

# ***Burkholderia thailandensis* Isolated from the Environment, United States**

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

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. David Wagner, a professor at the Pathogen and Microbiome Institute at Northern Arizona University. We'll be discussing the detection of *Burkholderia thailandensis* in the environment in the United States.

Welcome, Dr. Wagner.

[David Wagner] Thank you for having me. It's a pleasure to be here.

[Sarah Gregory] What is *Burkholderia thailandensis*?

[David Wagner] *Burkholderia thailandensis* is a gram-negative bacterium that lives in the soil and water, and sometimes can be an opportunistic pathogen in humans.

[Sarah Gregory] And what's the difference between a gram-negative and a gram-positive bacterium?

[David Wagner] These are two different types of bacteria. One type, the gram-positives, have a thicker cell wall, and the cell wall is thinner in gram-negatives. 'Gram' refers to a stain test used to distinguish between these two types. Gram is actually the last name of the scientist that developed this approach. And this test uses violet dye to stain the bacteria. Because gram-positives have thicker cell walls, they will retain the dye and appear violet. In contrast, the dye will leak out of the thin cell walls of the gram-negatives, and they will appear red. So you can distinguish between them via these two different colors.

[Sarah Gregory] Explain to us how this bacterium is related to *Burkholderia pseudomallei*, which is the cause of melioidosis.

[David Wagner] They appear to be very closely related. Of all of the *Burkholderia* species described to date, none are more closely related to *Burkholderia pseudomallei* than *Burkholderia thailandensis*. And for that reason, it's sometimes used as a surrogate for *Burkholderia pseudomallei*. Of course, there could be more closely related species that just haven't been described yet, but from what we know so far, *B. thailandensis* is the most closely related organism to *Burkholderia pseudomallei*.

[Sarah Gregory] And how serious is the *B. thailandensis* infection compared to the *B. pseudomallei* infection?

[David Wagner] Infections with *Burkholderia thailandensis* are much less serious, both in mice and humans. Most *Burkholderia pseudomallei* strains will readily kill mice, whereas *B. thailandensis* strains do not. And *Burkholderia pseudomallei* can cause very serious disease in humans, even death, especially in immunocompromised people. So we actually know very little about human infections with *Burkholderia thailandensis*, but given how common it can be in the environment in some parts of the world, it likely does not cause serious infections in people exposed to it under normal circumstances.

[Sarah Gregory] And where globally is it usually found?

[David Wagner] *Burkholderia thailandensis* is usually found in Southeast Asia and the tropical northern end of Australia. However, those are also areas where *Burkholderia pseudomallei* is

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commonly found. Most people, including us, do not go out and look for *Burkholderia thailandensis* on its own, but rather, we find it and isolate it when we're out looking for *Burkholderia pseudomallei*. Given that the global distribution of *Burkholderia pseudomallei* itself is still pretty poorly understood, I'd say that we know almost nothing about the global distribution of *Burkholderia thailandensis*.

[Sarah Gregory] What do we know then about how common it is in the United States?

[David Wagner] It's hard to say because, again, people aren't actively looking for it. But one of the things that we found in our study is that the *Burkholderia thailandensis* strains that we do know about from the United States are very diverse—that is, when you compare them, they have a lot of differences in their DNA. So that suggests that *Burkholderia thailandensis* has been in the United States for a long time and it has had a lot of time to persist in local locations, hence all the DNA differences among different isolates from different locations in the United States.

[Sarah Gregory] So it's pretty rare and apparently hard to get. So how do people get it?

[David Wagner] Yeah, good question. *Burkholderia thailandensis* is what we would call an opportunistic pathogen. It typically does not cause infections, but it can if given an opportunity. So it's notable that all four of the described human cases from the United States involved traumatic injuries occurring outside, and three of them involved the injured individuals also being exposed to environmental water once they were injured. So that's not a lot of cases overall, but the pattern is striking. So the working hypothesis is that injuries that are exposed to the environment (water and soil) allow *Burkholderia thailandensis* present in those environments to get into humans and cause opportunistic infections. We see a similar pattern in other places, like Thailand.

