



Naegleria fowleri Primary Amebic Meningoencephalitis (PAM) Brain-eating amoeba

Disease Fact Sheet

What are *Naegleria fowleri* and Primary Amebic Meningoencephalitis (PAM)?

Naegleria fowleri (commonly referred to as the "brain-eating amoeba"), is a warm-water-loving amoeba (single-celled organism) found around the world, often in warm or hot freshwater lakes, rivers and hot springs. *Naegleria fowleri* is normally found in the natural environment and is well adapted to surviving in various habitats, particularly warm-water environments up to 115 F. The amoeba becomes dormant in cold temperatures and can survive buried in the sediment of water bodies. There are no known ways to control the amount of natural *Naegleria fowleri* in lakes and rivers.

When water containing the *Naegleria fowleri* amoeba enters the nose, the amoeba can travel up the nose and into the brain. This causes the disease Primary Amebic Meningoencephalitis (PAM), which destroys brain tissue and causes brain swelling and death. *Naegleria fowleri* infections are very rare and usually fatal. Of 135 people infected in the United States since 1962, only 3 people survived.

Where and when do *Naegleria fowleri* infections occur?

In the U.S., most infections have come from freshwater lakes, rivers, and hot springs located in southern states. No cases of PAM have been identified in Wisconsin to date. Recently, however, people have become infected in Indiana (2012) and Minnesota (2010 and 2012) following periods of very warm temperatures. Recreational water-associated infections occur most often in July, August and September, when temperatures are high for prolonged periods, causing water temperatures to rise and water levels to decrease.

How are *Naegleria fowleri* infections spread?

People are infected when water containing the amoeba enters the body through the nose. Recreational water-associated infections most often occur when people go swimming or diving during the summer in warm freshwater places, like lakes and rivers. Sometimes infections occur after people put their heads under water in hot springs. Infection has also occurred when people use contaminated drinking water to cleanse their nasal passages during religious practices, use a neti pot or other device to rinse their sinuses through the nose, or get the contaminated water up their nose during recreational play.

You cannot get *Naegleria fowleri* infection from drinking contaminated water, and the infection cannot be spread from one person to another.

Who gets *Naegleria fowleri* infections and PAM?

Naegleria fowleri infections are more common in young boys and after use of warm freshwater lakes, rivers and hot springs. While the reasons are unclear, young boys might participate in more water activities like diving and playing in the sediment at the bottom of lakes and rivers. These types of activities increase the chances of getting water up the nose and stirring up amoebae from the bottom.

What are the symptoms of PAM? How soon do symptoms occur?

Symptoms can be mild at first, but they worsen quickly. Symptoms usually start about 5 days after infection (range 1–9 days) and can include headache, fever, nausea or vomiting. Later symptoms can include stiff neck, confusion, lack of attention to people and surroundings, loss of balance, seizures and hallucinations. After symptoms start, the disease usually causes death within about 5 days (range 1–12 days).

How is PAM diagnosed?

PAM is a serious infection. The disease is diagnosed using specific laboratory tests available in only a few laboratories in the United States. Because of the rarity of the infection and the difficulty in initial detection, about 75 percent of diagnoses are made after the patient's death. Diagnosis is made by detecting evidence of the amoeba or the amoeba itself in cerebrospinal fluid, biopsy or tissue specimens.

What is the treatment for PAM?

Recently an investigational drug called miltefosine has shown some promise in the treatment of PAM when cases are diagnosed early. The U.S. Centers for Disease Control and Prevention (CDC) now has a supply of this drug available to physicians for the treatment of *Naegleria fowleri* infection.

What precautions can be taken to prevent getting *Naegleria fowleri* infections and PAM?

When swimming:

People should assume there is always a low level of risk of *Naegleria fowleri* infection whenever they enter warm freshwater lakes, rivers and hot springs, especially in southern-tier states. The only certain way to prevent an infection when swimming is to avoid water-related activities in warm freshwater lakes and rivers.

- If you choose to swim, limit the amount of water going up the nose and avoid water where *Naegleria fowleri* might live.
- Hold your nose shut, use nose clips or keep your head above water when taking part in water-related activities in warm freshwater bodies, including warm water discharged from industrial plants.
- Avoid putting your head under water in hot springs and other untreated geothermal waters.
- Avoid water-related activities in warm freshwater lakes and rivers during periods of high water temperatures and low water levels.
- Avoid digging in, or stirring up, the sediment while taking part in water-related activities in shallow, warm freshwater areas.
- Keep backyard swimming pools well maintained with adequate chlorine levels. In clear water, chlorine at standard concentrations (1 ppm) will kill the ameba in about an hour.

When rinsing sinuses, including with neti pots:

When making a solution for irrigating, flushing or rinsing your sinuses (for example, when using a neti pot, sinus rinse bottle, or other irrigation device, or performing ritual nasal rinsing), use safe water to protect yourself. Take **at least one** of these actions to lower your risk of becoming infected:

- **Buy distilled or sterile water:** Use water with a label specifying it contains distilled or sterile water.
- **Boil the water:** Use water that has been previously boiled for 1 minute and left to cool. At elevations above 6,500 feet, boil for 3 minutes.
- **Filter the water:** Use a filter designed to remove some water-loving germs. The label should read “NSF 53” or “NSF 58.” Filter labels that read “absolute pore size of 1 micron or smaller” are also effective.
- Rinse the irrigation device after each use with safe water, and leave the device open to air dry completely.