

# Leprosy and Armadillos

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

[Sarah Gregory] Nine-banded armadillos are naturally infected with *Mycobacterium leprae* and have been implicated in zoonotic transmission of leprosy. Early studies found the disease mainly in Texas and Louisiana, but armadillos in the southwestern United States appeared to be free of infection. The authors screened 645 armadillos from 8 locations in the southeastern United States not known to harbor enzootic leprosy for *M. leprae* DNA and antibodies. They found *M. leprae*-infected armadillos at each location, and 106 animals had serologic/PCR evidence of infection. The geographic range and complexity of zoonotic leprosy is expanding.

Today, I'm talking with Dr. Richard Truman, Chief of the National Hansen's Disease Program Laboratory Research Branch. He's talking with me today about leprosy.

Welcome, Dr. Truman.

[Richard Truman] Thank you very much for having me, I'm glad to be here.

[Sarah Gregory] Dr. Truman, is this the same leprosy that we think of as being so deadly in medieval times and before? Leper colonies and black hooded robes and appendages falling off? Has it actually still been around all this time?

[Richard Truman] You know, there are tremendous misconceptions about leprosy. And so let's try to clarify a few things to begin with. First, of course, leprosy is an infectious disease, it's caused by a bacterium, *Mycobacterium leprae*. It is an obligate intracellular parasite that can't be cultivated on artificial medium. *M. leprae* have the unique ability to invade peripheral nerves, especially Schwann Cells, where they bring about really extensive neuritis and damage to the nerves. And it's this nerve damage that underlies the gross pathology and deformity that we sometimes associate with leprosy. However, you know, appendages don't just fall off, rather the lack of sensation makes them very susceptible to secondary injury and trauma. Pain is really a great aid in medicine and if you can't feel pain, you don't know that you've injured yourself or to seek attention about a wound.

With regards to the age, clearly, leprosy is a very old infectious disease and it's been around for millions of years. It probably originated in East Africa or India and moved around the globe with human migration. It was probably present in the Middle East in Biblical times, and was highly prevalent in Europe in the Middle Ages. People with leprosy were segregated from others because of their deformity and the general fear of contagion. But in reality, you know, leprosy is relatively hard to catch, it's really not highly contagious. Probably 95 percent of the world's population is naturally immune to leprosy and will never acquire the infection. Today, we treat most cases on an outpatient basis, and people are no longer segregated from their families.

In terms of spread, leprosy was not present in the New World prior to colonization; it was brought here from Europe and Africa and Asia. However, by the 1750s the disease was lowly endemic among all the countries surrounding the Gulf of Mexico and it persists in the region today. In the United States we have only about 200 new cases each year, but there were more than 340,000 cases presenting in the regions of the Americas over the last decade, and the majority of those came from Brazil.

[Sarah Gregory] Why armadillos? They seem so tank-like and not something that would be susceptible.

[Richard Truman] Well, *Mycobacterium leprae* has a preference for cool temperatures. In man, the lesions manifest mainly on the arms, legs, ears, nose -- cooler regions of the body. Although most animals are highly resistant to *M. leprae* and will rapidly dispose the organisms, laboratory mice will develop a very limited infection when they are inoculated into the cool temperatures of their hind foot pads. Armadillos have an internal body temperature of only 32-35C, and it was this cool body temperature that first attracted the attention of leprosy researchers.

However, armadillos are also unique and appear to be markedly susceptible to the infection. They develop a fully disseminated disease which involves their internal organs as well as their nerves, and they can manifest massive numbers of bacilli in their tissues. Because of this, armadillos rapidly became the hosts-of-choice for in vivo propagation of leprosy bacilli, and, since armadillos and humans are the only hosts that can develop extensive neurological involvement with *M. leprae*, they're leading models for piloting new therapies and diagnostics.

[Sarah Gregory] How did the armadillos get leprosy in the first place?

[Richard Truman] Yeah, armadillos must have acquired the infection from humans sometime in the last few hundred years. Just how the disease was transferred from humans to armadillos, or armadillos to humans is not really known. However, people have long taken armadillos as food and they can have fairly close associations with them. Fortunately, this transfer of organisms appears to be somewhat inefficient. Over the range of armadillos in the southern United States we have identified only 2 major strain-types -- genotypes -- of *Mycobacterium leprae* suggesting there were at least 2 introductions of the bacilli into the animals.

