New vaccine could be first to prevent deadly emerging tropical disease

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Melioidosis is a tropical disease caused by bacteria found in water and soil that can be ingested, inhaled or enter open wounds of someone walking in a rice paddy, for example. Now researchers at Tulane University have developed what may be the first vaccine capable of protecting against the disease. (Photo by Shutterstock)

Melioidosis is a little-known tropical disease now seen as an emerging global public health threat. The disease is caused by bacteria that live in soil and groundwater, and no vaccine exists to prevent infection, which can rapidly cause life-threatening pneumonia or sepsis.

Now, researchers at Tulane University have developed the first vaccine shown to successfully protect nonhuman primates from melioidosis. The findings, published in Nature Communications, are a key step toward human clinical trials and preventing a bacterial infection that's often resistant to treatment — and which public health experts see spreading to areas it was not previously found.

"This bacteria can cause an aggressive form of pneumonia within 72 hours that can obliterate the lung. Our study found that the animals protected by this vaccine showed no damage; their lungs were completely normal," said corresponding author Lisa Morici, PhD, a microbiologist and immunologist at Tulane University School of Medicine. "It's an incredible result and we hope to advance the vaccine soon to human clinical trials."

Melioidosis is caused by *Burkholderia pseudomallei*, bacteria most often found in Southeast Asia and northern Australia. Although long considered absent from the United States, *B. pseudomallei* has been recently found in the Gulf Coast region as well as in Puerto Rico and the U.S. Virgin Islands. The bacteria can enter open wounds of someone walking in a rice paddy, for example, or be ingested or inhaled.

There are an estimated 165,000 cases of melioidosis worldwide annually, though it's believed to be highly underreported, as symptoms can vary drastically. Mortality rate ranges from 20-50% as the bacteria are naturally resistant to many antibiotics, and relapse can occur even after months of intensive therapy.

"With rising temperatures, melioidosis is occurring in new places with endemic cases in the U.S., and we're also seeing an increased risk to global travelers and people in the military," Morici said. "This bacteria is a Tier 1 Select Agent — the same threat level as the virus that causes smallpox and the bacteria that causes anthrax — and we're closer than ever to being able to protect people against it."

Morici is a pioneer in developing next-generation vaccines using a new class of adjuvants or immune system triggers based on outer membrane vesicles (OMVs), which are nanoparticles shed by bacteria as they grow. Our bodies recognize OMVs secreted by live bacteria during natural infection. When used in vaccines, they can fool the body into mounting a powerful immune response.

While the vaccine has not yet gone to human clinical trial, it was tested on human immune cell samples. The resulting antibody and T cell responses "suggested that the vaccine will produce the desired immune responses for protection in humans,"

Morici said.

Development of the vaccine has taken more than a decade and required global collaboration between Tulane University, Northern Arizona University, University of California Irvine and Charles Darwin University in Australia.

“Our vaccine was effective against aerosolized bacteria, the most lethal and difficult to protect against,” Morici said. “This has been a massive undertaking that we hope will be able to protect people from a very dangerous disease.”

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