Healthy Swimming: Prevent and Treat Infections Caused by Brain-Eating Amebas and Chlorine-Tolerant Parasites

Clinician Outreach and Communication Activity (COCA) Webinar
July 19, 2014
Objectives

At the conclusion of this session, the participant will be able to accomplish the following:

- Describe the epidemiology, clinical features, diagnostic testing, and treatments available
- Discuss the steps that can be taken to prevent PAM and cryptosporidiosis
- State the protocol for contacting CDC to obtain clinical consultation, diagnostic testing, and the investigative drug miltefosine for treatment of PAM caused by *Naegleria fowleri*
In compliance with continuing education requirements, CDC, our planners, our presenters, and their spouses/partners wish to disclose they have no financial interests or other relationships with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters.

Planners have reviewed content to ensure there is no bias.

The presentation will not include any discussion of the unlabeled use of a product or a product under investigational use with the exception of Dr. Cope’s discussion on miltefosine. She will be discussing the use of miltefosine, a drug recently approved in the U.S. for the treatment of leishmaniasis but it is being used under an investigational new drug protocol for free-living ameba infections including *Naegleria*.

CDC does not accept commercial support.
Accrediting Statements

CME: The Centers for Disease Control and Prevention is accredited by the Accreditation Council for Continuing Medical Education (ACCME®) to provide continuing medical education for physicians. The Centers for Disease Control and Prevention designates this live activity for a maximum of 1.0 AMA PRA Category 1 Credits™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

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AAVSB/RACE: This program was reviewed and approved by the AAVSB RACE program for 1.0 hours of continuing education in jurisdictions which recognize AAVSB RACE approval. Please contact the AAVSB RACE program if you have any comments/concerns regarding this program’s validity or relevancy to the veterinary profession.
TODAY’S PRESENTER

Jennifer Cope, MD, MPH
Medical Epidemiologist
Waterborne Disease Prevention Branch
National Center for Emerging and Zoonotic Infectious Diseases
Centers for Disease Control and Prevention
Michele Hlavsa, RN, MPH
Epidemiologist
Waterborne Disease Prevention Branch
National Center for Emerging and Zoonotic Infectious Diseases
Centers for Disease Control and Prevention
Healthy Swimming: Epidemiology, Diagnosis, Treatment, and Prevention of Cryptosporidiosis

Michele Hlavsa, RN, MPH
Epidemiologist/Healthy Swimming

COCA Call
June 19, 2014
Objectives

- Describe epidemiology, clinical features, diagnostic testing, and treatment available
- Discuss steps that can be taken to prevent cryptosporidiosis
Cryptosporidiosis by the Numbers

- 748,000 cases in U.S. estimated annually
  - $10^7$–$10^8$ oocysts excreted in single bowel movement*
  - <10 oocysts can cause infection in healthy persons†,§
- >95%¶ of cases caused by
  - Cryptosporidium parvum
  - Cryptosporidium hominis

Cryptosporidiosis Risk Factors

- Contact with infected
  - Persons, particularly caregivers of young children
  - Animals, particularly pre-weaned calves
- Ingestion of contaminated
  - Recreational water (e.g., pools)
  - Drinking water
  - Food
- International travel
EPIDEMIOLOGY
Rate of Cryptosporidiosis, by Year
United States, 1995–2012

- Laboratory-confirmed cases
- Non-confirmed cases*

Source: Yoder JS et al. MMWR 2012;61:1–12. 2011 and 2012 data are PRELIMINARY.
* Non-confirmed cases includes probable cases, suspect cases, and cases of unknown status.
Cryptosporidiosis Rate*, by Reporting Jurisdiction† — United States, 2012 (n=8,008)

Source: 2012 data are PRELIMINARY.
* Per 100,000 person years.
† Differences in reported rate among jurisdictions might reflect differences in risk factors; number of cases associated with outbreaks; or capacity to detect, investigate, and report cases.
Number and Rate of Cryptosporidiosis Cases, by Age Group and Year — United States, 2011–2012 (N=17,113*)

<table>
<thead>
<tr>
<th>Age Group in Years</th>
<th>2011 Cases</th>
<th>2012 Cases</th>
<th>2011–2012 Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-9</td>
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<td>10-14</td>
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<td>15-19</td>
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<td>20-24</td>
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<td>25-29</td>
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<td>30-34</td>
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<td>35-39</td>
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<td>40-44</td>
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<td>45-49</td>
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<td>50-54</td>
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<td>55-59</td>
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<tr>
<td>60-64</td>
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<td></td>
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<tr>
<td>65-69</td>
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<td></td>
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<tr>
<td>70-74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75-79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2011 and 2012 data are PRELIMINARY.

