Blue-green Algae (Cyanobacteria) and Cyanotoxin Poisoning in Wisconsin: The Public Health Approach

Wisconsin Lakes Partnership Convention
April 12, 2019
Presented by Amanda Koch, MPH,
Waterborne Diseases Epidemiologist

Wisconsin Department of Health Services
Division of Public Health
Bureau of Environmental and Occupational Health
Human and Animal Health Effects
Not all cyanobacteria are harmful.

- Helped create the Earth’s atmosphere
- Over 2,600 described species
  - Estimated >6,000 species
  - About 50 are known to be toxin-producers
Cyanobacterial Toxins

Various toxin types

- **Hepatotoxins** (e.g., microcystin-LR, cylindrospermopsin)
- **Neurotoxins** (e.g., anatoxin-a, saxitoxin)
- **Dermatotoxins** (e.g., lipopolysaccharide endotoxins)
Cyanobacterial Toxins

Signs and symptoms depend largely on:

- Route(s) of exposure
- Species and toxin type(s) present
- Cyanobacterial cell and toxin concentrations
- Vulnerability (behaviors, body size, preexisting conditions)
How are people exposed?

- Activities
  - Recreational
  - Personal use
  - Occupational

- Exposure routes
  - Dermal
  - Ingestion
  - Inhalation
Dermal contact

- Rash
- Hives
- Skin blisters
- Lesions most common under swimsuits
Ingestion

- Abdominal pain
- Nausea
- Diarrhea
- Vomiting
- Numb lips
- Tingling fingers and toes
- Dizziness
Inhalation

- Influenza-like illness
- Runny eyes
- Runny nose
- Sore throat
- Asthma-like symptoms
Animals

• Particularly vulnerable due to their behaviors and smaller size
• Often serve as sentinels for human illness
Dogs

- Most common victims
- Deaths are well-documented
Symptoms in Animals

- Lethargy
- Vomiting
- Drooling
- Diarrhea
- Weakness
- Difficulty breathing
- Seizures
DPH HAB Program
DPH HAB Surveillance Program

• Established in 2008 through the CDC’s Harmful Algal Bloom Illness Surveillance System project (HABISS)
• Supported by CDC and the Great Lakes Restoration Initiative
  – Council of State and Territorial Epidemiologists (CSTE) Applied Epidemiology Fellowship Program
  – Other staffing and program support
We’re all about partnerships!

- Wisconsin Division of Public Health
- HABRI Surveillance and Response in Wisconsin
- Wisconsin Department of Natural Resources
- Wisconsin State Laboratory of Hygiene
DPH HAB Surveillance Program

We’re all about partnerships!

HABRI Surveillance and Response in Wisconsin
Conducts surveillance of health effects related to HAB exposure.

Investigates reports of human and animal illnesses.
DPH HAB Surveillance Program

Coordinates water sampling and analysis.

Helps local public health issue health advisories and beach closures.

Provides education and outreach.
Illness complaint reporting methods

- Online case-reporting tool on DPH blue-green algae website
- Direct contact with program staff
- Referrals from DNR, local health departments, and lake associations
- Wisconsin Poison Center
- Clinicians and laboratories
Blue-Green Algae

The Wisconsin Department of Health Services, Division of Public Health (DPH) collects information about human and animal illness resulting from exposure to blue-green algae. Tracking illness information will help DPH measure the problem of blue-green algae in our lakes and rivers.

If you get sick after swimming in a Wisconsin lake or river, please report possible algae-related illness. This program does not provide medical treatment, so if you are experiencing severe symptoms seek medical attention immediately.

NEW!

For healthcare providers: beginning 7/1/2018, report any suspected human cases of Cyanobacteria and Cyanotoxin Poisoning electronically through WEDSS or by mailing or faxing a completed Acute and Communicable Disease Case Report, F-44151 to the address on the form.

For members of the general public and veterinarians: call 608-266-1120 or complete the online form Harmful Algae Bloom (HAB) Illness or Sighting Survey, F-02152 to report any blue-green algae blooms and related human or animal illnesses to the Wisconsin Harmful Algal Bloom Program.
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Annual Health Complaints

Year: 2009 - 2018

- 2009: 37
- 2010: 27
- 2011: 36
- 2012: 33
- 2013: 13
- 2014: 27
- 2015: 12
- 2016: 33
- 2017: 16
- 2018: 25
# DPH HAB Surveillance Program

## Human HAB-Related Illness Interview Form

<table>
<thead>
<tr>
<th>Case classification:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmed case</td>
</tr>
<tr>
<td>Probable case</td>
</tr>
<tr>
<td>Suspect case</td>
</tr>
<tr>
<td>Not a case</td>
</tr>
</tbody>
</table>

