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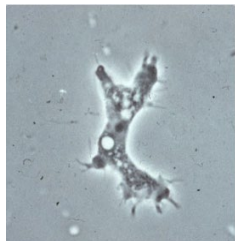
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Infection Caused by Free Living Amebae

Amebae are single-celled eukaryotic organisms that move and obtain food by altering their shape by extending and retracting pseudopods or ‘false feet.’ *Entamoeba histolytica* is a well-known human intestinal parasite that causes amoebiasis, and, occasionally, liver abscess in tropical regions where there is poor sanitation. Unlike *E. histolytica*, which is an obligate human parasite and relies on infection of a human to complete its life cycle, ‘free-living’ amebae are just that – they are able to grow and replicate all on their own. Three strains of free-living amoeba, *Acanthamoeba*, *Balamuthia* and *Naegleria*, cause the majority of human disease.

Acanthamoeba spp.



Acanthamoeba can be found worldwide in soil and water (freshwater, saltwater, swimming pools and tap water.) Infection can result in three major disease syndromes.

Acanthamoeba keratitis is an infection of the cornea of the eye. The disease, which can be difficult to diagnose and treat, may lead permanent impairment of vision or even blindness. The majority of people who develop *Acanthamoeba* keratitis are contact lens wearers; improper storage, handling and wearing of lenses are risk factors. For example, failing to properly disinfect lenses, using tap water on lenses, and showering, swimming or hot tubbing while wearing contact lenses all increase the risk of infection. The Centers for Disease Control and Prevention (CDC) publishes a webpage called “[Healthy Contact Lens Wear and Care](#)” which outlines specific practices to prevent *Acanthamoeba* keratitis and other eye infections in contact lens wearers. Early diagnosis and treatment is essential to prevent vision damage. Eye specialists usually diagnose the infection based upon clinical picture along with isolation of the organism from corneal culture or detection of the organism on histopathology.

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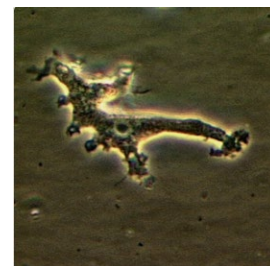
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Granulomatous amebic encephalitis (GAE) and Disseminated infection with *Acanthamoeba* primarily affect those with compromised immune systems. For either encephalitis or disseminated infection, amebae probably enter the body through the skin or the lungs and spread through the bloodstream. Signs of GAE include mental status changes, loss of coordination, fever, muscular weakness, partial unilateral paralysis, double vision and photophobia. Signs of disseminated infection include reddish nodules, skin ulcers or abscesses and inflammation of the lungs or sinuses.

GAE and disseminated infection are more difficult to diagnose than keratitis and are often at advanced stages when they are diagnosed. Biopsy of sites involved, such as skin and sinuses can be useful in diagnosis, however, most disseminated infections are fatal.

Balamuthia mandrillaris

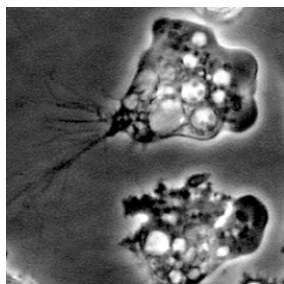
Balamuthia mandrillaris was first discovered in 1986 in the brain of a mandrill baboon that had died (hence, the name). It can be found in dust and soil throughout the world and may also live in water. Identified infections are rare (about 200 cases have ever been identified worldwide) and the incubation period may be long (weeks to months) so exactly how people are exposed is not always clear. The current theory is that people are likely infected when damaged skin comes into contact with *Balamuthia*-containing dust particles or when a person inhales *Balamuthia*-containing dust or soil. Diagnosis is difficult and often happens after death.



Balamuthia can cause infections of the skin, sinuses, brain or other organs. It can begin with a non-healing skin lesion and then progress to GAE. More than 89 percent of cases are fatal, however early identification of the disease and treatment increase survival. Both immunocompromised and immunocompetent people are at risk for infection and progression to GAE. Fatal infections have occurred in previously healthy children.

Two cases of *Balamuthia mandrillaris* infection have been reported in Washington State residents. In 2013, a patient developed a facial lesion. In 2017, a patient developed a cutaneous lesion on the nose which progressed to fatal encephalitis. Both reported frequent gardening, while the 2017 case also used tap water in a neti pot for nasal irrigation.

