Wisconsin Department of Health Services
Division of Public Health
P-02198 (Rev 6/2018)

Communicable Disease Case Reporting and Investigation Protocol

BLUE-GREEN ALGAE (CYANOBACTERIA) AND CYANOTOXIN POISONING

I. IDENTIFICATION AND DEFINITION OF CASES

A. **Overview:** Cyanobacteria, also known as blue-green algae, are aquatic photosynthetic bacteria that are naturally present in water bodies across Wisconsin. Some cyanobacterial species can produce water-soluble toxins called cyanotoxins. Exposure to cyanotoxins or algal material can cause cyanobacterial poisoning in humans and animals. The health risk from cyanobacteria exposure is greatest during cyanobacteria blooms (also known as harmful algal blooms or cyanoHABs) when the density of cyanobacteria in the water can increase dramatically. CyanoHABs are fueled by warm water temperatures, abundant sunlight, ample nutrient fertilizer, and stagnant water conditions. Blooms can occur at any time of the year but are most common during June through October in Wisconsin. Recognition and reporting of suspected cases of cyanobacterial poisoning enable public health professionals to investigate and intervene to prevent additional exposures and illnesses.

Cyanotoxins are a diverse group of compounds that can affect the liver, nervous system, skin, and other tissues based on toxicological target. In addition to toxins, exposure to other, still unidentified cyanobacterial metabolites and compounds from cyanobacteria can result in illness, even at relatively low cyanobacterial cell densities and toxin levels.[1]

People can develop acute cyanobacterial poisoning after being exposed to cyanotoxin-contaminated waters or algal material. Routes of exposure include:

- Ingestion of contaminated water or algal material during recreational activity.
- Ingestion of inadequately treated drinking water from a surface water source experiencing a bloom.
- Ingestion of cyanotoxins in blue-green algae dietary supplements.
- Direct skin contact with contaminated water or with accumulated or decaying algal scum along shorelines.
- Inhalation of airborne water droplets containing cyanotoxins during motorized water sports or while in proximity to irrigation or aeration of contaminated water.
- Less commonly, inhalation of volatile airborne compounds while in close proximity to a bloom, such as while walking along shorelines of water bodies experiencing severe blooms.

B. **Clinical Description:** Diagnosis of cyanobacteria and cyanotoxin poisoning involves the observation of symptoms and/or clinical signs after exposure to water that is suspected to contain elevated cyanobacteria and/or cyanotoxin levels (see section I D below). Symptoms of acute cyanobacterial poisoning may develop within minutes, hours, or days, but most commonly manifest within 24 hours of exposure. Skin rashes may take up to two days to appear.

Symptoms of cyanotoxin poisoning vary according to cyanotoxins present, their mechanisms of action, their concentrations, and the route(s) of exposure, but generally fall into three main syndromes:

- Gastrointestinal: Stomach pain, nausea, vomiting, and diarrhea, sometimes with severe headaches and fever. Exposure to large amounts of cyanobacterial liver toxins or repeated short-term exposure can cause liver damage. This is reflected in elevated serum gamma glutamyl transpeptidase (GGT) levels.
- Respiratory: Runny eyes and nose, cough, sore throat, pleuritic pain, asthma-like symptoms, or allergic reactions.
- Dermal: Rash, hives, or skin blisters (especially under swimsuits). Rash is typically limited to areas of the body exposed and may be worse in areas in contact with algal scums. Allergic and toxic dermal reactions have been observed; allergic predisposition may be a risk factor.

Treatment for both humans and animals is supportive. Illness in persons exposed to small amounts of cyanotoxins via ingestion or inhalational routes typically resolves within 2–5 days of exposure. Dermal symptoms typically

[1] World Health Organization. Chorus, I. and J. Bartram, eds. *Toxic Cyanobacteria in Water: A Guide to Their Public Health Consequences, Monitoring, and Management*. London, 1999: 161.

resolve within 1–2 weeks of exposure. Individuals sustaining liver damage may require longer recovery times; progress can be measured by monitoring serum GGT levels.

C. **Laboratory Criteria for Diagnosis:** None. Diagnosis is clinical; there are currently no commercially available clinical tests for the diagnosis of cyanotoxin poisoning.

D. **Wisconsin Surveillance Case Definition:**
Suspect: Clinically compatible illness with exposure to blue-green algal material, or untreated recreational water or surface drinking water suspected to contain elevated levels of cyanobacteria or cyanotoxins[†] in the week before illness onset, in the absence of other more likely diagnosis, should be reported as a suspected case.

Clinically compatible illness is defined as the presence of (alone or in combination):
- Gastrointestinal symptoms,
- Respiratory symptoms,
- Dermal symptoms, or
- Elevated serum gamma glutamyl transpeptidase (GGT),
  AND
- A history of exposure to a body of surface water that is suspected to contain elevated levels of cyanobacteria and/or cyanotoxins[†] in the 7 days before illness onset.

