Why some strains of Lyme disease bacteria are common and others are not

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New clues about the bacteria that cause Lyme disease could lead to a novel strategy to reduce infections, according to a study to be published in *mBio*, the online open-access journal of the American Society for Microbiology, on December 4.

The study reveals that the immune system of the white-footed mouse, a very common reservoir for Borrelia burgdorferi (the bacterium that causes the disease), responds differently to different strains of the bacterium, a finding that will help scientists tweak the animals' immune systems to prevent infection. A vaccine that keeps these wild mice free of the pathogen could significantly curb the spread of the disease from mice to ticks to humans.

"There's no human vaccine, and there's not likely to be one," says Alan Barbour of the University of California, Irvine, the lead author of the study. "We have to focus on lowering the risk. One way to do that is by treating the animals that carry the disease." Rabies offers a good example of how this might be accomplished, says Barbour. By deploying vaccine-laced food bait, public health officials have managed to lower the rabies infection rate in wildlife and significantly limited the spread of the disease to pets and humans.

Although Lyme disease only emerged in the U.S. in the past 40 years or so, around 25,000 cases are now reported every year in this country and the medical costs of these cases are estimated to range in the billions of dollars. Despite the growing importance of the disease, little is known

about the evolution and ecology of the bacterium that causes the illness.

Barbour and his colleagues sought to understand why as many as 15 different strains of *B. burgdorferi* exist in the wild at differing degrees of prevalence. In the parts of the country where Lyme disease is most common, the majority of white-footed mice are infected with *B. burgdorferi* during the course of the year. Unlike humans and lab mice, white-footed mice don't get sick when they're infected so the bacteria grow and multiply within them, and when a deer tick bites it sucks up the bacteria along with its blood meal.

In the lab, the group at UC Irvine exposed white-footed mice to various strains of *B. burgdorferi* and tracked the course of the infection. All the *B. burgdorferi* strains infected the white-footed mice, but some strains managed to grow to high densities in various mouse tissues while others did not.

Barbour says the immune reactions the mice mounted against the various strains explain these discrepancies: the greater the immune response, the fewer bacteria found in a mouse's tissues and vice-versa. Importantly, the strains that grew to greatest densities within the mice are also the strains that are most prevalent in the wild.

When they looked at the immune reaction to individual *B. burgdorferi* proteins the authors found a complex interplay of reactivities. The mice reacted in different degrees to the various proteins present in a single bacterial strain, which could explain why such a great diversity of *B. burgdorferi* strains are sustained in the wild, say the authors.

Barbour says knowing more about how the white-footed mouse reacts to all the various *B. burgdorferi* strains and immunogenic proteins will help vaccine developers select the best proteins to put in a vaccine. "The best candidate for the mouse vaccine is something that's the same in all the

[*B. burgdorferi*] strains," he says.

Once a vaccine for the white-footed mouse is developed, it will need to be tested by exposing immunized mice to a selected set of diverse *B. burgdorferi* strains, says Barbour, and the results of this study can help make that selection. "If we can find five that are representative, that would be an advantage."

This study, he says, "is going to provide a foundation for future studies in understanding the infection in these animals as we proceed with developing vaccines."

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