

## Naegleria fowleri

*Naegleria is an amoeba commonly found in warm freshwater and soil. Only one type (Naegleria fowleri) infects humans. Infections are very rare but are often fatal. Infection may occur when contaminated water goes up into the nose. Naegleria cannot survive in water that is clean, cool and adequately chlorinated.*

Last updated: 05 April 2017

### What is Naegleria fowleri?

*Naegleria fowleri* is an amoeba (a microscopic free-living single-celled organism) commonly found in warm freshwater and soil. There are over 20 species of *Naegleria* but *Naegleria fowleri* is the only type that infects humans.

The organism was first identified in South Australia during the 1960s. A number of cases of infection occurred in towns there served by unchlorinated water delivered through long above-ground pipelines. There have been no cases in South Australia since 1981, following chloramination of the water supply (a water treatment that ensures good residual levels of chlorine) and a public education campaign.

### How do you get infected with Naegleria fowleri?

*Naegleria fowleri* infects people by entering the body when water containing the amoeba goes up the nose. This may occur when people swim, dive or fall into warm unchlorinated water containing *Naegleria*, or when children play under sprinklers or with hoses using this water, or when infected water is inhaled to cleanse nasal passages. The amoebae travel up the nose to the brain where they infect and destroy brain tissue (called meningoencephalitis).

If water contaminated with *Naegleria fowleri* does go up the nose the chance of contracting infection is still extremely small. Children and young adults appear to be more susceptible to infection than older adults.

*Naegleria fowleri* infection cannot be spread from one person to another.

Infections do not occur as a result of drinking water contaminated with *Naegleria fowleri*. *Naegleria fowleri* does not occur in sea water. You cannot get *Naegleria fowleri* from a properly cleaned, maintained and chlorinated swimming pool.

### What are the symptoms of Naegleria fowleri infection?

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

Initial symptoms of PAM start about 5 days (range 1 to 9 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 5 days.

## How is it treated?

Several medicines 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 medicine combinations.

## Where is *Naegleria fowleri* found?

*Naegleria fowleri* is found around the world. It is a heat-loving (thermophilic) organism that grows best in warm water, especially between 25°C and 46°C. Any water body that seasonally exceeds 30°C or continually exceeds 25°C can support the growth of *Naegleria fowleri*.

*Naegleria fowleri* can potentially occur in any body of warm fresh water. This can include:

- lakes, rivers and dams
- bores, tanks and pipelines
- other natural hot waters such as hot springs
- swimming pools that are poorly maintained, under-chlorinated or unchlorinated

*Naegleria* can also be found in soil; however water is the only known source of human infection.

## Is there a simple way to test for *Naegleria fowleri* in water?

No. Identification of *Naegleria fowleri* in water requires specialised testing. It should be assumed that any warm body of fresh water as described above could contain *Naegleria fowleri*.

## When do *Naegleria fowleri* infections most commonly occur?

While infections with *Naegleria fowleri* are very rare, they occur mainly during the summer months. Infections usually occur when it is hot for prolonged periods of time, which results in higher water temperatures.

## How common are *Naegleria fowleri* infections?

Although *Naegleria fowleri* can be commonly found in the environment, infection is rare. Rare cases of *Naegleria* meningoencephalitis have been recorded in South Australia, Western Australia, Queensland and New South Wales, and in many countries throughout the world. Recent cases in Australia have been associated with exposure to untreated private water supplies (bore water and a farm dam).

In the USA, most cases report having had contact through recreational water activities (such as swimming, diving, or water skiing). It is estimated that the risk from recreational water activities in potentially contaminated untreated water in the USA is five cases of *Naegleria fowleri* infection for every billion episodes of recreational water activity.

## Does chlorine control *Naegleria*?

*Naegleria fowleri* cannot survive in water that is clean, cool and adequately chlorinated.

The primary disinfection must achieve a free chlorine concentration and contact time of greater than 30 mg/L.minute (before people contact the water). Free chlorine or chloramine residuals at 0.5mg/L or

higher will then control *Naegleria fowleri*, provided that the disinfectant persists through the water supply system.

## How is it prevented?

To prevent infection:

- avoid jumping or diving into bodies of warm fresh water or thermal pools
- keep your head above water in spas, thermal pools and warm fresh water bodies
- empty and clean small collapsible wading pools and let them dry in the sun after each use
- ensure swimming pools and spas are adequately chlorinated and well maintained
- flush stagnant water from hoses before allowing children to play with hoses or sprinklers
- if you are using unchlorinated water:
  - don't allow water to go up your nose when bathing, showering or washing your face
  - supervise children playing with hoses or sprinklers and teach them to not squirt water up their nose
- potentially contaminated water should not be used for any form of nasal irrigation or nasal lavage including Neti (an Ayurvedic practice of nasal cleansing).

## What about private bores and dams?

*Naegleria fowleri* has been identified where bore water is rested in above-ground dams then piped over distances in above-ground pipes to private homes. The presence of *Naegleria fowleri* will vary with ambient temperature, the distance water is piped, and the length of time the water is at temperatures favourable to the amoeba while in storage and pipework. This length of time may be related to the rate of water use.

In such circumstances, measures to prevent infection should be observed. Seek specialist advice regarding the benefits of water treatment processes (e.g. filtration and chlorination or chloramination).

Water from a dam, river, lake or bore can be contaminated with a range of micro-organisms, chemicals or algal blooms. It is not recommended that this water be used for drinking or cooking without appropriate treatment.

## What about home rainwater tanks?

Using water from home rainwater tanks has not been linked to infections with *Naegleria fowleri*. Still, it is a good idea to take the same precautions when using water from rainwater tanks as for other sources of unchlorinated water, including not allowing water to go up the nose when bathing, showering or face washing, and supervising children when they use this water.

For more information on the safe use of rainwater tanks see the NSW Health [Rainwater tank brochure](#) and [related information](#).

## What is the public health response?

*Naegleria fowleri* infection is not a notifiable disease and is believed to be extremely rare. Public health units may be contacted for advice on reducing the risk of infection, along with your local council and water supplier.

To contact your local public health unit call **1300 066 055**.

## Further information and references

- US Centers for Disease Control and Prevention (CDC). *Naegleria fowleri* — Primary Amebic Meningoencephalitis (PAM) — Amebic Encephalitis information. Available at: <https://www.cdc.gov/parasites/naegleria/index.html>
- The National Health and Medical Research Council. Australian Drinking Water Guidelines 2011. Available at: <https://www.nhmrc.gov.au/guidelines-publications/eh52>
- Water Research Australia, Fact Sheet - *Naegleria fowleri*. August 2016. Available at: <http://www.waterra.com.au/publications/document-search/?download=1268>
- Fowler M, Carter RF. Acute pyogenic meningitis probably due to *Acanthamoeba* sp.: a preliminary report. *Br Med J*. 1965 Sep 25; 2 (5464): 740-2. The initial report from the South Australian outbreak. Accessed at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1846173/>
- Nicholls CL, Parsonson F, Gray LEK et al. Primary amoebic meningoencephalitis in North Queensland: the paediatric experience. *Med J Aust* 2016; 205 (7): 325-8. DOI:10.5694/mja15.01223.
- NSW Health Rainwater tank brochure [http://www.health.nsw.gov.au/environment/water/Documents/rainwater\\_tanks.pdf](http://www.health.nsw.gov.au/environment/water/Documents/rainwater_tanks.pdf)
- NSW Health Rainwater tank resources <http://www.health.nsw.gov.au/environment/water/Pages/rainwater.aspx>