* 208 case reports did not include age data.
Rate of Cryptosporidiosis Cases, by Sex and Age Group
United States, 2011–2012

Source: 2011 and 2012 data are PRELIMINARY.
Number of Cryptosporidiosis Cases, by Date of Symptom Onset — United States, 2011–2012 (N=12,581*)

Source: 2011 and 2012 data are PRELIMINARY.
* 4,740 case reports did not include data on date of symptom onset.
Waterborne Diseases Outbreaks associated with Recreational Water (n=789), by year United States, 1978–2010

- Treated recreational water–associated outbreaks of cryptosporidiosis
- All other recreational water–associated outbreaks

CLINICAL FEATURES
Disease in Immunocompetent Patients

- Marked by profuse, watery and prolonged (>3 days) diarrhea
  - Other symptoms: abdominal pain, nausea/vomiting
  - Pediatric patients: pulmonary symptoms*
  - Asymptomatic infection can occur
- Self-limiting
  - Median duration 11 days†
  - Waxing and waning of symptoms

Disease in Immunocompromised Patients

- Severity dependent on degree of immunosuppression
  - Similar presentation as immunocompetent
  - Chronic, severe diarrhea
  - Life-threatening malabsorption and wasting
  - Incidence in HIV-infected persons dramatically decreased with introduction of highly active antiretroviral therapy
- Extra-intestinal cryptosporidiosis
  - Biliary or respiratory, rarely pancreatic
DIAGNOSTIC TESTING
Cryptosporidium Testing

- MUST specifically request Cryptosporidium testing
  - Why: Routine ova and parasites testing unlikely to include testing for Cryptosporidium
- Test 3 stool specimens collected on separate days before considering test results negative
  - Why: Oocyst excretion can be intermittent
- Direct fluorescent antibody testing = gold standard
  - Immunodiagnostic kits (e.g., immunochromatographic rapid card test)?

Alinia (Nitazoxanide): Immunocompetent Patients

- **Egypt (pediatric study)**
  - Clinical Cure: 80% (39/49) vs 41% (20/49) placebo
  - Parasitic Cure: 67% (33/49) vs 22% (11/50) placebo

- **Egypt (adult study)**
  - Clinical Cure: 96% (27/28) vs 41% (11/27) placebo
  - Parasitic Cure: 93% (26/28) vs 37% (10/27) placebo

- **Zambia (pediatric study)**
  - Clinical Cure: 56% (14/25) vs 23% (5/22) placebo
  - Parasitic Cure: 52% (13/25) vs 14% (3/22) placebo

## Treatment of Cryptosporidiosis in Immunocompetent Patients

<table>
<thead>
<tr>
<th>Age (in Years)</th>
<th>Dosage</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–3*</td>
<td>5 mL of oral suspension (100 mg nitazoxanide) q12h with food</td>
<td>3 days</td>
</tr>
<tr>
<td>4–11*</td>
<td>10 mL of oral suspension (200 mg nitazoxanide) q12h with food</td>
<td>3 days</td>
</tr>
<tr>
<td>&gt;12</td>
<td>1 tablet (500 mg nitazoxanide) q12h with food OR 25 mL of oral suspension (500 mg nitazoxanide) q12h with food</td>
<td>3 days</td>
</tr>
</tbody>
</table>

* Single tablet contains greater amount of nitazoxanide than recommended for pediatric dosing and thus should not be used for patients ≤11 years.
Treatment of Cryptosporidiosis in Immunocompromised Patients

- Immune restoration mainstay treatment
- HIV-infected patients
  - Symptomatic treatment of diarrhea with anti-motility agent
  - Aggressive rehydration and replacement of electrolyte loss
  - Adding protease inhibitors might be preferable because of direct anti-*Cryptosporidium* effect
    - Increases interferon-gamma
Treatment of Cryptosporidiosis in Immunocompromised Patients: Resources

