Utah Department of Health & Human Services

Naegleria fowleri: information for clinicians

- **Diagnostic assistance, specimen collection guidance, shipping instructions, and treatment recommendations are available 24/7 from the Centers for Disease Control and Prevention (CDC). Please contact the CDC Emergency Operations Center at 770-488-7100. More information can also be found here.**
- **CDC no longer provides miltefosine to treat free-living ameba infections, as it is now commercially available. Please visit impavido.com for more information on how to get miltefosine in the United States. If you have a patient with suspected free-living ameba infection please contact the CDC Emergency Operations Center at 770-488-7100 to consult with a CDC expert regarding the use of this drug.**

Clinical Features:

- Acute PAM (primary amebic meningoencephalitis) presents 1-9 days (median of 5 days) after exposure to *Naegleria fowleri*
- The most common early symptoms are headache, fever, nausea, and vomiting
  - Later symptoms include neck stiffness, lethargy, confusion/disorientation, photophobia, seizures, and cranial nerve abnormalities
- Exam findings may include meningeal signs and focal neurologic deficits
- Signs and symptoms mimic those of bacterial meningitis, especially in the early stages
- Abnormalities in taste or smell, nasal obstruction, and nasal discharge have been observed
- PAM progresses rapidly, and frequently leads to coma and death within 1-18 days (median of 5 days) after symptom onset
- Autopsy findings may include hemorrhagic necrosis of the olfactory bulbs and cerebral cortex
  - Other free-living ameba cause mostly sub-acute or chronic granulomatous amebic encephalitis, which progresses more slowly than PAM

Diagnosis:

- **Direct visualization:** The quickest way to diagnose *Naegleria fowleri* infection is microscopic examination of fresh, unfrozen, unrefrigerated cerebrospinal fluid (CSF). Brain biopsy or autopsy specimens may also be used. Samples should not be frozen or refrigerated because cold temperatures can kill the ameba. If ameba are identified in the CSF, a diagnosis should be confirmed by PCR or immunohistochemical tests.
- **Immunohistochemical staining:** Tests include immunofluorescent (IIF) staining or immune alkaline phosphate staining (IHC), and use an antigen specific for *Naegleria fowleri* followed by microscopic examination in CSF, tissue, or culture.
- **Serology:** Immunofluorescent antibody (IFA) testing is currently considered a research technique and has not been evaluated for routine diagnostic purposes.
- **PCR:** This technique is only available in selected reference diagnostic laboratories. CDC has developed a real-time PCR for qualitative assessment of *Naegleria fowleri.*
- **Culture:** This is a routine procedure used to identify free-living ameba in clinical and environmental samples. A negative culture does not rule out the presence of *Naegleria fowleri* and other tests should be performed.

Free-living ameba testing is available at CDC. If possible, the following specimens should be sent for pre-mortem diagnosis at CDC:

- Fresh CSF (NOT frozen and NOT refrigerated)
- Fresh, unfixed brain tissue
- Fresh, unfixed tissue other than brain
- Formalin-fixed, paraffin-embedded, tissue
  - Three H&E-stained slides
  - Six unstained slides
  - Paraffin-embedded tissue block
- Photos of gross brain morphology—particularly around olfactory and auditory areas
- Serum

Treatment:

- Most documented cases of PAM have been fatal, however, there have been five well-documented cases of survival. Based on treatment regimens used in survivors, CDC recommends a combination of amphotericin B, azithromycin, fluconazole, rifampin, miltefosine, and dexamethasone. More information regarding the treatment regimen and dosage can be found here. Please contact the CDC Emergency Operations Center to consult with a CDC expert regarding the use of these drugs.

Organ Transplantation:

- The risk of transmission of *Naegleria fowleri* by donor organs is unknown, although likely not zero, so the risks should be weighed for each individual organ recipient. More information can be found here.