

NAEGLERIA FOWLERI *AMEBA*

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PATHOGEN & ENVIRONMENT

- Physicians M. Fowler and R. F. Carter first described human disease caused by ameboflagellates in Australia in 1965.
- *Naegleria* is an ameba, commonly found in warm freshwater and soil.
- *Naegleria fowleri* is a heat-loving (thermophilic).

PATHOGEN & ENVIRONMENT

- Most of the time, *Naegleria fowleri* lives in freshwater habitats by feeding on bacteria.
- Once in the nose, the amoeba travels to the brain and causes a severe brain infection called *primary amoebic* meningoencephalitis (PAM), which is usually fatal
- Only one species (type) of *Naegleria* infects people: *Naegleria fowleri*.

WHERE IS *NAEGLERIA FOWLERI* FOUND?

- ***Naegleria fowleri*** is found around the world.
The amoeba can be found in:
 - Bodies of warm freshwater, such as lakes and rivers
 - Geothermal (naturally hot) water, such as hot springs
 - Warm water discharge from industrial plants
 - Swimming pools that are poorly maintained, minimally-chlorinated, and/or un-chlorinated

WHERE IS *NAEGLERIA FOWLERI* FOUND?

- Water heaters. *Naegleria fowleri* grows best at higher temperatures **up to 115°F (46°C)** and can survive for short periods at higher temperatures.
- Soil
- *Naegleria fowleri* is **not found in salt water**, like the ocean.

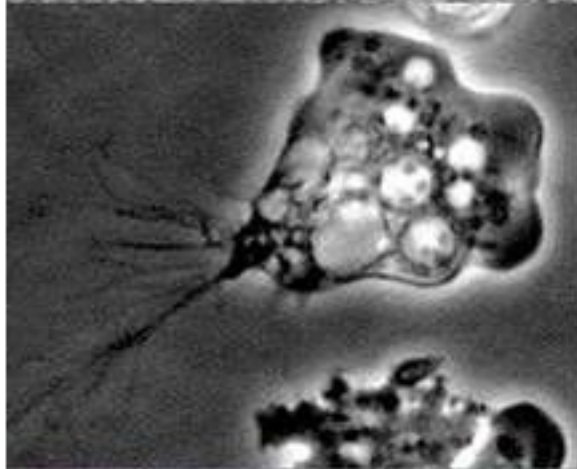
THE PATHOGEN AND LIFE CYCLE

- ***Naegleria fowleri*** has 3 stages in its life cycle: ameboid trophozoites , flagellates, and cysts
- The only infective stage of the ameba is the ameboid trophozoite
- Trophozoites infect humans or animals by penetrating the nasal tissue and migrating to the brain via the olfactory nerves causing primary amebic meningoencephalitis (PAM).

