Tracking Down a Mysterious Tickborne Disease

Hidden away in Todd Damrow's freezer are the cold, dead bodies of Eunice, Filbert, and Harold. As spring approaches, Damrow looks forward to watching the body count rise.

Gayle C. Shirley

Damrow may sound like the villain in a sordid murder case, but he's actually one of the good guys in a public health mystery that may result in the discovery of a new disease in humans.

Damrow is the Montana state epidemiologist, and—along with his colleagues at the Montana Department of Public Health and Human Services, the Centers for Disease Control and Prevention (CDC), and the National Institutes of Health (NIH) Rocky Mountain Laboratories—he has spent the past few years investigating reports of a tickborne rash similar to that found in Lyme disease.

Eunice, Filbert, and Harold are Rocky Mountain wood ticks (*Dermacentor andersoni)*, and they are among the subjects in the group's investigation.

Adult female Rocky Mountain wood tick, *Dermacentor andersoni*.

Damrow first suspected something strange was going on a few years ago, when he began getting reports from patients and physicians of what appeared to be Lyme disease. The patients complained of fever and severe fatigue, as well as odd circular rashes at the site of a previous tick bite. The symptoms were similar to those of Lyme disease, but only deer ticks carry Lyme disease, and deer ticks are not indigenous to Montana. In addition, Montana is the only state, according to Damrow, that has never had a documented case of Lyme disease that was acquired in-state.

The rash also was not characteristic of Rocky Mountain spotted fever or other tickborne diseases in Montana.

"We'd do tests for Lyme disease, and they'd always come up negative," Damrow said. "So we could tell them what they didn't have, but not what they did have."

Then one spring, a public health worker mailed Damrow a photo of the distinctive rash. It was unlike anything he had seen before, and it prompted him to launch a more formal investigation. He knew CDC was looking into Lyme-like symptoms caused by unidentified infectious agents in Lone Star ticks in Texas and dog ticks in Missouri. Could the same thing be happening with wood ticks in Montana?

Lyme disease is not caused directly by ticks but by a spiral-shaped bacterium called *Borrelia burgdorferi* that invades the salivary glands of deer ticks (*Ixodes scapularis*). When an infected deer tick inserts its mouth into a human host to feast on his or her blood, it transfers the bacteria to the human. The tick must be attached to the person's skin for at least two days to spread the infection.

In the United States, Lyme disease occurs primarily in the northeastern, mid-Atlantic, and upper north-central regions and along the Pacific coast. It usually features a telltale circular or oval-shaped red rash that starts at the site of a tick bite and enlarges during the next several days or weeks. The rash is accompanied by nonspecific symptoms such as fever, malaise, fatigue, headache, muscle aches, and joint aches. The disease is rarely fatal, though it can be severe, chronic, and disabling. In its early stages, it usually responds well to antibiotics.

In 2002, 23,763 cases of Lyme disease were reported to CDC. The number of cases has been escalating, possibly because of an increase in the number of housing developments being built in rural areas, where deer ticks usually live.

In the Montana cases, Damrow hypothesized, perhaps some previously unknown *Borrelia* species had adapted to the wood tick. He worried that the unusual rash might not be the only effect of this potentially new disease.

The only way to solve the mystery was to collect the offending ticks, extract DNA from their salivary glands, and study it with molecular probes to find out whether some new bacterium or other pathogen had infected the ticks.

"So, last spring we launched a 'save the tick' campaign," Damrow said.

Through news releases and public service announcements on radio and TV, the state Department of Public Health and Human Services (DPHHS) asked Montanans who found ticks embedded in their skin to carefully remove the tick, drop it alive into a plastic bag, and take it immediately to their county health department.

DPHHS staff also notified physicians and county health workers about the study, and they

became integral partners in the research effort. They collected the ticks, documented patients' symptoms, and mailed the ticks to DPHHS.

Damrow was hoping to collect around 100 tick samples. "We thought it would be pretty hard to get people to hang onto ticks after removing them," he said. "Usually you just want to throw the nasty little buggers in the trash."

But the public information campaign was more effective than he had dared to hope. He soon had a collection of about 350 ticks. "And that was after excluding the ones that didn't actually bite someone."

As the bugs accumulated in his office, Damrow dropped them into individual test tubes and stored them in the office freezer to preserve their DNA.

"When the first ticks started coming in we were real excited, and we were pleasantly surprised that people were so cooperative," he said. "Some people even gave their ticks names and were really attached to them—no pun intended."

This spring, as the snow melts and famished wood ticks become active, Damrow will again launch his public information campaign and will again begin collecting tick samples. His colleague, CDC epidemiologist Kammy Johnson, plans to start tracking bite victims to find out whether the mysterious disease has any late-developing or long-term effects.

DPHHS enlisted researchers at the NIH Rocky Mountain Laboratories in Hamilton, Montana, to search for antibodies in the blood of bite victims that might help to identify the pathogen and confirm its role in the disease. The partnership with the labs seemed especially appropriate, Damrow noted, since it was the first laboratory to identify Rocky Mountain spotted fever almost a century ago. And in 1982, a scientist at the lab identified the causative agent in Lyme disease.

Damrow is mindful of the serious potential of any new disease, but he can't help but get enthusiastic about the chance to play detective. "We're really excited about this, because it isn't often that you get a chance to discover a new disease," he said. "This may be our chance—and that's why public health exists."

Damrow and his partners in deduction hope to solve their public health mystery and reveal the culprit sometime in the next couple of years.

Author

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Resources

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Research in the Rockies: The Rocky Mountain Laboratories

At the turn of the twentieth century, Rocky Mountain Laboratories (RML) comprised a few researchers working in scattered tents. Today, it is a vital research campus in small-town Hamilton, Montana, employing some 250 people.

RML scientists came to national prominence in the early 1900s, when they proved that the bacterial agent of Rocky Mountain spotted fever could be transmitted from wood ticks to humans. Today, some of the most skilled scientists in the world are working at the labs to unveil the mysteries behind a range of infectious diseases, including illnesses linked to prion proteins: mad cow disease in cattle, scrapie in sheep, chronic wasting disease in big-game animals, and Creutzfeldt-Jacob disease in humans.

Significant discoveries made by RML scientists over the years include identifying the causative agents of Q fever and Lyme disease. During World War II, RML scientists also helped produce vaccines to protect soldiers against spotted fever, yellow fever, and typhus.

As part of the National Institute of Allergy and Infectious Diseases, a component of the National Institutes of Health, RML's primary mission is to help develop new and improved medical tools to diagnose, treat, and vaccinate people to protect them from infectious diseases.

RML is organized much like a small college. Its activities are centered in three main laboratories: the Laboratory of Human Bacterial Pathogenesis, the Laboratory of Intracellular Parasites, and the Laboratory of Persistent Viral Diseases. RML also has the Rocky Mountain Veterinary Branch and the Administrative and Facilities Management Section, both of which support the research functions.

For more information about the Rocky Mountain Laboratories, visit their Web site at www.niaid.nih.gov/dir/infobsl4/bsl4faq.htm.