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# Melioidosis: Emerging beyond endemic areas

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**Abstract:** Recent cases suggest that melioidosis, an infection caused by *Burkholderia pseudomallei*, is an emerging infectious disease. Nurses have a key role in the care of patients with melioidosis. This article provides an overview of the epidemiology, clinical presentation, diagnosis, treatment, and prevention of melioidosis, and discusses unusual, non-travel-related cases of melioidosis.

**Keywords:** *Burkholderia pseudomallei*, endemic, infectious disease, melioidosis, tropical disease

Melioidosis, also known as Whitmore disease, is an infection in humans and animals caused by the Gram-negative bacterium *Burkholderia pseudomallei* (*B. pseudomallei*). It is endemic to many areas around the world, but in the US, it only occurs naturally in the Gulf coast region of southern Mississippi, Puerto Rico, and the US Virgin Islands.<sup>1-8</sup> Most melioidosis cases outside endemic areas have been linked to travel or immigration from endemic areas.<sup>2,5,7-10</sup>

Cases not associated with travel have been identified in areas outside endemic regions. Between March and August 2021, the CDC reported four cases of non-travel-associated melioidosis in four different US states.<sup>11,12</sup> The genomic analysis of the organisms in each case suggested unusual epidemiology such as a common source that had not yet been identified. The CDC alerted healthcare professionals of the situation via the Health Alert Network.<sup>11-14</sup> In October 2021, the

CDC confirmed an epidemiologic link to an imported product.<sup>15,16</sup> In July 2022, the CDC reported *B. pseudomallei* isolated from the soil and water in the Gulf Coast region of Mississippi and two cases of melioidosis associated with the same strain of *B. pseudomallei*.<sup>8</sup> This represents the first time that *B. pseudomallei* has been identified in the environment in the continental US. These cases, in addition to other recent reports in the literature, suggest that melioidosis is an emerging infectious disease.<sup>6,9,17-19</sup>

Nurses have a key role in the care of patients with melioidosis. This article provides an overview of the epidemiology, clinical presentation, diagnosis, treatment, and prevention of melioidosis, and discusses unusual, nontravel-related cases of melioidosis.

## What is melioidosis?

Melioidosis is an infectious disease in humans and animals caused by *B. pseudomallei*, a Gram-negative bacterium found in the soil and surface groundwater of endemic areas (see *Overview of melioidosis*).<sup>1-8</sup> The endemic areas encompass many tropical and subtropical regions. While most cases of melioidosis have been identified in Southeast Asia (Thailand, Malaysia, and Singapore) and

northern Australia, cases have also been reported in Central and South America, Africa, India, and the Caribbean.<sup>4-7</sup> As of 2022 melioidosis is now considered endemic to local areas of the Gulf Coast region of Mississippi in the continental US.<sup>1,8</sup>

## Transmission

Melioidosis is acquired via direct contact with contaminated soil and water.<sup>5,20</sup> This can occur through inhalation of contaminated dust or water droplets, ingestion of contaminated water or food, or other contact with contaminated soil or muddy water such as through skin breaks.<sup>8,20,21</sup> While person-to-person transmission is very rare, standard precautions are appropriate.<sup>12,15,20</sup>

## Epidemiology

In 1911, in Rangoon, Burma (present-day Yangon, Myanmar), Whitmore and Krishnaswami recognized melioidosis as a new disease caused by an organism different than the closely related organism *Burkholderia mallei* that caused glanders, an infectious disease in horses and occasionally humans.<sup>2,4,22</sup> In 1932, this new disease was named melioidosis from the Greek “melis” (distemper of asses) and “eidos” (resemblance).<sup>4</sup> Melioidosis has also been identified in ani-

mals such as sheep, goats, swine, horses, cats, dogs, and cattle, but zoonotic transmission to humans is rare.<sup>2,3,6,20</sup>

*B. pseudomallei* is a hardy organism and can survive in extreme environmental conditions.<sup>3,4,6,8</sup> The estimated global incidence of melioidosis is 165,000 cases and 89,000 deaths annually.<sup>2-7</sup> The incidence of reported cases is much lower, possibly due to inadequate lab facilities and lack of knowledge about the disease among clinicians.<sup>3,6,23</sup>

*B. pseudomallei* could be used as a bioweapon to threaten public health and safety.<sup>24-31</sup> It is naturally resistant to many commonly used antibiotics and can cause severe disease with high mortality in humans. Signs and symptoms are similar to those of influenza, tuberculosis, and community-acquired pneumonia.