- HIV-infected pediatric patients

- HIV-infected adult patients

PREVENTION
## Preventing Waterborne Cryptosporidiosis

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| 1. Do NOT participate in recreational water activities when ill with diarrhea and for 2 weeks after symptoms completely resolved | *Cryptosporidium* extremely chlorine-tolerant: inactivation taking 3.5–10.6 days at CDC—recommended free chlorine levels (i.e., 1–3 mg/L, pH 7.5, temperature 77°F [25°C])*
| 2. Avoid ingestion of recreational water | Treatment processes and regulations have prevented surface drinking water–associated outbreaks of cryptosporidiosis†

Do NOT drink water or use ice that has been inadequately treated

Travelers’ Health Resource: YellowBook

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† CDC. MMWR 2013;62;714–20.
### Preventing Other Cryptosporidioses

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash hands with soap and water for &gt;20 seconds</td>
<td>Alcohol-based hand sanitizers do not inactivate <em>Cryptosporidium</em></td>
</tr>
<tr>
<td>Exclude children ill with diarrhea from child care settings</td>
<td>Contact with persons 3–11 years of age = risk factor for cryptosporidiosis in immunocompetent persons†</td>
</tr>
</tbody>
</table>

CDC Crypto Website

www.cdc.gov/crypto
Required Disclaimer

The findings and conclusions in this presentation have not been formally disseminated by CDC and should not be construed to represent any agency determination or policy.
The Brain-Eating Ameba: 
*Naegleria fowleri* Infections in the United States

Jennifer Cope, MD, MPH
Centers for Disease Control and Prevention
Waterborne Disease Prevention Branch
COCA Call
June 19, 2014
Objectives

- Describe the epidemiology, clinical features, diagnostic testing, and treatments available for primary amebic meningoencephalitis (PAM)
- Discuss the steps that can be taken to prevent PAM
- State the protocol for contacting CDC to obtain clinical consultation, diagnostic testing, and the investigative drug miltefosine for treatment of PAM
Primary Amebic Meningoencephalitis (PAM)

- Rare and serious brain infection
  - 132 cases in U.S. since 1962
    - Nearly all diagnostic testing done at CDC
  - Fatal: only 3 known US survivors
  - Acute disease: exposure to death in ~10 days
- Caused by free-living ameba, *Naegleria fowleri*
- Most infections associated with swimming in lakes, rivers
  - Water containing *Naegleria* goes up nose to brain
- All infections in southern tier states in US until 2010
How *Naegleria* Causes Disease

- Water containing *Naegleria* enters the nose
- Travels up the olfactory nerve into the brain
- Causes primary amebic meningoencephalitis (PAM)
**Naegleria fowleri**: Organism

- Thermophilic, free-living ameba (113°F, 45°C)
- Identified by Fowler as the cause of primary amebic meningoencephalitis in Australia (1962)
- Only *Naegleria* species associated with PAM
  - Also infects animals (e.g., cattle)
- 300-400 cases identified worldwide
- Retrospective pathology study in Virginia has found evidence of cases occurring back to 1937
Number of Case-reports of Primary Amebic Meningoencephalitis, by Year — United States, 1962–2013

N=132; Year of exposure unknown for one case
Number of Case-reports of Primary Amebic Meningoencephalitis by Age Group and Gender — United States, 1962–2013

N=132; median age = 11.5; ~80% male
Number of case-reports of Primary Amebic Meningoencephalitis, by month of illness onset and probable water exposure — United States, 1962–2013

- N=121
- No information is available on the design, maintenance, or operation of these pools.
- ** Water was forced up the nose during use.
- Month of illness onset unknown for 11 cases. Of those case-reports missing the month of exposure, probable water exposures included lake, pond, reservoir (N =5), unknown/multiple (N=5), and geothermal water (N=1)
### Number of Case-reports of Primary Amebic Meningoencephalitis Caused by *Naegleria fowleri* (N=132) by State of Exposure*— United States, 1962–2013