STAGES IN NAEGLERIA FOWLERI 'S LIFE CYCLE



Cyst stage

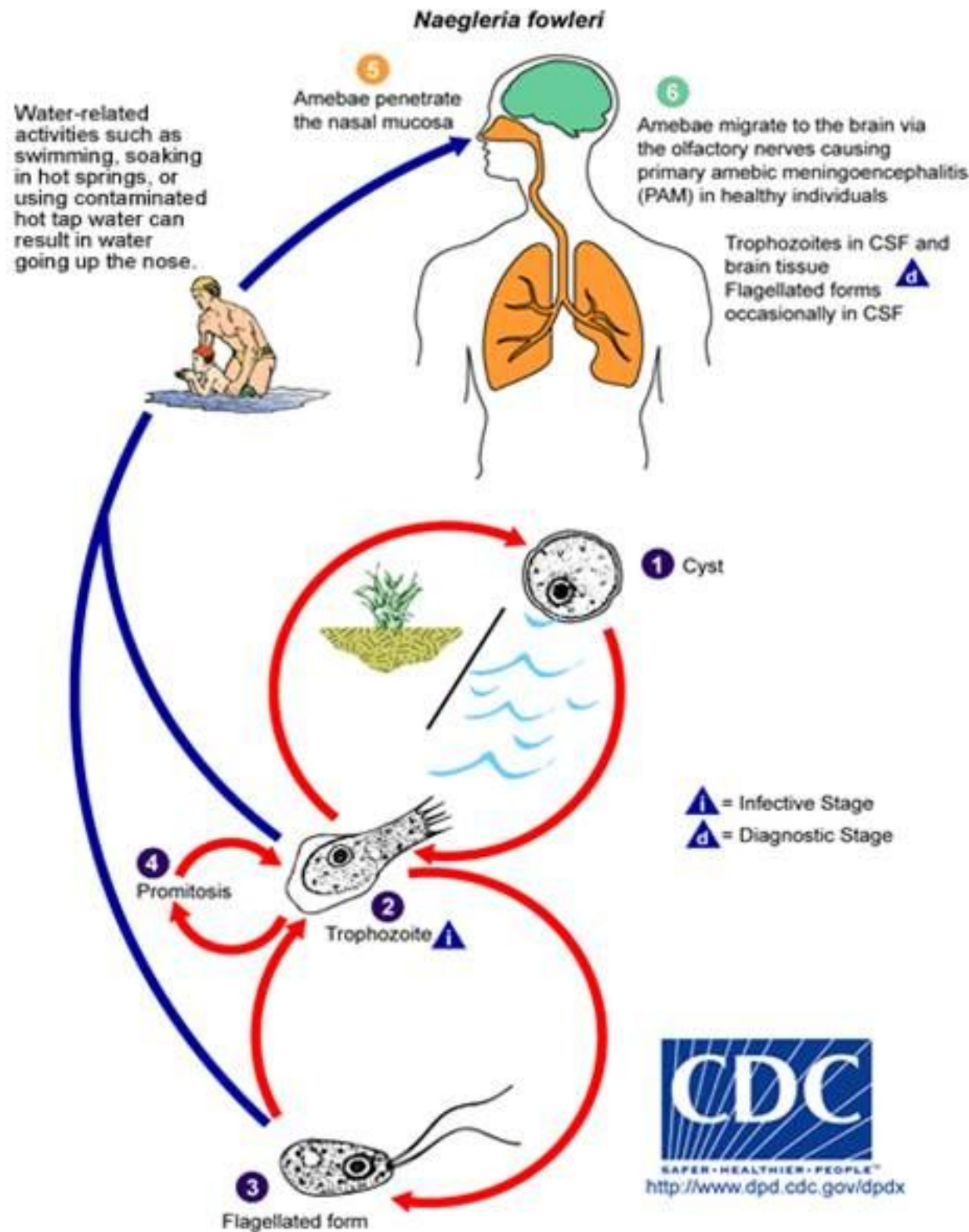


Trophozoite stage



Flagellated stage

LIFE CYCLE OF *NAEGLERIA FOWLERI*



ENVIRONMENTAL RESISTANCE

Temperature:

32°F
(0°C)

115°F
(46°C)

122°F - 149°F
(50°C - 65°C)



