plague era that's 1860s to present. During this modern plague era, of course, is when scientists discovered the cause, which is a bacteria called *Yersinia pestis*. But today, you really only hear about small outbreaks around the world that are much less frequent and much less fatal than they used to be, pretty much due to modern sanitation, use of antibiotics, and other prevention techniques.

[Sarah Gregory] Millions of people died in these plagues over the years, right?

[Alison Hinckley] That's true. It was responsible for killing one-third to one-half of populations during some of these pandemics.

[Sarah Gregory] But not this recent one?

[Alison Hinckley] No.

[Sarah Gregory] Where is plague still found?

[Alison Hinckley] Well, plague still occurs just about every year in Africa, Asia, South America, and North America. But in the United States, it's fairly rare. It really only occurs in rural and semirural areas of western states, most commonly those include New Mexico, Arizona, and Colorado.

[Sarah Gregory] I remember a couple of years ago—because I did a podcast on it—there was a small outbreak in Yosemite, right?

[Alison Hinckley] Yes. Over a couple of years in the recent past, there has been risk of plague in certain areas where camping occurs in Yosemite. Thankfully, with public health signs, people know where those areas are. And also, if they go camping and they come home and start to feel sick, they'll remember that plague was a possible risk and they can do what they need to do, which is go seek healthcare, a healthcare provider and get treatment right away.

[Sarah Gregory] Why would people be getting plague in Yosemite? What…what caused it?

[Alison Hinckley] Its natural ecologic conditions. So, the animals that can host infected fleas live there and do quite well. From time to time, the bacteria will increase in the flea population and lead to a death of the animals. It's when those deaths of animals occur that usually people are at

higher risk. The fleas can leave the animal bodies and then get on other animals or get on humans and infect them.

[Sarah Gregory] So, what are the different types of plagues—you mentioned *Yersinia pestis*—and do they have different kinds of symptoms or what?

[Alison Hinckley] Sure. All of them will make you very ill. There's three main types; all of them will have high fever, chills, headache, and weakness. The one that is talked about most commonly, that occurs most commonly, is bubonic plague. That's where you'll have the high fever but also swelling in your lymph nodes—a very large, prominent swelling—and we call those buboes. There's also septicemic plague, which is usually includes abdominal pain, can lead to shock, organ and tissue damage…it's where skin and other tissues can turn black. And then there's pneumonic plague, which is a rapidly developing pneumonia that includes shortness of breath, chest pain, cough with either bloody or watery mucus…that's the only form of plague that can spread from person to person. All of forms can progress to death if untreated, though.

[Sarah Gregory] So, what is the treatment?

[Alison Hinckley] Because plague is a very serious illness, it's important to get treatment right away. The treatment is usually very commonly available antibiotics. Earlier a patient seeks care and receives that treatment, the better it is for their outcome and survival.

[Sarah Gregory] I did a podcast recently with somebody that said that you needed to get it within 48 hours, any kind of antibiotics. Does that mean after 48 hours you're not going to get help? It won't work?

[Alison Hinckley] No. It certainly depends on your…on the person, the type of illness that they have. Getting bubonic plague treated is a little bit easier than getting pneumonic plague treated. But every situation is different. Definitely your chances of a very good outcome are better the earlier you get those antibiotics.

[Sarah Gregory] So, this plague bacteria is basically maintained in an enzootic cycle. Can you tell us what this means and describe what this plague cycle looks like?

[Alison Hinckley] Sure. Plague bacteria naturally cycles between rodents and their fleas, like I said, in certain parts of the country, and in sometimes very focal parts of areas such as in Yosemite. Every once in a while, plague infections in the rodents can increase and that leads to an epizootic or an outbreak among these animals. That's where usually the animals are rodents, rodents will die off…when they do that, the fleas that are on them look for other sources of food and that's when humans and other animals are at risk for being bitten and getting plague themselves.

[Sarah Gregory] Okay. So basically when people get plague nowadays, it's from infected fleas or animals and not from another person?

[Alison Hinckley] These days, that is pretty much true. Most people will become infected from flea bites, from handling sick or dead animals, or even from handling their household pets, such as cats and dogs. It is possible, as mentioned earlier with pneumonic plague, to acquire it from another human. That hasn't happened in the United States in any confirmed way since 1924.

[Sarah Gregory] Oh okay. So that's a good, long while. You're study looked at U.S. plague cases from 1970 to 2017. You said before there weren't too many, thankfully. So, how many were there?

[Alison Hinckley] No, there were about 482 cases reported during this time period in the United States. That's about seven human cases each year. More lately we've had about one to two cases reported per year. So, it's not terribly common, but it still happens. And for that reason, particularly in those southwestern states that I mentioned, people need to teach themselves how to…how to recognize it and protect themselves from…from being ill.

[Sarah Gregory] I think you've already sort of covered this, but during that time span what were the most common ways that people were exposed?