[†]Suspicion of elevated cyanobacteria and/or cyanotoxin levels may include any of the following (as reported by patient during exam or interview, in patient history, or by first-hand knowledge):
- Visual evidence of a cyanobacterial bloom (e.g., water discoloration, visible algal scum).
- Health advisory or cyanobacteria warning signage posted at the time and location of exposure.
- History of blooms and/or recent beach closures due to cyanobacteria at the location of exposure.
- Documented elevation of cyanobacteria levels and/or cyanotoxins through laboratory testing of water samples.

Health care providers and public health professionals should report all suspected cases of cyanotoxin poisoning to public health and the Wisconsin Electronic Disease Surveillance System (WEDSS) as suspect cases. Final case definitions (section VII) will be applied by Division of Public Health (DPH) staff at the conclusion of the case investigation and assessment.

II. REPORTING

A. **Wisconsin Disease Surveillance Category II—Methods for Reporting:** This disease shall be reported to the patient's local health officer or to the local health officer's designee within 72 hours of recognition of a case or suspected case, per Wis. Admin. Code § DHS 145.04 (3) (b). Report electronically through the Wisconsin Electronic Disease Surveillance System (WEDSS) as an incident of Blue-Green Algae (Cyanobacteria) and Cyanotoxin Poisoning, or mail or fax a completed DPH Acute and Communicable Disease Case Report (F-44151) to the address on the form.

Two or more illnesses associated with exposure to a common water source should be considered a suspected waterborne disease outbreak and also reported immediately per Wis. Admin. Code § DHS 145.04 (3) (a).

Members of the public wishing to report suspected cases directly to DPH can complete the online Harmful Algae Bloom (HAB) Illness or Sighting Survey (F-02152) on the DPH blue-green algae website.

Although not reportable by law, reported animal cases of cyanobacterial poisoning are also investigated by DPH as sentinels for human cases. Animal cases may be reported using the online Harmful Algae Bloom (HAB) Illness or Sighting Survey (F-02152) or to the DPH Harmful Algal Blooms (DPH HAB) Program at (608) 266-1120.

B. **Responsibility for Reporting**: According to Wis. Admin. Code § DHS 145.04(1), persons licensed under Wis. Stat. ch. 441 or 448, laboratories, health care facilities, teachers, principals, or nurses serving a school or day care center, and any person who knows or suspects that a person has a disease identified in Appendix A. Poison Centers suspecting cyanobacterial poisoning in clients should also report suspected cases to DPH.

C. **Clinical Criteria for Reporting:** Clinically compatible illness with exposure to blue-green algal material, or untreated recreational water or untreated surface drinking water suspected to contain elevated levels of cyanobacteria or cyanotoxins in the week before illness onset, in the absence of other more likely diagnosis, should be reported as a suspected case.

D. **Laboratory Criteria for Reporting:** None. There are currently no commercially available clinical tests for the diagnosis of cyanotoxin poisoning; diagnosis is clinical.

III. CASE INVESTIGATION

A. **Responsibility for case investigation**: Due to the complexity of case investigation and risk assessment, the DPH HAB Program will perform case investigations unless local health departments (LHDs) choose to conduct initial routine follow-up for all cases in their jurisdictions. Case investigation may include information collected by phone, in person, in writing, through review of medical records or disease report forms, and through environmental sampling and analysis. LHDs should immediately import or enter case reports into WEDSS and send cases to the state through WEDSS for investigation. **Timely investigation of suspected cyanotoxin poisoning cases is essential for preventing additional exposures and illnesses.**

LHDs that choose to perform their own initial case follow-up should notify the DPH HAB Program at dhsdphhabs@wi.gov by June 1 of each year. Initial case follow-up includes timely collection of information from reporters, completion of the full patient interview, and entry of interview information into WEDSS. LHDs should then send cases to the state through WEDSS for further investigation and risk assessment. DPH HAB Program staff will help coordinate environmental source investigation, sample collection, and testing with state and local agencies as appropriate, provide interpretation of testing results to LHDs, and aid LHDs in choosing appropriate public health interventions in response to investigation findings (see Additional Investigation Responsibilities below).

A. **Required Documentation:**

Documentation will be completed by DPH HAB Program staff unless the LHD has elected to perform follow-up for all cases in their jurisdiction as described above.