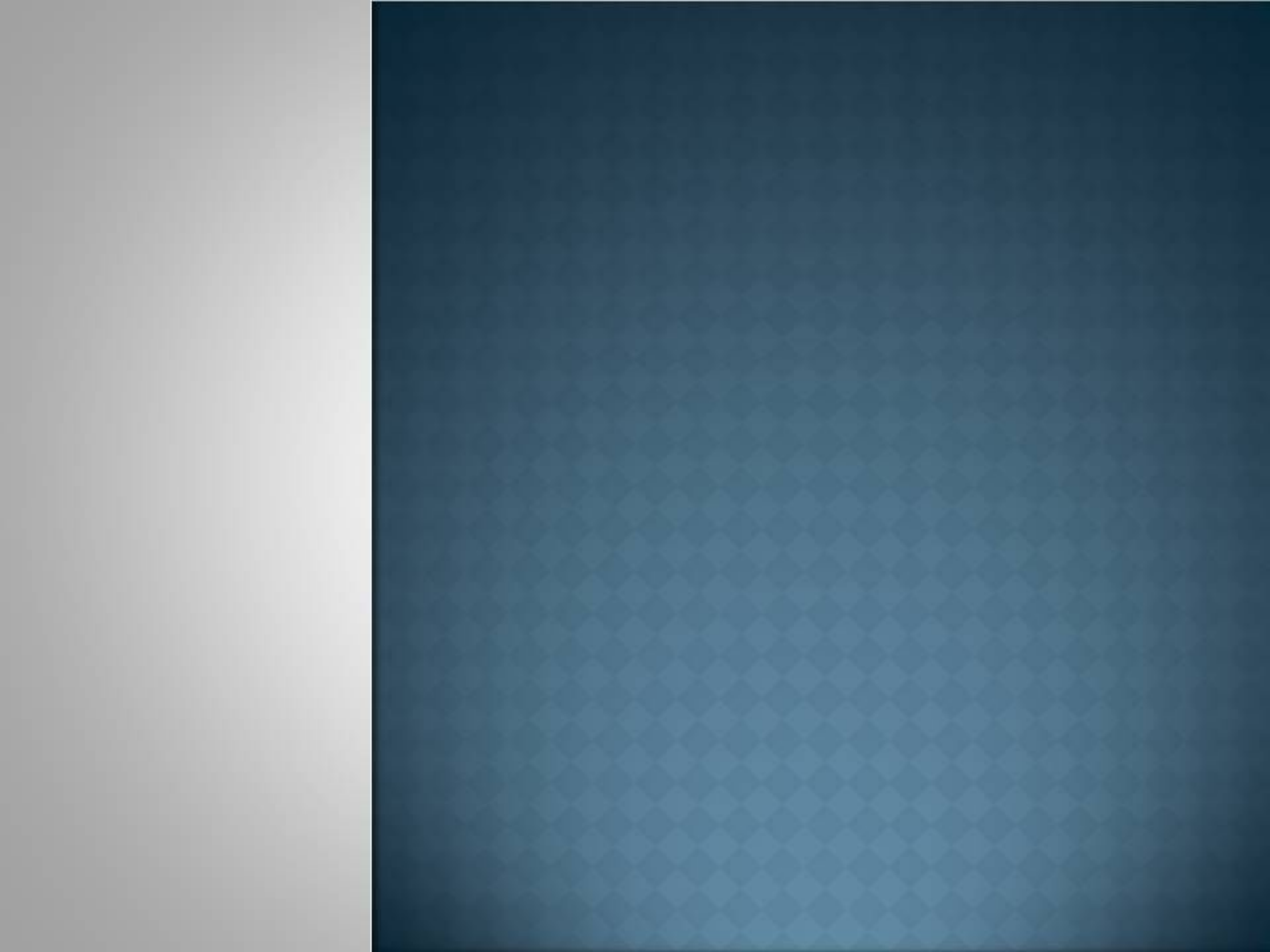
Although trophozoites are killed rapidly by refrigeration, cysts can survive for weeks to months at cold temperatures above freezing, although they appear to be sensitive to freezing

Naegleria fowleri grows best at higher temperatures up to 115°F (46°C)

Although the amoebae may not be able to grow well, *Naegleria fowleri* can still survive at higher temperatures for short periods of time. The trophozoites and cysts can survive from minutes to hours at 122-149°F (50-65°C) with the cysts being more resistant at these temperatures.

ENVIRONMENTAL RESISTANCE

- **Drying:** make trophozoites nonviable instantaneously and cysts nonviable in <5min
- **Disinfection:** sensitive to chlorination and monochloramine used for disinfection of drinking water and swimming pools
- **Salinity:** *Naegleria fowleri* does not survive in sea water and has not been detected in sea water



WHAT ARE SYMPTOMS AND SIGNS OF A *NAEGLERIA FOWLERI* INFECTION?

- Patients may initially notice **changes in smell or taste**. Fever, headache, loss of appetite, and nausea follow quickly.
- The patient becomes confused or semiconscious and finally comatose.
- Physical examination shows fever and meningismus .