**CDC Case ID:**

**WD HAB Report ID:**

**Wl Case ID:**

**WD HAB Report ID:**

**Date of interview:**

**Time:** _ AM PM

**DPH Staff Interviewer name:**

**Interview completed with:**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Surrogate (specify):</th>
</tr>
</thead>
</table>

**Outcome**

| (e.g. left message with household number, left voicemail, no answer, wrong number, refused interview) |

**INTERVIEW ATTEMPTS**

<table>
<thead>
<tr>
<th>Date attempted</th>
<th>Time</th>
</tr>
</thead>
</table>

**DEMOGRAPHIC INFORMATION**

- [ ] Anonymous complaint

<table>
<thead>
<tr>
<th>Name of patient:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of parent/guardian (if child):</td>
</tr>
<tr>
<td>Alternate phone:</td>
</tr>
<tr>
<td>Age (years):</td>
</tr>
<tr>
<td>Sex: M F</td>
</tr>
<tr>
<td>Are you of Hispanic ethnicity:</td>
</tr>
</tbody>
</table>

**With which race group do you most closely identify?**

- White
- Black/African American
- Asian
- Native Hawaiian/other Pacific Islander
- Native American/Alaskan
- Married race
- Biracial
- Other
- Unknown/unknown

**OWNERS INFORMATION**

| City: |
| State: |
| Zip code: |
| Home / Mobile / Work: |
| Phone number: |
| Alternate phone: |

**DESCRIPTIVE INFORMATION**

<table>
<thead>
<tr>
<th>How many animals are ill?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single animal</td>
</tr>
<tr>
<td>Multiple animals in same household (complete a separate interview for each animal)</td>
</tr>
<tr>
<td>Group of animals (e.g. herd, flock, school of fish)</td>
</tr>
</tbody>
</table>

**Case reporting method:**

- Online form
- Phone
- Email
- Other
- Automatic notification (WPC)
- During patient interview (case finding)

**Name of point of contact:**

**Agency name (if any):**

**Phone number ( ):** ext.

**POC's relationship to ill animal(s):**

**How did the POC hear about this program?:**

**Case classification:**

- Confirmed case
- Probable case
- Suspect case
- Not a case

**CDC Case ID:**

**WD HAB Report ID:**

**Wl Case ID:**

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Could the illness in question possibly be due to exposure to cyanobacteria and/or cyanotoxins?
Is the water representative of environmental conditions at the time of the exposure?

- What does the water look like now?
- How many days have passed since the person or animal was exposed?
- Have significant environmental events caused or are they suspected to cause changes to the bloom before sampling?
Harmful Algal Bloom Surveillance Program
Field Staff Sampling Protocol

Wisconsin Division of Public Health
Wisconsin Department of Natural Resources

2018 Update

When to use this kit:
For Response Monitoring by DNR staff when these three criteria are met:
• illnesses suspected to be related to HAB exposure are reported;
• DHS Division of Public Health partners determine the case histories, symptoms, and environmental conditions are consistent with HAB exposure;
• full cyanobacterial identification and enumeration, cyanotoxin analysis, water chemistry, and coliform bacteria testing are required.
Use may be warranted in other situations with public health impact but consult with the Statewide Blue-green Algae Coordinator before using the kit.

When NOT to use this kit:
• Confirmation of bloom presence only.
• Cyanobacterial identification and/or enumeration without requirement for cyanotoxin analysis, water chemistry, or E. coli testing.
Consult with the Statewide Blue-green Algae Coordinator for photo identification, or seek identification and enumeration services from the Wisconsin State Laboratory of Hygiene (WSLH).

If non-DNR entities (county staff, homeowners) are seeking cyanobacterial testing, please refer them to the Statewide Blue-green Algae Coordinator. They can seek services from WSLH, but if testing results are going to be used for beach monitoring or other public health issues, the coordinator needs to brief them on availability of messaging resources and the need to work with local public health officials.
DPH HAB Surveillance Program
### Wisconsin Department of Natural Resources
#### Laboratory Report

**08/03/2016**

**Laboratory:** Wisconsin State Laboratory of Hygiene  
2001 Agriculture Dr  
Madison, WI 53715  
Phone: 800-442-4618  
Fax Phone: 608-224-6213

**Sample:**
- **Sample Description:** Surface Water  
- **Sample Source:** End of Channel on Lake  
- **Sample Time:** 2:10 pm

**Analyses and Results:**

<table>
<thead>
<tr>
<th>Analysis Method</th>
<th>Analysis Date</th>
<th>Lab Comment</th>
</tr>
</thead>
<tbody>
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<td>nU/ml.</td>
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<td>98437</td>
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<td>30</td>
<td>pg/L</td>
<td>2.00</td>
<td></td>
<td>3.00</td>
</tr>
</tbody>
</table>
**Wisconsin Department of Natural Resources**