[Alison Hinckley] Well, more than half the people had animal exposure. And with domestic animals, most of them had exposure through casual handling or co-sleeping, or even caring for the sick or dead animal. Some of those people with domestic animal exposures found some plague whenever the animal brought home another dead animal or…or pet that had fleas. For people exposed through wild animals, most often this through skinning, handling—again, a sick or dead animal—or through even just casual contact. These wild animal exposures are usually higher risk or more direct exposures.

[Sarah Gregory] So, did you notice any trends in plague frequency over the years?

[Alison Hinckley] There are trends. Geographic distribution—over the many years that it's been in the United States—it sort of began by coming in through port cities—it's progressed to the current distribution (kind of in the southwestern United States) because of the changing ecology since that time, and particularly during the Dust Bowl, which really affected sort of the host species that are involved with the plague ecology. There's been changes with clinical outcomes, of course. Without antibiotics, it was a highly fatal disease. But after the introduction of antibiotics, the fatality rate really decreased dramatically so that since the 1960s, it's been stable at around 10 percent of all cases will die. And then, the third sort of trend over the years has been a change in route of exposure. The frequency has decreased, but the proportion of cases related to animal exposure has actually increased. For that reason, it's important for public health practice to recognize it, maybe change our messaging, communicating about this risk with…with both the public, but also healthcare providers is important, and especially veterinarians who can recognize plague in domestic animals that may be brought in, or even wild animals, and get that information out to the community as needed.

[Sarah Gregory] Is your domestic cat or dog treatable also?

[Alison Hinckley] Yes, the domestic cat or dog is treatable. Cats are much more likely when infected to become sick with plague. It's important to get them treatment because they can, of course, infect humans by coughing on them. Just like from human to human transmission, there's cat-to-human transmission. Dogs are much less likely to get sick and transmit plague, but they can also still bring humans in contact with infected fleas. One of the ways this has been brought up in the recent published literature is through co-sleeping.

[Sarah Gregory] So according to your study, it seems like it peaked in the 1980s. Do we know why?

[Alison Hinckley] Well, so the disease naturally cycles everywhere where plague occurs. That's true in the United States and that's true in Africa. Sometimes we see more cases than expected, and sometimes less. Again, this is…it's thought that these cycles are driven by ecologic changes. For example, plague might happen more commonly in the years following a lot of years of

rainfall. In the 1980s, we did see an example of a natural upswing where we saw, you know, tens of cases rather than the one or two that are seeing more commonly in these recent years.

[Sarah Gregory] So we already just kind of talked about this, and people definitely won't probably like your answer, but one of your exposure patterns as we said was people sharing a bed with a pet dog or, I guess, cat. So, is this actually something people should be worried about and you recommend not doing? Or what do you say?

[Alison Hinckley] Yes. Well, in plague-endemic areas, we do recommend that people do not sleep with their pet, and especially whenever those pets roam free. Again, it just increases the amount of close contact with the pet and it makes it easy for fleas to move from pets to people. But for pet owners in nonendemic areas, they don't need to worry about getting plague by co-sleeping, but they should still know the importance of regular use of flea and tick control products for their pet, to keep them from being exposed to a number of other possible bug-borne diseases.

[Sarah Gregory] I spend a fortune on those kinds of things, yes. Do you see any parallels between historic outbreaks of plague and the modern ones?

[Alison Hinckley] Well, sure. Conditions that have helped sort of facilitate large outbreaks of plague in both the Middle Ages and today are the same. That includes poor infrastructure, being in a close proximity with rodents, and just general poor health. One of the major differences between historic outbreaks and today is that recent plague outbreaks are much smaller and much less severe. And again, this is likely the result of effective control measures and the advent of antibiotics.

[Sarah Gregory] How did you personally become interested in plague? What do you do at CDC? And also, why do you think people are so fascinated by it?

[Alison Hinckley] Well, who wouldn't be fascinated by plague? Anything that had such a tremendous impact on populations of Europeans, populations in Asia over time…I think it's just got great historical context, and there's just still so much for us to learn. So, it's been a pleasure of mine to be able to learn about that and try and help people with the information that we do get at CDC. And it's still a problem in much of the world. But in addition to plague, I actually work on surveillance, research, and prevention for a number of other diseases transmitted by fleas and ticks. As you said at the beginning, I'm an epidemiologist at CDC's Division of Vector-borne Diseases in Fort Collins, Colorado.

[Sarah Gregory] So, what would be some of those other diseases you work on?

[Alison Hinckley] Oh, we work on tularemia, tickborne relapsing fever, Lyme disease, and *Bartonella* in my branch.

[Sarah Gregory] And tularemia is spread by rabbits, right?

[Alison Hinckley] Tularemia is associated with rabbits. Also spread by deer flies, ticks. It's another one of these fascinating diseases with a great ecology.

[Sarah Gregory] So, I actually didn't know it was spread by ticks…goodness. Thank you so much for joining us today, Dr. Hinckley. This has been fascinating.

[Alison Hinckley] Absolutely, Sarah. Thank you so much.

[Sarah Gregory] And thank you out there for joining us also. You can read the December 2019 article, Animal Exposure and Human Plague, United States, 1970–2017, 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.