THE DISEASE PROGRESS

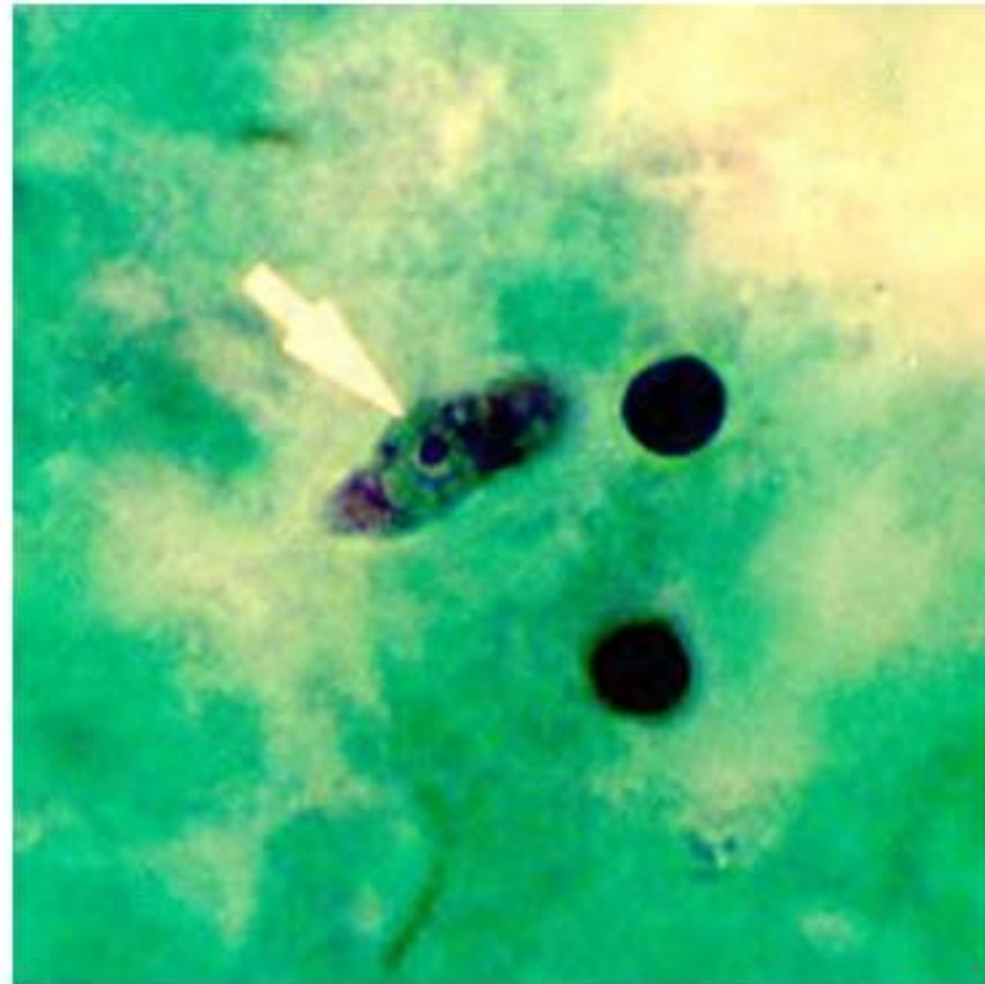
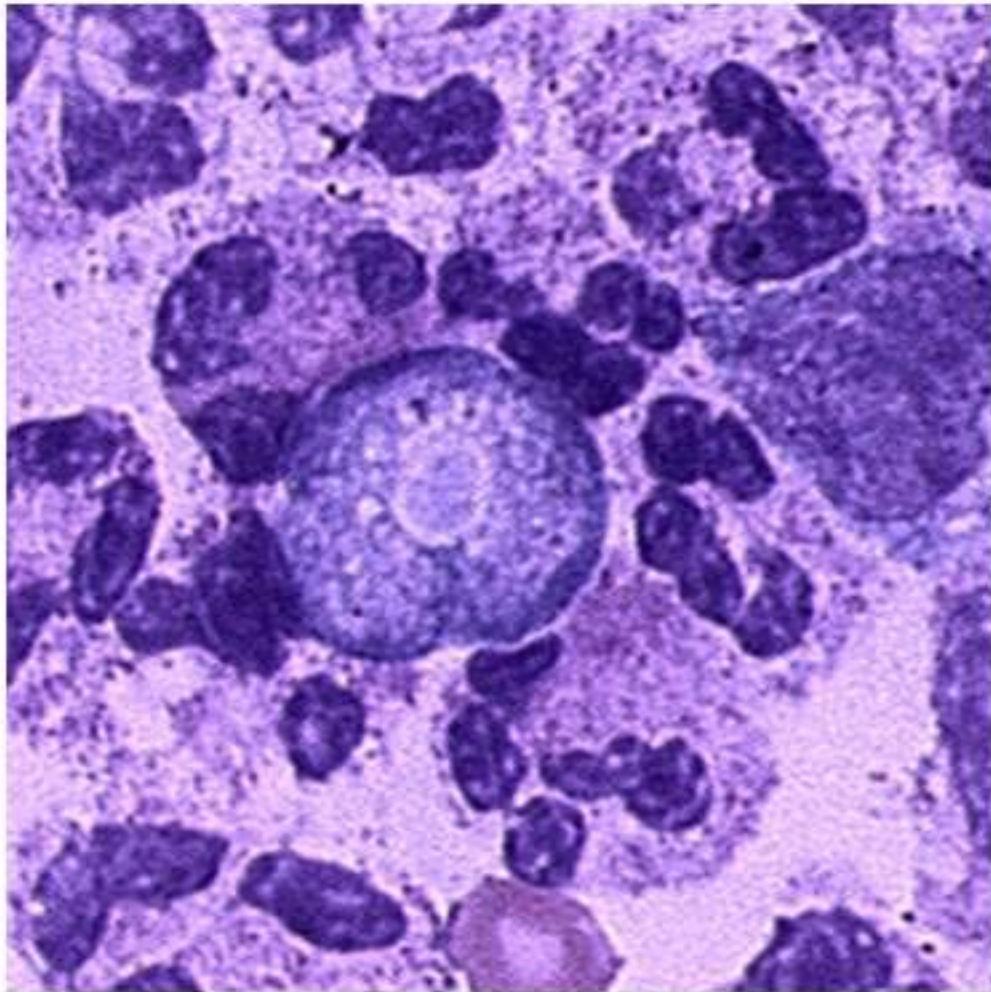
- Initial symptoms of PAM start about 5 days (range 1 to 7 days) after infection.
- The early symptoms of *Naegleria fowleri* infection are similar to bacterial meningitis.
- After the start of symptoms, the disease progresses rapidly and usually causes death within about 5 days (range 1 to 12 days).