**Laboratory Report**

**Lab:** Wisconsin State Laboratory of Hygiene

**Sample:**
- **Field #**
- **Collection Start:** 8/03/2016 2:10 pm
- **Collection End:** 8/03/2016 2:10 pm
- **Collected by:** [Redacted]
- **Sample Location:** END OF CHANNEL ON LAKE
- **Waterbody/Outfall ID:** [Redacted]
- **ID Point #:** [Redacted]
- **Account #:** [Redacted]
- **Sample Description:** END OF PIER
- **Sample Source:** Surface Water
- **Sample Depth:** 0.5F
- **Sample Status:** COMPLETE
- **Sample Reason:** [Redacted]
- **Date Reported:** 8/03/2016

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<td>SM 10200 Aphanocapsa sp., count</td>
<td>08/03/2016</td>
<td>25</td>
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<td></td>
<td></td>
<td></td>
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<td>102</td>
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<td>SM 10200 Euglena sp., count</td>
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<td>13</td>
<td>cells/ml</td>
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<td></td>
<td>cells/ml</td>
<td></td>
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**Field Data**

- **Code**: 20
- **Description**: AMBIENT AIR TEMPERATURE FIELD
- **Result**: 25.7 °C
- **Units**: °C

- **Code**: 300
- **Description**: DISSOLVED OXYGEN FIELD
- **Result**: 10.4 mg/L
- **Units**: mg/L

- **Code**: 10
- **Description**: TEMPERATURE FIELD
- **Result**: 28.1 °C
- **Units**: °C

**Microcystin Immunoassay Screen**

**Analysis Date**: 08/03/2016

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<tr>
<td>30437</td>
<td>MICROCYSTIN</td>
<td>30</td>
<td>µg/L</td>
<td></td>
<td></td>
<td></td>
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**Lab Comment**: [Redacted]
Toxic blue-green algae may be present in this area. Avoid swallowing lake water and do not touch algal scums. Keep pets away from the water. Do not swim in areas where you cannot see your feet in knee-deep water.

Be alert! Avoid water that:
- Looks like pea soup or spilled paint
- Is discolored or has colored streaks
- Has surface scums, mats, or films
- Has green dots or globs floating below the surface

For more information, call the [county name] Health Department at [phone number] or visit [department website].
HAB-Related Illness Case Studies
Human Illness Case Study

In August 2017, DPH received faxed report from the Wisconsin Poison Center (WPC).

- 17-year-old male became ill with abdominal cramping and diarrhea the day after recreating in Lake A for less than 30 minutes
- Illness reported to WPC by mother
Human Illness Case Study

- DPH interviewed the mother the following week
  - Husband and son entered water, mother didn’t
  - **Husband also ill**
- Exposure location: near shoreline of county park
- Activities: swimming near shoreline, dunking, playing catch in waist-deep water
Human Illness Case Study

- Signs and symptoms:
  - First sign: headaches within 1 hour of exposure
  - Following morning: abdominal cramping and diarrhea lasting <24 hours
  - No known ill contacts
  - Did not seek medical care

- Environmental conditions:
  - Murky green, "pea soup" water with rotten egg odor
  - Three dead carp present
Human Illness Case Study

- Water Sampling
  - Too late for illness response sampling
  - Other data available?
    - Citizen monitoring at deep hole on day of exposure:
      - Secchi depth: 2.5 ft
      - Trophic state index: 64
      - Clarity: murky
      - Color: green
    - Unknown conditions at shallower shoreline locations
Conclusion

• Signs and symptoms characteristic of cases of HAB-related gastrointestinal illness
• There was observational and environmental evidence of a bloom
• Lab-based HAB data unavailable

Probable case
Two dogs died within 1 hour of each other on the same day after swimming in the same lake.

- Dogs had no connection
- Dogs swam at different beaches on Lake B (Beach A, Beach B)
- No blooms were visually observed
- Owner of one dog went to the media
Animal Illness Case Study

Cavalier King Charles Spaniel

- **Activities at Beach A:** swimming, playing fetch
- **Exposure duration:** 1 hour
- **Signs of illness:**
  - First sign: loss of balance 40 minutes into swimming
  - During walk home: loose stool and frequent urination
  - At home: salivation and frothing at the mouth, vomiting, panting, head and front leg extension, unconsciousness
- **Environmental conditions:** brown and murky water; no observed algal bloom
Animal Illness Case Study

Border Terrier

- **Activities at Beach B:** swimming, playing fetch
- **Exposure duration:** 20-25 min.
- **Signs of illness:**
  - First sign: ataxia/staggering approximately 20 minutes after returning home
  - Other signs/symptoms at home: twisting/turning, convulsions, unconsciousness
- **Environmental conditions:** brown and murky water; no observed algal bloom
Animal Illness Case Study