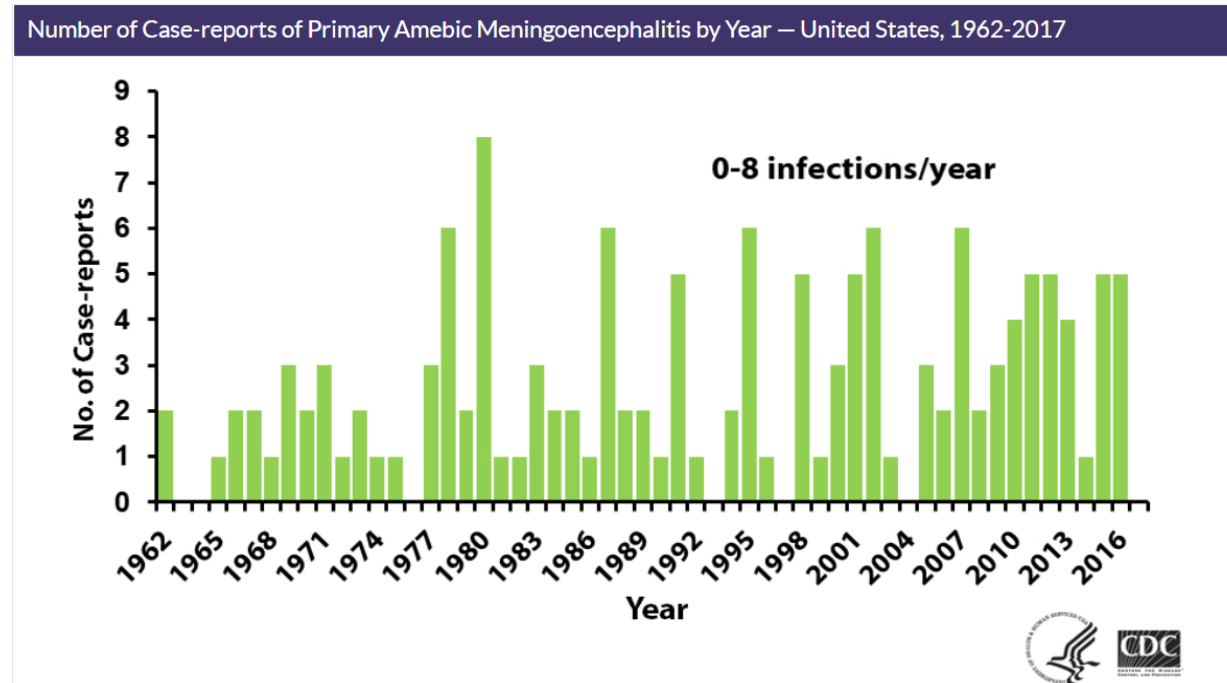
Naegleria fowleri



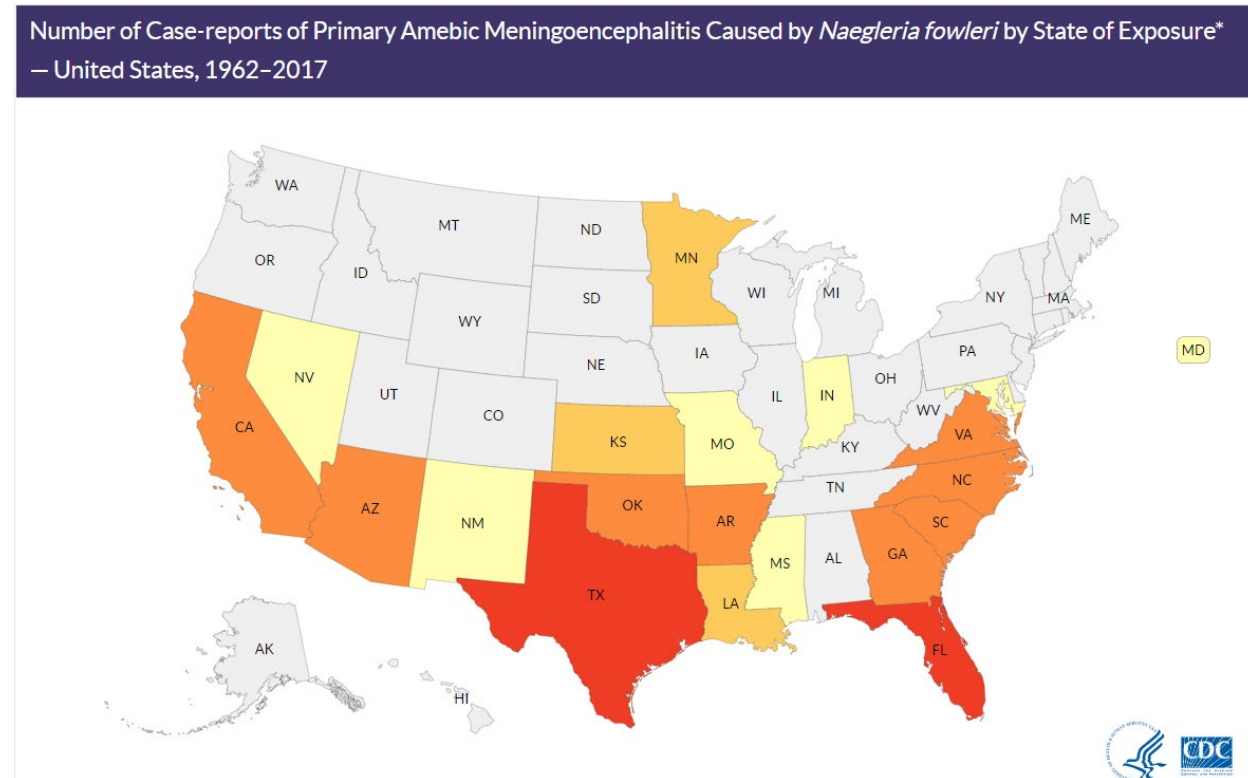
Naegleria fowleri is found throughout the world in warm fresh water such as lakes, rivers and hot springs. Infection with *Naegleria fowleri* causes primary meningoencephalitis (PAM), which is almost universally fatal. *Naegleria fowleri* is often referred to in the media as the ‘brain-eating ameba.’ Symptoms begin one to nine days after exposure and are similar to those of bacterial meningitis, including headache, fever, nausea and vomiting followed by stiff neck, photophobia, seizures and cranial nerve abnormalities. In contrast to GAE, it is a rapidly progressing illness

which usually leads to coma and death within weeks. This short incubation period and rapid progression makes pinpointing likely exposure sources much easier for *Naegleria* than the other types of ameba, which can have an exposure period stretching from months to years.

Naegleria fowleri is thermophilic (tolerates heat) and can grow at temperatures up to 115° F. Risks for exposure include fresh water recreation such as playing, swimming, diving or using a backyard plastic water slide. Nasal rinsing and using a neti pot are also risk factors. Zero to eight cases are reported each year in the United States.



In this country, case patients with primary meningoencephalitis are more likely to live in the southern United States, though cases have been reported as far north as Minnesota.



Naegleria fowleri has been detected in disinfected public drinking water systems in Australia, Pakistan and Louisiana as well as untreated geothermal well-supplied drinking water in Arizona.