## Risk factors

The major risk factors for acquiring melioidosis are living in or traveling to endemic areas and exposure to soil or water contaminated with *B. pseudomallei*.<sup>2-9,20</sup> Construction workers, agricultural workers such as rice farmers, adventure travelers, and military troops are examples of individuals whose contact with contaminated soil or water may increase their risk.<sup>2-7,20</sup>

## Overview of melioidosis<sup>1</sup>

Etiologic organism	Signs and symptoms	Acquisition & transmission	Geographic regions	Risk factors	Precautions	Treatment
<i>Burkholderia pseudomallei</i> - Gram-negative bacterium	The most common presentation is a respiratory infection, which often mimics infections such as tuberculosis or other pulmonary infections.  <i>B. pseudomallei</i> can cause localized wound infections or disseminated infection.	Acquired through inhalation or ingestion of soil particles or water droplets contaminated with <i>B. pseudomallei</i> .  Person-to-person transmission is rare.	Endemic in tropical and subtropical regions. In the US, this includes the Gulf coast region of Mississippi	Living or traveling in an endemic area  Severe weather events in endemic areas  Immunocompromise or underlying medical conditions	Measures to limit contact with contaminated soil and water in endemic areas  Standard precautions for all patient care	Antibiotic therapy: intensive short-term (2 to 8 weeks) followed by a 3 to 6 months course of antibiotics

Cases are predominantly reported in males, possibly due to occupations or involvement in outdoor activities, such as adventure travel or ecotourism, that expose them to interactions with contaminated soil.

Additional risk factors include underlying health disorders such as diabetes, liver disease, renal disease, thalassemia, cancer, or other immunocompromised conditions.<sup>3,5,6,8,12</sup> Severe weather conditions such as increased rainfall, monsoons, typhoons, hurricanes, and dust storms within endemic areas have been associated with subsequent increases in melioidosis cases.<sup>2,6,32-38</sup> Earthquake-induced tsunamis have resulted in an increased incidence of melioidosis in tropical endemic areas but not in nonendemic areas.<sup>39,40</sup> In a review of scientific articles following the 2004 Indian Ocean tsunami (an endemic area for melioidosis), 17% referred to aspiration pneumonia caused by *B. pseudomallei* as well as other reports of wounds complicated by *B. pseudomallei*.<sup>39</sup> These cases involved both residents of the area as well as tourists. There were no reports of melioidosis following the 2011 tsunami in Japan (a non-endemic area).<sup>39</sup>

Non-travel cases reported in non-endemic areas have been associated with reptiles (green iguanas) and freshwater tropical fish imported from endemic areas due to contact with contaminated transport water and tanks or cages.<sup>41-43</sup> Unprotected handling of or contact with lab specimens has resulted in melioidosis in some lab workers.<sup>9,10, 44</sup> In November 2021, the CDC confirmed that the four non-travel-associated US cases were linked to aromatherapy room spray manufactured in India.<sup>15,16,45,46</sup>

## Signs and symptoms

Melioidosis has been called the “Great Mimicker” because it can present in many forms, with a variety of signs and symptoms that resemble other infections such as tuberculosis

or other forms of pneumonia.<sup>3,10,47,48</sup> The incubation period can range from 1 day to many years, but the usual time between exposure and onset of signs and symptoms is 1 to 21 days with an average of 9 days.<sup>3,5-8</sup>

Melioidosis infection can be classified as acute, chronic, latent, or recurrent.<sup>3,6</sup> Eighty-five percent of melioidosis cases are acute infections that may present as a localized infection, pulmonary infection, bloodstream infection, or disseminated infection.<sup>6,47,48</sup> It may also present as a subclinical or asymptomatic infection.

Pulmonary infection is the most common presentation, ranging from mild bronchitis to severe pneumonia.<sup>48</sup> Fifty percent of melioidosis cases present as pneumonia.<sup>3,5,6</sup> High fever, headache, anorexia, cough, and myalgia are typical. The patient may have chest pain. Cavitory lesions like those of pulmonary tuberculosis may be seen on a chest X-ray.<sup>2,6,48</sup>

Localized infection may present as an ulcer, nodule, abscess, or swelling at the site of entry such as an open wound or skin break, along with fever and pain. The infection may remain localized or become disseminated.<sup>47,48</sup>

Bloodstream infection is more likely to occur in individuals with underlying diabetes and chronic kidney disease and may progress rapidly to septic shock.<sup>48</sup> Signs and symptoms may include fever, headache, respiratory distress, abdominal discomfort, joint pain, muscle tenderness, and cognitive changes. Abscesses may be seen throughout the body, especially in the liver, spleen, or prostate.<sup>2,3,6,48</sup>