1. Complete the WEDSS disease incident investigation report, including appropriate, disease-specific tabs. This can be facilitated by interviewing the patient using the Human Blue-Green Algae (Cyanobacteria) and Cyanotoxin Poisoning Investigation Questionnaire.
2. Upload any bloom photos, laboratory results from water or environmental testing, medical records, or other case investigation documentation to the WEDSS disease incident filing cabinet. After completion of initial follow-up, LHDs should update the resolution status to “sent to state.”
3. If the case is epidemiologically linked to additional human or animal illnesses, a new outbreak investigation should be created in the WEDSS outbreak module and any human or animal cases linked to the outbreak.
4. DPH staff should update the disease incident process status to “final” after completing the public health assessment of the case and assigning the appropriate resolution status (classification) in WEDSS.
5. DPH staff should report both the cyanoHAB event and all associated human and/or animal illnesses to the Centers for Disease Control and Prevention’s (CDC) One Health Harmful Algal Blooms System.

B. **Additional Investigation Responsibilities:**

1. **Source investigation:** In coordination with DPH, a source investigation by the LHD, Wisconsin Department of Natural Resources (DNR) staff, or other agency is needed to help determine if there is an ongoing risk to the public at the exposure location. Active cyanobacterial blooms are considered a human health hazard, as defined in Wis. Stat. §254.01 (2). The investigation may include visitation of the exposure site to assess current water conditions, collection of photographic evidence of water conditions, collection of water samples, and posting of health advisory signage, as appropriate.

2. **Water sampling:** Water samples may be collected in response to a human or animal illness complaint in consultation with DPH HAB Program staff. Based on case investigation findings, DPH staff will coordinate water sampling and analysis, if appropriate. Fee-exempt testing of water samples for cyanobacteria and/or cyanotoxins at the Wisconsin State Laboratory of Hygiene (WSLH) must be approved by DPH HAB Program staff before collection. Samples should be collected using established DNR blue-green algae sample

collection protocols and specialized cyanoHAB sample collection kits (available from WSLH). Samples may also be collected to help assess anticipated or ongoing risk to public health posed by a bloom.

3. **Public health risk assessment:** DPH shall investigate the human health implications of an incident and assess ongoing risk to the public through review of data collected during the case investigation, environmental source investigation, and results of any environmental testing, and determine if a human health hazard exists. The results of this assessment, as well as appropriate recommendations to protect public health (e.g., beach closure, advisory posting), will be communicated to the local public health officer in the jurisdiction of exposure. Risk of adverse health effects is evaluated using observational data, as well as the World Health Organization's (WHO) Guidelines for Safe Recreational Water Environments and the U.S. Environmental Protection Agency's (EPA) Draft Human Health Recreational Ambient Water Quality Criteria and/or Swimming Advisories for Microcystins and Cylindrospermopsin.

IV. PUBLIC HEALTH INTERVENTIONS AND PREVENTION MEASURES

A. **Responsibility for health advisories, beach or water body closures, and public messaging:** Per Wis. Stat. §. 254.46 (Beaches), the local health officer or the department shall close or restrict swimming, diving and recreational bathing if a human health hazard exists in any area used for these purposes on a body of water and on associated land in their jurisdiction and shall require posting of the area. LHDs have primary authority for issuing health advisories, beach or water body closures, and public messaging. DNR has the authority to post signage and close public beaches at state park and Great Lakes beaches.

B. **Prevention of additional exposures**: Timely assessment of water conditions and evaluation of ongoing risk to the public is important. Depending on the extent and severity of the health hazard, intervention may include posting health advisory signage, beach closure, water body closure, or other appropriate intervention. DPH can provide guidance and technical assistance to LHDs to assist in this process.

1. **Recreational Water Exposures:**
High concentrations of cyanobacteria or the presence of an algal scum on the water or shoreline are associated with high risk of adverse health effects and require immediate intervention. Risk of adverse health effects is considered lower at lower concentrations of cyanobacteria; however, even at lower concentrations, children, pets, and other susceptible individuals may still experience illness. Based on available water quality observations and cyanobacterial or cyanotoxin test results, the relative probability of adverse health effects should be evaluated in consultation with DPH using established criteria.

Important note: Direct visual observation or indirect visual (i.e., photographic) observation of water or beach conditions supportive of high risk of adverse health effects is considered sufficient grounds for LHDs to issue health advisories and beach closures; laboratory testing results are not a prerequisite. Interventions can be made in advance of water testing or while results are pending to protect public health.

a. **Criteria for public health advisory posting ("caution")**:
- Visual evidence suggesting cyanobacteria concentrations of 20,000-40,000 cells/mL (DPH HAB Program staff can evaluate photographs of water conditions), OR
- Laboratory test results indicating:
  - Measured cyanobacteria concentrations of 20,000-40,000 cells/mL (toxin-producing species), OR
  - Measured microcystin concentrations of 4-8 µg/L, OR
  - Measured cylindrospermopsin concentrations 4-8 µg/L.