<table>
<thead>
<tr>
<th>State (Abbreviation)</th>
<th># of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona (AZ)</td>
<td>7</td>
</tr>
<tr>
<td>Arkansas (AR)</td>
<td>6</td>
</tr>
<tr>
<td>California (CA)</td>
<td>7</td>
</tr>
<tr>
<td>Florida (FL)</td>
<td>34</td>
</tr>
<tr>
<td>Georgia (GA)</td>
<td>5</td>
</tr>
<tr>
<td>Indiana</td>
<td>1</td>
</tr>
<tr>
<td>Kansas (KS)</td>
<td>1</td>
</tr>
<tr>
<td>Louisiana (LA)</td>
<td>4</td>
</tr>
<tr>
<td>Minnesota (MN)</td>
<td>2</td>
</tr>
<tr>
<td>Mississippi (MS)</td>
<td>1</td>
</tr>
<tr>
<td>Missouri (MO)</td>
<td>1</td>
</tr>
<tr>
<td>Nevada (NV)</td>
<td>1</td>
</tr>
<tr>
<td>New Mexico (NM)</td>
<td>1</td>
</tr>
<tr>
<td>North Carolina (NC)</td>
<td>4</td>
</tr>
<tr>
<td>Oklahoma (OK)</td>
<td>6</td>
</tr>
<tr>
<td>South Carolina (SC)</td>
<td>7</td>
</tr>
<tr>
<td>Texas (TX)</td>
<td>32</td>
</tr>
<tr>
<td>Virginia (VA)</td>
<td>7</td>
</tr>
</tbody>
</table>

*State of exposure unknown for 4 cases.  
*Does not include one case from USVI.*
GEOGRAPHIC DISTRIBUTION
Number of PAM Case-Reports by State of Exposure: United States, 1962–2009
Number of PAM Case-Reports by State of Exposure: United States, 1962–2009

Orlando, FL

Richmond, VA

14

6
Number of PAM Case-Reports by State of Exposure: United States, 1962–2009
Number of PAM Case-Reports by State of Exposure: United States, 2010–2012
Changes in geographic range of PAM, 2010–2012?

1st case in VA since 1969
Changes in geographic range of PAM, 2010–2012?

1st case in KS
Changes in geographic range of PAM, 2010–2012?

1st case in IN
Changes in geographic range of PAM, 2010–2012?

MN: 2 cases (2010, 2012)
TRANSMISSION
Changes in PAM transmission patterns?

LA: premise plumbing/neti pots (2 cases)
Louisiana, 2011

- Both residential premise plumbing systems positive for *Naegleria fowleri*
  - Municipal water system samples negative
  - Free-living amebas in premise plumbing common (~79% of 467 households in OH study)

- Both cases regular users of neti pots for nasal irrigation
Nasal Irrigation and Neti Pots

- At least 1 PAM death in 1970’s in Australia due to rinsing of nasal passages in shower
- 13 deaths in healthy young adults in Pakistan likely from Muslim ritual ablution: putting water up nose

- Neti pots
  - Ancient yogic cleansing method
  - Used for nasal irrigation during illness and on regular basis
  - Recommended by Dr. Oz/Oprah in 2007
    - Sales apparently increased 3-4-fold
    - Millions sold per year
U.S. Virgin Islands, 2012

- Nov 18: 47 year-old Muslim male found unresponsive taken to medical center
- Nov 19: CSF showed motile ameba
- Nov 20: CDC notified of possible PAM case
- Nov 21: Case confirmed, patient death, no recreational freshwater exposure
- Dec 15 to 24: Investigation conducted
## Environmental Investigation in Home

<table>
<thead>
<tr>
<th>Sample</th>
<th>Chlorine (mg/L)</th>
<th><em>N. fowleri</em> PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shower head (water)</td>
<td>&lt;0.02</td>
<td>Positive</td>
</tr>
<tr>
<td>Hot water heater (water)</td>
<td>&lt;0.02</td>
<td>Positive</td>
</tr>
<tr>
<td>Shower head</td>
<td>Not tested</td>
<td>Positive</td>
</tr>
</tbody>
</table>
## Environmental Investigation in Mosque

<table>
<thead>
<tr>
<th>Sample</th>
<th>Chlorine (mg/L)</th>
<th>N. fowleri PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ablution fountain (water)</td>
<td>0.02</td>
<td>Negative</td>
</tr>
<tr>
<td>Ablution fountain (swab)</td>
<td>Not tested</td>
<td>Negative</td>
</tr>
<tr>
<td>Mosque filter</td>
<td>Not tested</td>
<td>Negative</td>
</tr>
</tbody>
</table>
Louisiana, 2013

- 4 y/o child diagnosed with PAM on autopsy
- No contact with lake, pond, river, etc.
- Played all day on slip-n-slide
  - Increased risk for water going up nose
- Water samples, hoses, slip-n-slide shipped to CDC
- *Naegleria* in residential plumbing system, hot water heater, hoses supplying slip-n-slide
- Same parish as 2011 neti pot-associated infection
  - Tested municipal water system (negative in 2011), positive in 2013
Changing Epidemiology of PAM: 2010-2013