HOW IS A *NAEGLERIA FOWLERI* INFECTION DIAGNOSED?

Examination of the spinal fluid is imperative

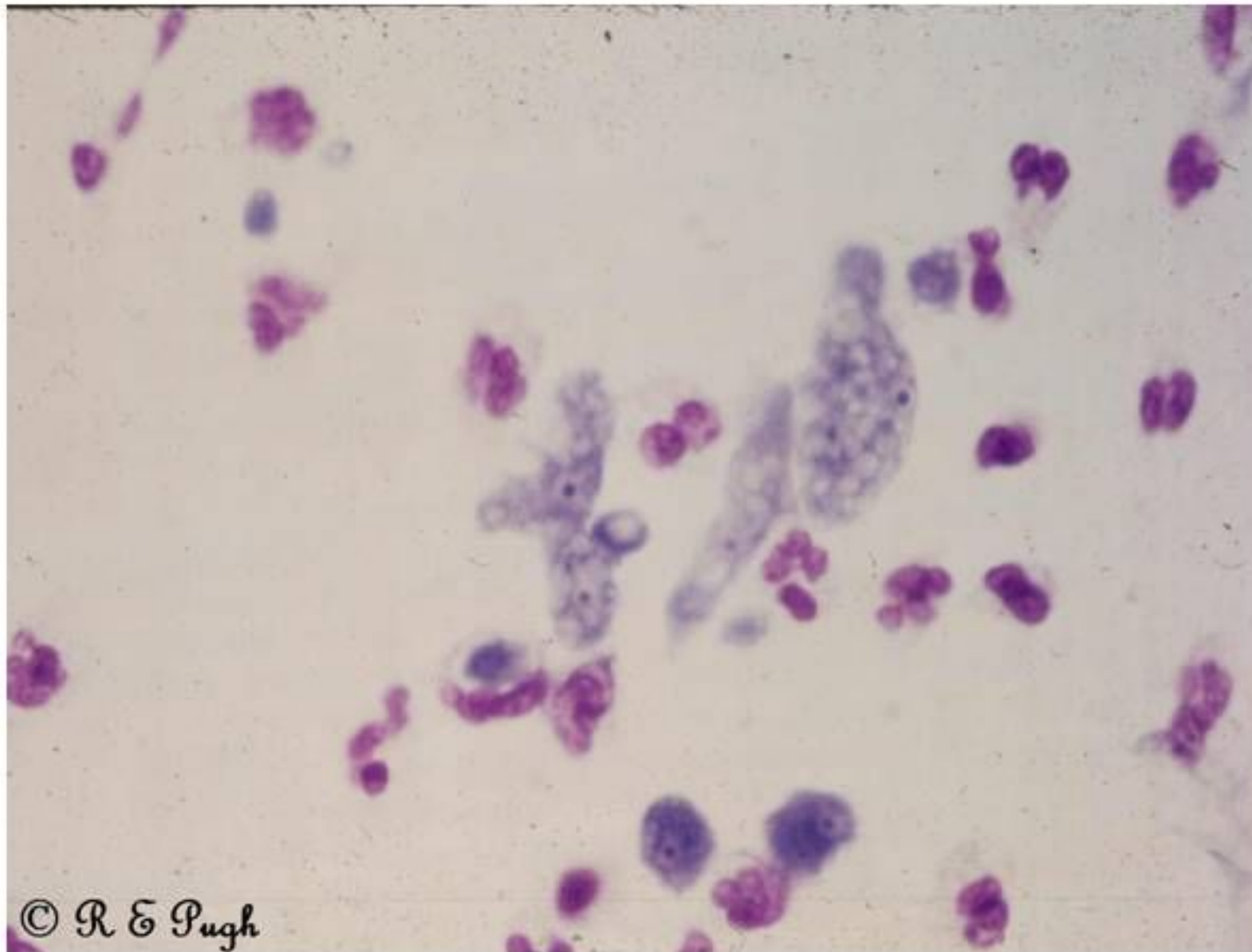
- ❑ Direct visualization
- ❑ Immunohistochemistry (IHC)
- ❑ Polymerase Chain Reaction (PCR)
- ❑ Ameba culture