Dog Deaths Response

WDNR

WDPH

WSLH
Animal Illness Case Study

**WDPH**
Interviewed dog owners and served as point-of-contact between investigation partners

**WDNR**
Collected and analyzed water samples at Beach A and Beach B where dogs were exposed

**WSLH**
Analyzed water samples and dogs’ stomach contents for cyanobacteria and cyanotoxins
Animal Illness Case Study

- **Local Health Dept.**
  - Collected and analyzed water samples for cyanobacteria and cyanotoxins

- **Local Lake Assoc.**
  - Shared results from routine monitoring at Beach A on day of dogs’ exposures

- **Vets**
  - Received, examined, and attempted to treat animals during ER visits; performed necropsies and additional post-mortem testing on both dogs
Animal Illness Case Study

Water sample analysis

- **Low** cyanobacterial cell counts with either **non-detectable** or **very low** levels of cyanotoxins

Stomach content analysis

- Cavalier King Charles Spaniel: **non-detectable** cyanotoxins
- Border Terrier: **non-detectable** cyanotoxins

Post-mortem analyses and necropsies

- Ruled out cyanotoxin exposure
- Identified possible other causes of death
Animal Illness Case Study

Water sample analysis

- Low cyanobacterial cell counts with either **non-detectable** or **very low** levels of cyanotoxins

Stomach content analysis

- Cavalier King Charles Spaniel: **non-detectable**
- Border Terrier: **non-detectable**

Post-mortem analyses and necropsies

- Ruled out cyanotoxin exposure
- Identified possible other causes of death

*Not a case!*
Public Health Importance
Public Health Importance

- Emerging public health problem worldwide.
- Projected increases in severity and magnitude.
- Health impacts are still poorly understood.
Public Health Challenges

- Poor recognition of cases.
- Failure to associate illness with algal bloom exposure.
- Challenging to diagnose.
  - Non-specific symptoms
  - Medical attention not sought
  - Low case recognition among doctors and vets
  - No clinical diagnostic test
Illness Prevention
How Can I Help?
How Can I Help?

- Become familiar with the signs and symptoms and water conditions.
How Can I Help?

- Become familiar with the signs and symptoms and water conditions.
- Educate others.
How Can I Help?

- Become familiar with the signs and symptoms and water conditions.
- Educate others.
- Report suspected illnesses.
How Can I Help?

• Become familiar with the signs and symptoms and water conditions.

• Educate others.

• Report suspected illnesses.

• Encourage others to report suspected illnesses.
How Can I Help?

- Become familiar with the signs and symptoms and water conditions.
- Educate others.
- Report suspected illnesses.
- Encourage others to report suspected illnesses.
- Report obvious blooms to the Wisconsin DNR.
Illness Prevention
Illness Prevention

Do not swim or allow your kids or pets to swim where water is discolored or where you see foam, scum, or algal mats.
Illness Prevention

Do not swim or allow your kids or pets to swim where water is discolored or where you see foam, scum, or algal mats.

Do not boat, tube, water ski, jet ski, or wakeboard through algal blooms.
Illness Prevention

Do not swim or allow your kids or pets to swim where water is discolored or where you see foam, scum, or algal mats.

Do not boat, tube, water ski, jet ski, or wakeboard through algal blooms.

Shower after swimming in lakes, rivers, and ponds.
Illness Prevention

Keep pets out of discolored water or where you see foam, scum, or mats of algae.
Illness Prevention

Keep pets out of discolored water or where you see foam, scum, or mats of algae.

If dogs swim in scummy water, rinse them off right away—do not let them lick algae off their fur.
Illness Prevention

Keep pets out of discolored water or where you see foam, scum, or mats of algae.

If dogs swim in scummy water, rinse them off right away—do not let them lick algae off their fur.

Respect beach closures and health advisories.
Illness Prevention

When in doubt, stay out!
Report illnesses in humans & animals online, or call 608-266-1120

NEW!
For healthcare providers: beginning 7/1/2013, report any suspected human cases of Cyanobacteria and Cyanobacterial Poisoning electronically through WEDSS or by mailing or faxing a completed Acute and Communicable Disease Case Report, F-44155, to the address on the form.

For members of the general public and veterinarians call 608-266-1120 or complete the online form: Harmful Algae Bloom (HAB) Report or Sighting Survey, F-02110 to report any blue-green algae blooms or related human illnesses to the Wisconsin Harmful Algae Bloom Program.

Please let the DNR know about significant bloom events!
DNRHABS@wisconsin.gov
Bloom location with lake, town, & county name, size, duration, photos

DHSDDPHHABS@dhs.wisconsin.gov
Gina.LaLiberte@wisconsin.gov

dhs.wisconsin.gov
Search for “algae”
dnr.wi.gov
Search for “algae”