

Primary Amebic Meningoencephalitis (PAM)

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Naegleria is an amoeba commonly found in the environment worldwide. Most commonly, the amoeba is found in warm bodies of fresh water, (such as lakes, rivers, and hot springs), warm water discharge from industrial plants, under-chlorinated swimming pools, and soil. Only one species of *Naegleria* has been found to infect humans. Although *Naegleria* is commonly found in the environment, infection occurs rarely. However, this disease has public health importance because of its high fatality rate. From 1998 to 2007, 33 infections were reported in the U.S., all but one died. *Naegleria* infection cannot be spread from person to person contact and will not occur as a result of drinking contaminated water.

Infection with *Naegleria* is most common during the summer months of July, August, and September. They usually occur when it is hot for prolonged periods causing higher water temperatures and lower water levels. Infections can increase during heat wave years. In the United States, it has caused infections in 16 states (AR, AZ, CA, FL, GA, LA, MO, MN, MS, NC, NM, NV, OK, SC, TX, and VA).

Infection with *Naegleria* occurs when the amoeba enters the body through the nose. Generally, this occurs when people use warm freshwater for activities like swimming or diving. The amoeba travels up the nose to the brain and spinal cord where it destroys the brain tissue causing the disease primary amebic meningoencephalitis (PAM).

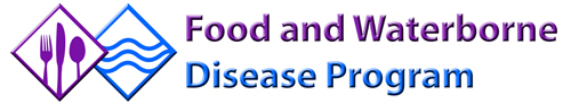
The initial symptoms of PAM start 1 to 14 days after infection. Initial signs and symptoms of PAM include headache, fever, nausea, vomiting, and stiff neck. As the amoeba causes more extensive destruction of brain tissue this leads to confusion, lack of attention to people and surroundings, loss of balance and bodily control, seizures, and hallucinations. The disease progresses rapidly and infection usually results in death within 3 to 7 days.

Several drugs are effective against *Naegleria* in the laboratory. However, a variety of treatments have been used to treat infected persons, although their effectiveness is unclear since most infections have still been fatal. Prompt diagnosis and treatment may help.¹

According to the Centers for Disease Control and Prevention (CDC), the only known way to prevent *Naegleria* infections is to refrain from water-related activities. However, some measures that might reduce risk by limiting the chance of contaminated water going up the nose include:

- Avoid water-related activities in bodies of warm freshwater, hot springs, and thermally-polluted water such as water around power plants.
- Avoid water-related activities in warm freshwater during periods of high water temperature and low water levels.
- Hold the nose shut or use nose clips when taking part in water-related activities in bodies of warm freshwater such as lakes, rivers, or hot springs.
- Avoid digging in or stirring up the sediment while taking part in water-related activities in shallow, warm freshwater areas.

¹ CDC, Division of Parasitic Diseases – *Naegleria* Infection Fact Sheet
http://www.cdc.gov/ncidod/dpd/parasites/naegleria/factsht_naegleria.htm



For further information on protecting yourself from recreational water illnesses, go to <http://www.cdc.gov/healthyswimming>.

Prior to 2008, primary amebic meningoencephalitis was not a reportable disease in Florida. However, 32 cases have been documented from 1962 through 2009. Of the 32 cases, 21 were from Central Florida. In 2009, 3 cases were reported from Madison, Orange and Polk counties. In 2008, no PAM cases were reported. In 2007, 3 were reported in Orange County. The other cases were from the following counties: Baker, Brevard, Broward, Citrus, Lee, Miami-Dade, Orange, Pasco, Pinellas, Polk, Putnam, Seminole and 3 unknown counties. All cases died from the disease.

Editorial Note: Recreational water users should assume that there is always a low level of risk associated with entering all warm fresh water in southern tier states. Because the location and number of ameba in the water can vary a lot over time, posting signs is unlikely to be an effective way to prevent infections. In addition, posting signs on only some fresh water bodies might create a misconception that bodies of water that are not posted are *Naegleria*-free.

Information about the risks associated with *Naegleria* infection should be included in public health messages discussing general issues of recreational water safety and risk.

For additional information on outbreaks involving PAM, go to <http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5512a1.htm>
<http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5108a1.htm>
<http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5308a1.htm>
<http://www.cdc.gov/mmwr/preview/mmwrhtml/ss4904a1.htm>
<http://www.cdc.gov/mmwr/preview/mmwrhtml/00055820.htm>

Other Resource Articles:

- 1 Wellings, F. M., et al. (1977). Isolation and Identification of Pathogenic *Naegleria* from Florida Lakes: Applied and Environmental Microbiology, Dec. 1977, Vol. 34, No. 6, p. 661-667. American Society for Microbiology
- 2 Craun, G. F., et al, (2005). Outbreaks associated with recreational water in the United States: International Journal of Environmental Health Research, August 2005; 15(4): 243-262
- 3 Rose, J. B., et al, (2001). Climate Variability and Change in the United States: Potential Impacts on Water and Foodborne Diseases Caused by Microbiological Agents: Environmental Health Perspectives, May 2001; 109(suppl 2); 211-220
- 4 Cabanes, P. A., et al, (2001). Assessing the Risk of primary Amoebic Meningoencephalitis from Swimming in the Presence of Environmental *Naegleria fowleri*: Applied and Environmental Microbiology, July 2001, Vol. 67, No. 7, p. 2927-2931. American Society for Microbiology
- 5 Chang, Shih-Lu, (1978). Resistance of Pathogenic *Naegleria* to Some Common Physical and Chemical Agents: Applied and Environmental Microbiology, (1978), Vol. 35, No. 2, p., 368-375. American Society for Microbiology
- 6 Grate, Isaac Jr., MD (2006). Primary amebic meningoencephalitis: a silent killer: Can J Emerg Med 2006; 8(5):365-9. JCMU