- First cases reported in MN, KS, and IN
- First cases associated with tap water and neti pot use
- First case associated with ritual nasal cleansing
- First death associated with water from a treated drinking water system
CLINICAL FEATURES
Primary Amebic Meningoencephalitis (PAM)

- Exposure to symptom onset: average 5 days (range 1–7)
- Symptom onset to death: average 5.3 days (1–12 days)
- Early symptoms: fever, headache, nausea, and vomiting
- Later symptoms: neck stiffness, altered mental status, and seizures—bacterial meningitis
- CSF: Elevated pressure, WBC, protein; low glucose
- Trophozoites can be detected in spinal fluid (25%) but diagnosis is usually at autopsy (75%)
## Cerebrospinal Fluid (CSF)

<table>
<thead>
<tr>
<th></th>
<th><strong>Primary Amebic Meningoencephalitis</strong></th>
<th><strong>Bacterial Meningitis</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Amebae</td>
<td>Motile trophozoites usually present</td>
<td>None</td>
</tr>
<tr>
<td>WBC</td>
<td>Greatly elevated (&gt;500 cells/mm³, PMN* predominant)</td>
<td>Greatly elevated (&gt;500 cells/mm³, PMN* predominant)</td>
</tr>
<tr>
<td>RBC</td>
<td>None to many</td>
<td>None</td>
</tr>
<tr>
<td>Protein</td>
<td>Usually elevated</td>
<td>Usually elevated</td>
</tr>
<tr>
<td>Glucose</td>
<td>Usually normal or low</td>
<td>Usually low</td>
</tr>
<tr>
<td>Pressure</td>
<td>Usually elevated</td>
<td>Usually elevated</td>
</tr>
</tbody>
</table>
A wet mount of *Naegleria fowleri* trophozoites cultured from the CSF of a patient with primary amebic meningoencephalitis (PAM) viewed using phase contrast microscopy. Magnification: 600x.
Wet mount of CSF from a PAM patient, 2012
A cytospin of fixed CSF showing a *Naegleria fowleri* trophozoite (arrow) stained with Giemsa-Wright amidst polymorphonuclear leukocytes and a few lymphocytes. Within the trophozoite, the nucleus and nucleolus can be seen. Magnification: 1000x.
<table>
<thead>
<tr>
<th></th>
<th><strong>Naegleria</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CT</strong></td>
<td>CT often normal early in disease, then may show cerebral edema with contrast enhancement and obliteration of basilar cisterns</td>
</tr>
<tr>
<td><strong>MRI</strong></td>
<td>Might show one or more small enhancing round lesions</td>
</tr>
</tbody>
</table>
DIAGNOSIS AND TREATMENT
**Naegleria fowleri**: Diagnostics/Detection

- Direct visualization – motile trophozoites seen in the CSF
- Immunohistochemistry – antibody staining of the amebae in tissue
- Polymerase chain reaction (PCR) – detecting ameba DNA
Treatment and Medical Guidance

- Until summer 2013, 1/128 documented cases survived
  - Treated with combination of antibiotics
  - No other person in U.S. (one in Mexico) has survived despite being treated with similar cocktail during same stage of disease

- FLA lab has tested many new drugs for *in vitro* efficacy

- Investigational drug: miltefosine
  - Has been used in other ameba infections; appears to improve survival rates
  - Previously not licensed in U.S., manufactured in Germany---days to obtain
  - Time delays and regulatory issues made it unlikely that we could get drug on board early in disease progression

- CDC has received FDA approval to hold drug so it can get to the patient within 12-24 hours
Arkansas and Texas, 2013: First two U.S. PAM survivors since 1978

12-Year-Old Brain-Eating Amoeba Survivor, Kali Hardig, Heads Home

12-Year-Old Brain-Eating Amoeba Survivor Speaks Out
### Recommended Treatment for Primary Amebic Meningoencephalitis Caused by *Naegleria fowleri*