Disseminated infection may present with multiple signs and symptoms such as fever, weight loss, abdominal or chest pain, myalgia, arthralgia, headache, central nervous system infection, and seizures. Disseminated melioidosis may be seen in acute or chronic cases and involve organs such as the liver, spleen, and prostate, as well as joints, bones, viscera, lymph nodes, skin, or brain. Disseminated

infection presenting with abscess formation in various organs may be associated with sepsis.<sup>2,3,6,48</sup>

Chronic melioidosis has been defined as a symptomatic infection that lasts longer than 2 months.<sup>3</sup> Latent infection, estimated to be less than 5% of cases, can occur when the initial infection is asymptomatic but the organism is not cleared from the body and activates at a later time to cause symptomatic disease.<sup>3</sup> The latent period has been reported to be from 19 to 29 years; however, it is unclear if this represents reactivation or prolonged incubation.<sup>6</sup>

Recurrent melioidosis is the new onset of signs and symptoms of infection with culture-proven *B. pseudomallei* after response to therapy.<sup>6</sup> Recurrent melioidosis can be either relapse of the primary infection (repeat *B. pseudomallei* culture results genetically match the primary infection) or reinfection (isolates do not share identical composition). Relapse of melioidosis has been reported in about 5% to 6% of cases.<sup>3,6</sup>

## Diagnosis

Melioidosis diagnosis is made by isolation of *B. pseudomallei* from cultures of blood, urine, sputum, skin lesions, or abscesses.<sup>3,8, 49</sup> Specimen collection may include blood cultures, a throat culture or rectal swab, urine, pus from abscesses, or sputum of those with pneumonia. Notify the lab and label specimens as “suspected *B. pseudomallei*” so that lab workers can follow appropriate precautions while handling the specimen.<sup>8,11-14,50</sup>

*B. pseudomallei* is a small Gram-negative bacilli that shows bipolar staining (“safety pin” appearance); however, this bipolar staining is not unique to *B. pseudomallei* therefore the Gram stain alone should not be used to make a presumptive diagnosis of melioidosis.<sup>6</sup>

*B. pseudomallei* can grow on most routine lab media but could be unrecognized, misidentified as other bacte-

ria such as *Pseudomonas* spp., or *Bacillus* spp., or dismissed as a contaminant.<sup>5,6,8,49-51</sup> Lab testing methods using automated algorithms may misidentify *B. pseudomallei* as another organism.<sup>8,15,50,51</sup> It is never considered normal human flora and should be considered as diagnostic for melioidosis if isolated from any clinical sample. The lab may need to hold the specimens for up to 4 days for the specimen to grow. It may be appropriate to repeat cultures if there is a strong clinical indication of melioidosis and initial negative cultures. Local or state public health departments can assist with confirmatory testing of suspected *B. pseudomallei* isolates.<sup>11-15</sup>

## Treatment

Early diagnosis of melioidosis with the initiation of appropriate antimicrobial therapy is critical to successful patient outcomes.<sup>3,4,8</sup> Treatment is in two phases: initial intensive therapy with I.V. antimicrobials followed by eradication therapy with oral antimicrobials.<sup>3,8,15,52,53</sup> Initial therapy is I.V. ceftazidime every 6 to 8 hours or meropenem every 8 hours, usually for a minimum of 2 weeks.<sup>4,6,8,44,52,53</sup> I.V. antimicrobial therapy may continue for up to 8 weeks depending on the severity of the infection in critically ill patients with extensive pulmonary disease, deep collections or abscesses,

osteomyelitis, septic arthritis, or neurologic melioidosis.<sup>3,5,52,54</sup> Oral antimicrobial therapy for 3 to 6 months continues after the I.V. therapy.<sup>3,6,8,52</sup> Oral antimicrobial agents are trimethoprim-sulfamethoxazole every 12 hours or amoxicillin/clavulanic acid (co-amoxiclav) every 8 hours.<sup>3,6,52</sup> The long course of oral antimicrobial therapy is recommended to eradicate the pathogen and prevent relapse or recurrence.<sup>3</sup>

## Prevention

Prevention in endemic areas can be enhanced by wearing shoes while outdoors as well as personal protective equipment (PPE) such as waterproof boots and gloves to protect against contact with soil and water. Skin lacerations, abrasions, or burns should be cleaned if contaminated with soil or surface water.<sup>5,6,8,55</sup> Protect open wounds from contact with soil or water by covering them with waterproof bandages; if open wounds come into contact with soil, wash thoroughly.<sup>8</sup> Stay inside during severe weather.<sup>6</sup> Wearing respiratory protection or PPE to decrease inhalation of contaminated dust during dust storms in endemic areas may also decrease risk.<sup>36</sup> Maintaining the safety of potable water in endemic areas may decrease the risk of infection via ingestion

of *B. pseudomallei*-contaminated water.<sup>20,56</sup> Do not drink water directly from shallow wells, lakes, rivers, ponds, and streams in endemic areas.<sup>8</sup> Lab workers should follow safety precautions for handling specimens suspected of having *B. pseudomallei*.<sup>8,11-15,31,50</sup> As of this writing, no vaccine is available to prevent melioidosis.<sup>3,6,10</sup>