[Sarah Gregory] So it's not as bad as *pseudomallei*, but what are the signs and symptoms of *thailandensis* if someone actually does get it?

[David Wagner] It really depends on how the exposure occurs. If it occurs via an infected wound on, say, your arm or your leg, it will appear like a typical infected wound—swelling, for example. But if infected water was aspirated (taken into the lungs), then it can present as pneumonia and all of the symptoms that can go along or arise from that, such as fever. So it can really vary.

[Sarah Gregory] Has it ever been known to be deadly?

[David Wagner] Yeah, I looked into that pretty closely and I couldn't find any fatal cases that were associated with *Burkholderia thailandensis* infection on its own. So on its own, it does not appear to be deadly. But again, there has just been a few cases described and many of the people have other complications, such as injuries, as I mentioned.

[Sarah Gregory] What's the treatment for it?

[David Wagner] Yeah, treatment for *Burkholderia thailandensis* infections are the same as they would be for *Burkholderia pseudomallei*—we treat people with antibiotics. That said, *Burkholderia thailandensis*, like many other *Burkholderia* species as well as many other environmental bacteria, are naturally resistant to a number of antibiotics. But there are ones that work against it.

[Sarah Gregory] And since it's so rare and not readily known to people, how is it detected? Is there a certain test? I mean, how do you know when you have it?

[David Wagner] Yes, good question. It can be grown in a laboratory and then tested for its ability to perform certain metabolic reactions. In testing it, a number of these reactions produces a phenotypic fingerprint. Despite that, just one of those reactions separates *Burkholderia thailandensis* from *Burkholderia pseudomallei* in those tests. So *Burkholderia thailandensis* can also be detected via PCR, but PCR assays that are specific to that species would be rare in a clinical setting. But *Burkholderia pseudomallei*-specific PCR assays would be more common. And of course, if an isolate is obtained it can be whole genome sequenced, and that could be evaluated.

[Sarah Gregory] What happens if someone is diagnosed with *pseudomallei* but it's actually *thailandensis*? Does it matter? It doesn't seem like it does if it's the same antibiotics.

[David Wagner] Actually, it does matter. *Burkholderia pseudomallei* is a very serious pathogen and a potential bioterrorism threat, and it's also quite rare in the United States. So misdiagnosing someone in the United States with melioidosis is a big deal because that's going to trigger a lot of responses. So we need to get it right.

[Sarah Gregory] Ah, that's very interesting.

Where else in the United States has it been found previously?

[David Wagner] In our study, we found *Burkholderia thailandensis* in the environment in Texas, Mississippi, and Puerto Rico. It had previously been reported from humans in Louisiana, Texas, and Arkansas, and we report another human isolate from Oklahoma in our paper. But previous to this study, it had not been reported from the environment in the United States.

[Sarah Gregory] Was there a specific reason you chose Texas, Puerto Rico, and Mississippi to collect these samples from?

[David Wagner] Yes, because we were looking for *Burkholderia pseudomallei* in those places and found *Burkholderia thailandensis* in the process.

[Sarah Gregory] How did you conduct this study? What kinds of samples did you test?

[David Wagner] We collected and tested two main types of samples: soil and water. We also collected environmental scrapes from inside of a water tank at the residence of an individual in Texas that previously has melioidosis. Then we took them back to the laboratory and attempted to grow *Burkholderia* species from those samples.

[Sarah Gregory] And what did you find?

[David Wagner] We isolated *Burkholderia thailandensis* from one water sample in Texas, four water samples from Puerto Rico, and one soil sample from Mississippi.

[Sarah Gregory] Tell us about only finding *B. thailandensis* in water samples from Texas and Puerto Rico, but not in any soil samples?