Only five people are known to have survived PAM infection in North America. Because the illness progresses so quickly, early suspicion and diagnosis are key. The amoebae can be visualized as rapidly moving organisms on a cerebrospinal fluid (CSF) specimen and can be confirmed by antigen detection or PCR in CSF, biopsy or tissue. Miltefosine (trade name Impavido), a leishmaniasis drug, shows some promise for treatment. Currently approximately 75 percent of patient are diagnosed post-mortem.

Reporting of illness

In Washington State, granulomatous amoebic encephalitis, primary amoebic meningitis and disseminated infection due to *Acanthamoeba* or *Balamuthia* should be reported to the local health jurisdiction (LHJ) as a 'rare diseases of public health significance'. Individual cases of *Acanthamoeba* keratitis are not reportable, though clusters of cases should be reported.

Local health jurisdictions can assist clinicians who want to send specimens through Washington State Public Health Laboratories to the CDC Free-Living Ameba Laboratory. Results are always sent to the state of patient residence which will be forwarded to the local health jurisdiction. However, be aware that some clinical laboratories have begun to offer testing and may not always share the results with public health authorities.

Resources

- Centers for Disease Control and Prevention. [Acanthamoeba Infection](#)
- Centers for Disease Control and Prevention. [Balamuthia mandrillaris - Granulomatous Amebic Encephalitis \(GAE\)](#)
- Centers for Disease Control and Prevention. [Naegleria fowleri Infection](#)