N. FOWLERI IN CSF



Trophozoite of *N. fowleri* in CSF, stained with (H&E) and trichrome. Image courtesy of the Texas State Health Department.

N. FOWLERI IN CSF



Naegleria fowleri with Giemsa occur in 2 forms - Trophozoites and flagellate with 2 flagella.

IS THERE EFFECTIVE TREATMENT FOR INFECTION WITH *NAEGLERIA FOWLERI*?

- Several drugs are effective against *Naegleria fowleri* in the laboratory.
- *Naegleria* is very sensitive to the antifungal drug ***amphotericin B***, it has been used as the first line of antimicrobial drugs in almost all cases.
- However, their effectiveness is unclear since almost all infections have been fatal.

WHAT IS THE FATALITY RATE FOR AN INFECTED PERSON WHO BEGINS TO SHOW SIGNS AND SYMPTOMS?

→ The fatality rate is over 99%. Only 1 person out of 123 known infected individuals in the United States from 1962 to 2011 has survived.

WHEN DO *NAEGLERIA FOWLERI* INFECTIONS MOST COMMONLY OCCUR?

→ While infections with *Naegleria fowleri* are very rare, they occur mainly during the summer months of July, August, and September

CAN INFECTION BE SPREAD FROM ONE PERSON TO ANOTHER?

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

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.

CAN I GET A *NAEGLERIA*
FOWLERI INFECTION FROM A DISINFECTED
SWIMMING POOL?

→ No. You cannot get a *Naegleria fowleri* infection from a properly cleaned, maintained, and disinfected swimming pool.

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 cause ***water to go up the nose.***

HOW CAN I REDUCE THE RISK OF INFECTION WITH NAEGLERIA FOWLERI?

→ The only certain way to prevent a *Naegleria fowleri* infection is to refrain from water-related activities in or with warm, untreated, or poorly treated water.

HOW CAN I REDUCE THE RISK OF INFECTION WITH *NAEGLERIA FOWLERI*?

In very rare instances, *Naegleria* infections may occur when people irrigate their sinuses (nose) using a neti pot.



HOW CAN I REDUCE THE RISK OF INFECTION WITH *NAEGLERIA FOWLERI*?

Use water that has been:

- Boiled for ≥ 1 minute
- Filtered, using a filter with an absolute pore size of 1 micron or smaller
- Use distilled or sterile water

- You **cannot** be infected with *Naegleria fowleri* by **drinking** contaminated water

WHAT SHOULD I DO IF I THINK I HAVE SYMPTOMS ASSOCIATED WITH *NAEGLERIA FOWLERI*?

- 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.

SUMMARY

- Infection with *Naegleria fowleri* is very rare.
- The fatality rate is over 99%.
- *Naegleria fowleri* infection cannot be spread from one person to another.
- Difficulty in initial detection
- Infection with *Naegleria fowleri* can be prevented by avoiding aspiration of fresh water into the nose

THANKS FOR YOUR ATTENTION