However, armadillos range from throughout the southern United States, down through Latin America and all the way to Northern Argentina. Recognizing that there have been at least 2 introductions of the bacilli to armadillos in the United States suggests that there may be multiple additional strain-types involved elsewhere in the Americas and armadillos could be playing a role in helping to perpetuate leprosy transmission throughout the Western hemisphere.

[Sarah Gregory] Okay, so how do people get it from an armadillo? Is it from touching one that's infected or being near them?

[Richard Truman] Yeah, the exact mechanism of leprosy transmission is not well known. We believe the disease is spread mainly by respiratory routes and it appears to be transmitted most effectively through long term close associations with another infected individual. As such, direct exposure to the blood or tissue of an infected animal would probably be the highest risk for spread of *M. leprae* from armadillos to humans and people taking armadillos as food should really be apprised of the fact--or at least, the potential risk that they could encounter *M. leprae*.

So, both humans and armadillos infected with *M. leprae* also can shed the bacilli through sneezing and coughing and bodily secretions. But *M. leprae* will only survive for only a short period of time in the natural environment, the organisms are not very robust: so 90 percent of them will die in a single freezing, they die in a microscope slide in about 2 hours and they may survive for only a few days in moist soil. However, fomites and exposure to environmentally shed organisms also may be implicated in transmission. Certainly the highest risk would be exposure to the fresh tissue or blood of an infected animal.

[Sarah Gregory] Dr. Truman, what are the signs and symptoms of infection in people?

[Richard Truman] Leprosy is a very slow chronic infection. There are no laboratory tests which can aid early detection of the infection and it can only be diagnosed once clinical symptoms are present. Most people probably incubate the disease for 3-5 years before ever manifesting symptoms, even then the signs are relatively subtle and non-specific. The earliest signs might be a dry or hypopigmented patch of skin that's anesthetic and does not respond well to ordinary therapies. The diagnosis is confirmed by taking a biopsy and examining the dermal nerves for the presence of acid fast bacilli, or with a PCR reaction.

[Sarah Gregory] If we think we may have been infected, can a doctor test for it?

[Richard Truman] If you are concerned about possibly having leprosy, you should see your Dermatologist, let them examine you. Tell them about your history of exposure in foreign endemic countries or your history with armadillos. The important thing is that this disease moves very slowly and it persists for a long period of time. Depending on your symptoms, he may take a biopsy, which he should examine with a Fite stain and be able to test whether you have leprosy or not.

[Sarah Gregory] Okay, how about a vaccine, and is it treatable?

[Richard Truman] Oh yes, Leprosy can be cured! That is actually the motto of the American Leprosy Missions.

There is an experimental vaccine being developed at the Infectious Disease Research Institute in Seattle that's under the sponsorship of the American Leprosy Missions. It will be deployed for field trials in about 2018 or so, but is likely to be used in family contacts or as an immunotherapeutic in conjunction with antibiotic therapy, not in mass administration.

Generally, leprosy is treated with a cocktail of 3 different antibiotics. We believe that this antibiotic treatment kills all the bacilli in the host within only a couple of weeks of therapy. The regimen itself takes 6 months to 2 years to complete, and the bacilli are only slowly cleared from the body. Since a preferred site of infection is the peripheral nerve, these residual bacilli can provide a rich antigenic substrate for immune interaction and patients have to be monitored closely.

[Sarah Gregory] Do you have any advice for people who are concerned about contracting leprosy?

[Richard Truman] Yeah, you know, many animal species harbor infectious agents that are potentially harmful to humans. Leprosy in the armadillo is just another. There is not going to be an epidemic of leprosy, just because we now know that the animals harbor leprosy bacilli. Obviously the animals have been harboring these agents for many years now and we have not seen large numbers of new leprosy cases arise. Rather with information, people can minimize their risk for exposure by avoiding contact with armadillos, especially their fresh blood or tissues, and practicing good hygiene, such as hand washing or wearing gloves while gardening or in other outdoor activities. If you are exposed, remember, 95 percent of people are naturally immune, the infection will take 3-5 years to manifest, and if you have it, we can cure it with antibiotic therapy.

[Sarah Gregory] Thank you, Dr. Truman for taking the time to talk with us.

Listeners can read the entire December 2015 article, Zoonotic Leprosy in the Southwestern United States, online at [cdc.gov/eid](http://cdc.gov/eid).

I am Sarah Gregory for Emerging Infectious diseases.

*[Announcer] For the most accurate health information, visit [www.cdc.gov](http://www.cdc.gov) or call 1-800-CDC-INFO.*