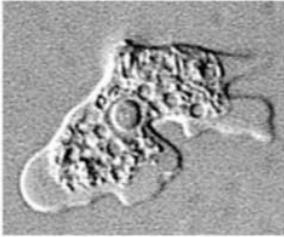


Brain-Eating Ameba (Naegleria)

What is Naegleria, the brain eating ameba?

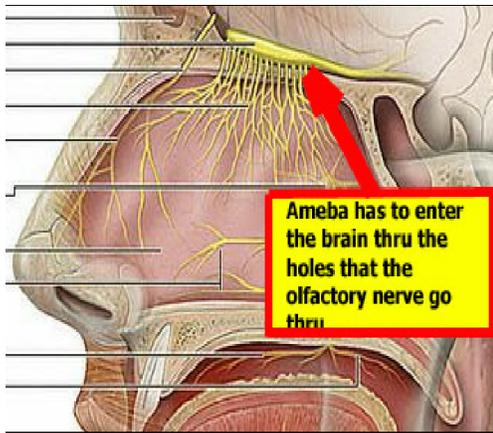
Naegleria fowleri is an ameba (a one-celled organism) commonly found in bodies of freshwater (lakes, rivers, hot springs) and soil. It is also found in the soil near warm-water discharges of industrial plants, and in unchlorinated or minimally-chlorinated swimming pools.



Naegleria lives freely in nature. It feeds on bacteria found in the sediment in lakes and rivers. It is found throughout the world.

It can be seen in either an amoeboid (picture under the microscope shown here) or temporary flagellate (with a tail-like extension).

How do you get infected?



You get infected when contaminated water goes up into your nose. Between the ceiling of your nose and the floor of the skull, there are many small holes. It is through these small holes that the olfactory nerve (nerve

that carries the smell /odors) goes through to the brain. The water that carries the amebas has to be pushed with some force to these small holes to cause the infection.

This happens when you dive in a lake, a river or if water is pushed up your nose, for example if going on a water slide.

Can you get infected in a swimming pool?

No if the swimming pool is properly maintained and disinfected with chlorine.

Can you get infected when drinking contaminated water?

No. Water does not go up to the ceiling of the nose when drinking. Even if you laugh when drinking water, amebas could not make their way to the brain.

How common are *Naegleria fowleri* infections in the United States?

Naegleria fowleri infections are rare. In the 10 years from 2006 to 2015, 37 infections were reported in the U.S. Of those cases,

33 people were infected by contaminated recreational water, three people were infected after performing nasal irrigation using contaminated tap water, and one person was infected by contaminated tap water used on a backyard slip-n-slide.

When do *Naegleria fowleri* infections most commonly occur?

While infections with *Naegleria fowleri* are rare, they occur mainly during the summer months of July, August, and September. Infections are more likely to occur in southern states, but can also occur in other more northern states. Infections usually occur when it is hot for prolonged periods of time, which results in higher water temperatures and lower water levels.

Can infection be spread from one person to another?

No. *Naegleria fowleri* infection cannot be spread from one person to another.

What are the symptoms of *Naegleria fowleri* infection?

Naegleria fowleri causes the disease primary amebic meningoencephalitis (PAM), a brain infection that leads to the destruction of brain tissue. In its early stages, symptoms of PAM may be similar to symptoms of bacterial meningitis.

Initial symptoms of PAM start in about five days (range 1 to 7 days) after infection. The initial symptoms may 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 the start of symptoms, the disease progresses rapidly and usually causes death within about five days (range 1 to 12 days).

What is the actual mechanism of death from *Naegleria fowleri* infection?

The infection destroys brain tissue causing brain swelling and death.

What is the fatality rate for an infected person who begins to show signs and symptoms?

The fatality rate is over 97%. Only three people out of 138 known infected individuals in the United States from 1962 to 2015 have survived.

Is there effective treatment for infection with *Naegleria fowleri*?

It is not clear. Several drugs are effective against *Naegleria fowleri* in the laboratory. However, their effectiveness is unclear since almost all infections have been fatal, even when people were treated with similar drug combinations. Recently, two people with *Naegleria* infection survived after being treated with a

new drug called miltefosine that was given along with other drugs and aggressive management of brain swelling.

What should I do if I have been swimming or playing in freshwater and now think I have symptoms associated with *Naegleria fowleri*?

Infection with *Naegleria fowleri* is rare. The early symptoms of *Naegleria fowleri* infection are similar to those caused by other more common illnesses, such as bacterial meningitis. People should seek medical care immediately whenever they develop a sudden onset of fever, headache, stiff neck, and vomiting, particularly if they have been in warm freshwater recently.

How common is *Naegleria fowleri* in the environment?

Naegleria fowleri is commonly found in lakes in southern states during the summer but more recently has caused infections in northern states. This means that recreational water users should be aware that there will always be a low level risk of infection when entering these waters. In very rare instances, *Naegleria* has been identified in water from other sources such as inadequately chlorinated swimming pool water or heated and contaminated tap water. *Naegleria fowleri* grows best at higher temperatures up to 115°F (46°C) and can survive for short periods at higher temperatures.

Is there a routine and rapid test for *Naegleria fowleri* in the water?

No. It can take weeks to identify the amoeba, but new detection tests are under development. Previous water testing has shown that *Naegleria fowleri* is commonly found in freshwater venues. Therefore, recreational water users should assume that there is a low level of risk when entering all warm freshwater, particularly in southern states.

How does the risk of *Naegleria fowleri* infection compare with other water-related risks?

The risk of *Naegleria fowleri* infection is very low. There have been 37 reported infections in the U.S. in the 10 years from 2006 to 2015, despite millions of recreational water exposures each year. By comparison, in the ten years from 2001 to 2010, there were more than 34,000 drowning deaths in the U.S.

What swimming behaviors have been associated with *Naegleria fowleri* infection?

Behaviors associated with the infection include diving or jumping into the water, submerging the head under water or engaging in other water-related activities that can cause water to go up the nose.

How will the public know if a lake or other water body has *Naegleria fowleri*?

Recreational water users should assume that *Naegleria fowleri* is present in warm freshwater across the United States. Posting signs based on finding *Naegleria fowleri* in the water is unlikely to be an effective way to prevent infections. This is because:

- *Naegleria fowleri* occurrence is common, infections are rare.

- The relationship between finding *Naegleria fowleri* in the water and the occurrence of infections is unclear.
- The location and number of amoebae in the water can vary over time within the same lake or river.

There are no rapid, standardized testing methods to detect and quantify *Naegleria fowleri* in water.

Posting signs might create a misconception that bodies of water without signs or non-posted areas within a posted water body are *Naegleria fowleri*- free.

How can I reduce the risk of infection with *Naegleria fowleri*?

Naegleria fowleri infects people when water containing the amoeba enters the body through the nose. Infection is rare and typically occurs when people go swimming or diving in warm freshwater places, like lakes and rivers. Very rarely, infections have been reported when people submerge their heads or get water up their nose, cleanse their noses during religious practices, or irrigate their sinuses (nose) using contaminated tap or faucet water. *Naegleria fowleri* can grow in pipes, hot water heaters, and water systems, including treated public drinking water systems.

Personal actions to reduce the risk of *Naegleria fowleri* infection should focus on limiting the amount of water going up the nose and lowering the chances that *Naegleria fowleri* may be in the water.