[David Wagner] Yeah, that's interesting and a bit hard to explain. We collected soil from both Texas and Puerto Rico during their dry seasons, and we know that during dry periods *Burkholderia pseudomallei* is found further down in the soil, closer to the water table. So it's possible that *Burkholderia thailandensis* was present in the soil in Texas and Puerto Rico, but just deeper down. Our samples were only collected at 30 cm, so about one foot below the surface. And those were hard enough to get because the soil was really dry and hard to dig.

[Sarah Gregory] Other than that, were there any surprising findings?

[David Wagner] Yes. The large amount of genomic diversity we observed among the *Burkholderia thailandensis* strains isolated in the continental United States. That suggests that *Burkholderia thailandensis* has been present here in the continental United States for a long time. But in contrast, we found very little diversity among the multiple strains we obtained from Puerto Rico, which suggests a much more recent introduction there.

[Sarah Gregory] You touched on this a minute ago, but based on what you found, do you think *B. thailandensis* is more common in the Western Hemisphere than initially thought?

[David Wagner] Yes, definitely. It's just that no one is out there looking for it.

[Sarah Gregory] What's most important about your study? What are the public health implications?

[David Wagner] That *Burkholderia thailandensis* is present in the environment in the United States and perhaps widespread—that had not been previously demonstrated before our study. The public health implication is that physicians should take this into account when diagnosing what looks like a *Burkholderia pseudomallei* infection—it's important to make sure that it's not actually *Burkholderia thailandensis*. And that's especially important as the CDC recently documented for the first time that *Burkholderia pseudomallei* can naturally be found in the environment in the continental United States (they found it in soil in Mississippi). And my team and the CDC also have documented *Burkholderia pseudomallei* in the environment in Puerto Rico and the US Virgin Islands.

[Sarah Gregory] How can people protect themselves from getting this infection?

[David Wagner] Again, these infections are very rare, but not exposing injuries to soil and water and not aspirating natural water would be good. But of course, those are good ideas anyway, and not something anyone should be doing.

[Sarah Gregory] Tell us about your job now and how you became interested in studying *Burkholderia* species.

[David Wagner] I'm a Professor of Biological Sciences and the Associate Director of the Pathogen and Microbiome Institute at Northern Arizona University. My team and I conduct research on a variety of different diseases, including melioidosis, plague, tularemia, leptospirosis, and Rocky Mountain Spotted Fever, among others. I was originally trained as a wildlife biologist and, thus, I did a lot of fieldwork. And I switched to studying infectious diseases when all of my study animals (ground squirrels) started dying of plague. And after the anthrax letter attacks, the government became more interested in a number of different potential bioterrorism agents, including *Burkholderia pseudomallei*, so suddenly there was funding to study *Burkholderia pseudomallei*. And because it's an environmental organism, that appealed to me, so I went to Australia and Thailand and learned from the experts there how to sample for it in the environment. And since then, I've been working with the CDC Bacterial Special Pathogens Branch to look for it in the environment in the United States.

[Sarah Gregory] EID publishes about 40 articles a month and I do a podcast every week. All this makes me pretty nervous about diseases. Do you worry about diseases? Is there any particular monster under your bed?

[David Wagner] Well, COVID was a pretty big monster, and the next pandemic could be much worse. As terrible as COVID was and as many people that died, we sort of got lucky with it as it had a relatively low fatality rate. Future pandemics have the potential to be much worse, of course. That said, this is not something I worry about a lot. When people ask me that question, I typically tell them to wear their seatbelts, as not wearing one is a far higher risk than most infectious diseases. That and get your vaccinations. I get every vaccination that I can, because I think they are some of the greatest inventions humans have ever come up with.

[Sarah Gregory] Oh, me too. I do that too.

Thank you so much for taking the time to talk with me today, Dr. Wagner.

[David Wagner] It was my pleasure. Thank you for reaching out to me.

[Sarah Gregory] And thanks for joining me out there. You can read the March 2023 article, *Burkholderia thailandensis* Isolated from the Environment, United States, online at [cdc.gov/eid](https://www.cdc.gov/eid).

I'm Sarah Gregory for *Emerging Infectious Diseases*.

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