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Route</th>
<th>Maximum Dose</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amphotericin B</strong></td>
<td>1.5 mg/kg/day in 2 divided doses</td>
<td>IV</td>
<td>1.5 mg/kg/day</td>
<td>3 days</td>
<td></td>
</tr>
<tr>
<td>then</td>
<td>1 mg/kg/day once daily</td>
<td>IV</td>
<td></td>
<td>11 days</td>
<td>14-day course</td>
</tr>
<tr>
<td><strong>Amphotericin B</strong></td>
<td>1.5 mg once daily</td>
<td>Intrathecal</td>
<td>1.5 mg/day</td>
<td>2 days</td>
<td></td>
</tr>
<tr>
<td>then</td>
<td>1 mg/day every other day</td>
<td>Intrathecal</td>
<td></td>
<td>8 days</td>
<td>10-day course</td>
</tr>
<tr>
<td><strong>Azithromycin</strong></td>
<td>10 mg/kg/day once daily</td>
<td>IV/PO</td>
<td>500 mg/day</td>
<td>28 days</td>
<td></td>
</tr>
<tr>
<td><strong>Fluconazole</strong></td>
<td>10 mg/kg/day once daily</td>
<td>IV/PO</td>
<td>600 mg/day</td>
<td>28 days</td>
<td></td>
</tr>
<tr>
<td><strong>Rifampin</strong></td>
<td>10 mg/kg/day once daily</td>
<td>IV/PO</td>
<td>600 mg/day</td>
<td>28 days</td>
<td></td>
</tr>
<tr>
<td><strong>Miltefosine</strong></td>
<td>Weight&lt;45 kg 50 mg BID Weight&gt;45kg 50 mg TID</td>
<td>PO</td>
<td>2.5 mg/kg/day</td>
<td>28 days</td>
<td>50 mg tablets</td>
</tr>
<tr>
<td><strong>Dexamethasone</strong></td>
<td>0.6 mg/kg/day in 4 divided doses</td>
<td>IV</td>
<td>0.6 mg/kg/day</td>
<td>4 days</td>
<td></td>
</tr>
</tbody>
</table>

[http://www.cdc.gov/parasites/naegleria/treatment-hcp.html](http://www.cdc.gov/parasites/naegleria/treatment-hcp.html)
CDC Service

- 24/7 diagnostic and clinical assistance for free-living amebae
  - DPDx—telediagnosis (http://www.dpd.cdc.gov/dpdx)
  - Clinical sample testing (microscopy, PCR)
    - call EOC 770-488-7100
- Clinical guidance and support
  - call EOC 770-488-7100
PAM Prevention: Swimming

- Hold your nose shut, use nose clips, or keep your head above water when taking part in water-related activities in bodies of warm freshwater.
- Avoid putting your head under the water in hot springs and other untreated thermal waters.
- Avoid water-related activities in warm freshwater during periods of high water temperature.
- Avoid digging in, or stirring up, the sediment while taking part in water-related activities in shallow, warm freshwater areas.

http://www.cdc.gov/parasites/naegleria/swimming.html
PAM Prevention: Sinus Rinsing and Neti Pots

- **Boil:** Use water that has been previously boiled for 1 minute and left to cool.
  - At elevations above 6,500 feet, boil for 3 minutes.
- **Filter:** Use a filter designed to remove some water-loving germs.
  - The label may read "NSF 53" or "NSF 58."
  - Filter labels that read “absolute pore size of 1 micron or smaller” are also effective.
- **Buy:** Use water with a label specifying that it contains distilled or sterile water.
- **Disinfect:** Learn how to disinfect your water to ensure it is safe from *Naegleria*.
  - Chlorine bleach used at the right level and time will work as a disinfectant against this germ.

http://www.cdc.gov/parasites/naegleria/sinus-rinsing.html
CDC Naegleria Health Communications

Naegleria website

Naegleria factsheet
(available on website)
Conclusions: PAM & *Naegleria fowleri*

- Changing epidemiology means all clinicians should be aware of PAM
  - Geographic shift north
  - New transmission patterns: neti pots and drinking water
- **Consider a PAM diagnosis in a patient with**
  - Nasal freshwater exposure (swimming, neti pot use, ritual ablution)
  - CSF profile consistent with bacterial meningitis
- Do CSF wet mount if suspicious for PAM
- Call CDC 24/7 to discuss your patient with a *Naegleria* subject matter expert

**770-488-7100**

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.
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  - “Click” the Q&A tab at the top left of the webinar tool bar
  - “Click” in the white space
  - “Type” your question
  - “Click” ask

- **On the Phone**
  - Press Star (*) 1 to enter in the queue to ask a question
  - State your name
  - Listen for the operator to call your name
  - State your organization and then ask your question
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Please email us questions at coca@cdc.gov

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