## Nursing considerations

Nurses should be alert for patients presenting with signs and symptoms of melioidosis (see *Melioidosis resources*).<sup>8,47</sup> Ask about international and domestic travel to and from endemic areas since the Gulf coast region of Mississippi is now considered an endemic area.<sup>8</sup> Be alert for public health advisories notifying of unusual infections, as noted in the cases from the summer of 2021 and cases reported in 2022 of patients who had no international travel history or who may have had exposure to contaminated products.<sup>8,11-16,45</sup> Notify the health-care facility's Infection Prevention Department if melioidosis is suspected. An infectious-disease consult should be considered.

Provide nursing care as appropriate for the patient's clinical status. Use standard precautions to provide care to patients with suspected or confirmed melioidosis.<sup>20</sup> Standard precautions include wearing appropriate PPE for the task and care being provided.<sup>57</sup> These may include eye protection and a mask if irrigating a wound or performing aerosol-generating procedures such as suctioning the respiratory tract unless using in-line suction catheters, gloves and hand hygiene, and environmental cleaning and disinfection.<sup>31</sup> Use standard precautions to collect and handle lab specimens.

Notify the lab in advance and label all specimens as "suspected *B. pseudomallei*" so that the lab personnel is alerted to handle the specimens appropriately.<sup>8,11-15,50</sup>

## Melioidosis resources

- General information: [www.cdc.gov/melioidosis/index.html](http://www.cdc.gov/melioidosis/index.html); <https://www.emergency.cdc.gov/han/2022/han00470.asp>
- For healthcare professionals: [www.cdc.gov/melioidosis/health-care-workers/index.html](http://www.cdc.gov/melioidosis/health-care-workers/index.html)
- Treatment: [www.cdc.gov/melioidosis/treatment/index.html](http://www.cdc.gov/melioidosis/treatment/index.html)
- Prevention: [www.cdc.gov/melioidosis/prevention/index.html](http://www.cdc.gov/melioidosis/prevention/index.html); <https://www.emergency.cdc.gov/han/2022/han00470.asp>
- Melioidosis and travel: <https://travel.state.gov/content/travel/en/international-travel/before-you-go.html>; <https://wwwnc.cdc.gov/travel/yellowbook/2020/travel-related-infectious-diseases/melioidosis>; <https://www.emergency.cdc.gov/han/2022/han00470.asp>
- For patient/family education about antibiotics: [www.cdc.gov/antibiotic-use/about.html](http://www.cdc.gov/antibiotic-use/about.html)



Educate patients and their families about antibiotics that have been prescribed, including how to take them; the importance of completing the full course of therapy as prescribed; potential adverse reactions; and notifying the healthcare provider (HCP) immediately of signs or symptoms suggestive of allergic reaction or adverse reactions such as rash, nausea, diarrhea, or yeast infection.<sup>59</sup> Patients and their families should be encouraged to contact the HCP about any other related issues or concerns.

Report melioidosis cases to state and local health departments.<sup>8</sup> Public health staff will follow up with the circumstances of the case.<sup>30,45</sup> The lab should report the recovery of *B. pseudomallei* to the Federal Select Agent Program.<sup>10</sup>

Educate patients on planning international or domestic travel to an area where melioidosis is endemic to prevent or reduce their risk of exposure to *B. pseudomallei*.<sup>8</sup> The US Department of State provides country-specific travel information with tips for traveling abroad.<sup>58</sup>

## Conclusion

Melioidosis is an infectious disease that often occurs in endemic areas around the world, but cases reported in nonendemic areas have been linked to travel or exposure to imported animals or contaminated products. Its clinical presentation may mimic other infections making it difficult to identify or delay identification in nonendemic regions. Increased risk of exposure to *B. pseudomallei* may occur as a result of increasing global travel to endemic areas, increased incidence of severe weather in endemic areas, increasing numbers of people with underlying medical risk factors who also travel, and importation of exotic pets or contaminated products from endemic areas. Clinicians across the world should have a heightened awareness of melioidosis as an infec-

tion with emerging or expanding impact. In the US, an outbreak in 2021 related to an imported aromatherapy product contaminated with *B. pseudomallei* and the identification of *B. pseudomallei* in the soil and water of the Gulf Coast region of Mississippi in 2022 indicate that melioidosis can occur in the US, especially in people with risk factors. ■

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