

# NAEGLERIA FOWLERI: UNDERSTANDING AND MITIGATING A RARE AMOEBIC DANGER

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## ABSTRACT

*Naegleria fowleri*, belonging to Percolozoa phylum (thermophilic), is an ameboflagellate and eukaryotic, free-living amoeba that is responsible for affecting the nervous system and brain-causing primary amoebic meningoencephalitis (PAM), and sub-acute or chronic granulomatous amoebic encephalitis two severe waterborne diseases. This amoeba, belonging to the unique genera of free-living amoebae (FLA), can lead to opportunistic or non-opportunistic infections in humans, affecting the brain, skin, or cornea. *N. fowleri* is commonly found in lukewarm environments such as lakes, streams, spas, pools, domestic water reservoirs, heating and air conditioning units, and water supplies. It can lead to death within a 10-day cycle. This amoeba doesn't form a cyst inside the body. While water is the primary transmission route for PAM, there's also a potential alternative route through dust.

### Introduction:

*Naegleria (N.) fowleri* has created a remarkable presence in the news over the last 5 years due to several high-profile cases as well as in the general public. *N. fowleri* is a thermophilic flagellate, eukaryotic, free-living amoeba belonging to the phylum Protozoa. *Naegleria* has about 20 strains while only *N. fowleri* causes disease in humans and animals. *Naegleria* is the unique genera of free-living amoeba (FLA). The first reported PAM infection was filed in 1965 in Australia. The causative agent at that time was unknown, later on, the first report was published in 1966 and it was named *N. fowleri*. Only 4 cases out of 157 have survived from 1962 to 2022.

### *Naegleria fowleri* in Pakistan

In Pakistan, it is an emerging problem in Karachi although some cases also have been reported in other cities. The first case of primary amoebic meningoencephalitis (PAM) was reported in 2008 and by the end of October 2019, the case toll had reached 146 which is an exceeding number of disease cases than the total cases in the half-century in the USA (142 cases from 1968 to 2019). Findings have also suggested that the strain present in Pakistan has developed resistance to saline environments. Moreover, *N. fowleri* has also been found in our local water supply which can be a source of infection when splashing water for washing face (5).

### Life Cycle

The incubation period is 2-8 days (median 5 days) although some cases have reported the appearance of symptoms as early as 24hrs. *N. fowleri* enters the body in trophozoite form. It has three stages in life including cyst (when in an unfavorable environment this amoeba changes to a cystic form that can survive in harsh environments). Drying can render non-viable in less than 5 minutes. Cysts can survive a temperature of 122°F-149°F (50°C-65°C). While on the other side, it may survive freezing temperatures for weeks to months. Trophozoite enters the body in this stage and infects the brain leading to PAM. On analysis of CSF, trophozoites may be seen. Trophozoite can occasionally turn into a non-feeding stage that ultimately reverts.

### Pathogenesis

This amoeba causes the fatal devastating waterborne disease PAM with no clinically proven treatment to date. Infection starts with the entry of amoeba in the nose with water splashes or while swimming, diving, or while a dive or through soil/dust. No one can get infected by drinking contaminated water (1). Once this amoeba reaches the mucosa of the nose it lodges there and starts its locomotion toward the olfactory nerve and passes through a cribriform plate (which is more porous at a young age) to reach the olfactory bulb in the CNS. So the resulting damage of nerves and CSF tissues results in coma and death (3, 4).

### Signs/Symptoms

It has 2 stages of disease progression: the first stage has headache, fever, nausea, and vomiting. The second stage has stiffness of the neck, seizures, altered mental status, hallucinations, and coma.

### Diagnosis

Positive Kerning sign which is a pain when passive extension of knees past 135 degrees is used to check meningitis. Increased intra-cerebral and CSF pressure (600 mm H<sub>2</sub>O), CSF examination (color changes from grey to red in late stages), presence of trophozoites in CSF, increase in polymorphonuclear cells in CSF, and MRI of the brain shows various abnormalities (6).

### Treatment

There are no proven clinical trials up to date that show a confirm treatment option for *N. fowleri*. The most agreed-upon medication for this is Amphotericin B which is an anti-fungal medication for some serious fungal infections. It has a minimum amoeboid effect at 0.01 µg/ml while 0.1 µg/ml is enough for suppressing 90% growth while 0.39 µg/ml is needed to completely regress the growth. Tests have been carried out on the efficacy of Amphotericin B against *N. fowleri* in *in-vitro* studies as well as in lab animals like mice. It is administered via intravenous (IV) route in very high doses. Other anti-fungal drugs like fluconazole, miconazole, and rifampin have shown positive signs as treatment in survivor cases (2, 6).

### Prevention

Chlorinated and saltwater bodies have been shown to have no *N. fowleri* in them as *N. fowleri* cannot survive in such an osmotic environment. So, freshwater bodies should be added with chlorine. Moreover, it is advised not to jump in freshwater bodies like lakes, ponds, pools, etc. to avoid splashing that causes entry of *N. fowleri* in nasal sinuses. Furthermore, it is also recommended to treat water by boiling or filtering through a filter of pore size of 1 µm or even smaller.

“Stay safe by using purified water not only for drinking but for cleaning ourselves”

### Conclusion

*N. fowleri* is a rare but serious brain infection caused by an amoeba, spread via contaminated water bodies. The Government should address the issue of *N. fowleri* infection among people. The government needs to prioritize the health and safety of citizens. There should be strict water quality regulations and conducting tests of various water sources.

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