Physical signage with cautionary messaging warning the public about the potential risk posed from cyanobacteria should be posted at public beaches and access points on the affected water body while the bloom is occurring. Consult the DPH HAB Program for guidance on public messaging.

b. **Criteria for immediate beach closure (with "warning" public health advisory posting) include any of the following:**

- Presence of a visible scum layer on the surface of the water or along the shoreline in bathing areas (scum may be a variety of colors and densities).
- Visual evidence suggesting very high concentrations of cyanobacteria in water, such as water that is "pea soup" green or opaque.
- Visual evidence suggesting cyanobacteria concentrations of >40,000 cells/mL (DPH HAB Program staff can evaluate photographs of water conditions).
- Laboratory test results indicating:
  - Measured cyanobacterial concentrations >40,000 cells/mL (toxin-producing species), OR
  - Measured microcystin concentrations > 8 µg/L (all congeners), OR
  - Measured cylindrospermopsin concentrations > 8 µg/L.

Beach closures are designed to prevent the public from being exposed to high concentrations of cyanobacteria and cyanotoxins when risk of adverse health effects is highest. Physical signage with "warning: no swimming" language should be posted at affected public beaches and access points while the bloom is occurring. In large water bodies, a combination of signage and public messaging should be used. LHDs may also use media releases to inform the public at-large about ongoing risk at a water body in their jurisdiction.

c. **Water body closure:** Water body closures temporarily close an entire water body to all recreational activity, including boating, fishing, and swimming. They are typically employed when cyanobacterial and/or cyanotoxin concentrations are extremely high (>10,000,000 cells/mL, scum formation), or prolonged in order to prevent any exposure to the bloom through contact, ingestion, or aerosols. LHDs should use signage and public messaging to advertise the closure.

2. **Drinking Water Exposures:**
If finished drinking water from a public drinking water system is suspected to be a source of illness, DPH should be notified immediately. DPH, DNR, and LHDs will work collaboratively to investigate and respond to these incidents in accordance with existing memoranda of understanding.

C. **Provision of health education:**

- **Recreational exposures:** Educate patients on how to evaluate water conditions before swimming and learn to recognize and avoid blooms.
  - Follow and observe any posted water quality advisories or closures at water bodies to protect your health.
  - Choose safe locations to swim. If you can wade knee-deep into water (without disturbing the sediment) and cannot see your feet because the water is green or not clear, or if the water is any other unusual color, you should stay out.
  - Do not swim in water that looks like "pea soup", green or blue paint, or that has a scum layer or puffy blobs floating on the surface.
  - Do not boat, water ski, etc. over water that looks like "pea soup", green or blue paint, or that has a scum layer or puffy blobs floating on the surface (people can be exposed through inhalation).
  - Small children and pets should always be kept away from water experiencing blooms, since they are more likely to accidentally swallow water. Do not let children play with scum layers or accumulated scum on the shoreline shore.
  - Always take a shower or wash hands after coming into contact with any surface water.
  - Always avoid swallowing untreated surface water— it may contain things other than blue-green algae which could make you ill, like potentially harmful bacteria and viruses.
- **Drinking water exposures:** Drink only safe water. During a "do not drink" advisory for cyanotoxins, follow instructions provided by the issuing agency. Drink only bottled water or water from a safe source during a drinking water advisory for cyanotoxins. Do not boil water containing cyanotoxins—this will concentrate the toxins in the water.
- **Pets and animals:** Do not let pets swim in or drink from waters experiencing blue-green algae blooms or noticeably green water. Provide fresh clean water from a safe source. If a pet has contact with an algal bloom, rinse the pet immediately with clean water. Do not allow pets to lick algae off their fur or consume algal material accumulated along shorelines. See your veterinarian immediately if your pet has exposure to algae and exhibits symptoms.

- **Irrigation:** Avoid using water from bloom-affected lakes for irrigating lawns, crops, or gardens whenever possible. Avoid fruits and vegetables that have come into contact with contaminated water until they have been washed with clean water. Aeration fountains and irrigation sprays can create airborne water droplets containing toxins. Toxins can also accumulate on crops over time. Avoid contact with and being in close proximity to irrigation spray.
- **Fish consumption:** Watch for posted health advisories indicating if a bloom is present. If an algal bloom is present, clean the fish thoroughly, rinse with clean water, and discard the viscera (guts), where toxins may accumulate. Algal toxins have not shown to accumulate to acutely toxic levels in the fillet. Wash hands and arms after handling fish caught during an algal bloom.

V. CONTACTS FOR CONSULTATION

A. Wisconsin Poison Center: 800-222-1222 (for persons currently experiencing symptoms)

B. HAB Program, Bureau of Environmental and Occupational Health, Division of Public Health, DHS: 608-266-1120 (to report suspected cases of human or animal illness related to cyanobacteria or cyanotoxin exposure and for health-related inquiries, public health risk and intervention consultation, laboratory result interpretation, messaging assistance)

C. Wisconsin State Laboratory of Hygiene: 1-800-862-1013 (for inquiries related to environmental sample collection and storage; water and environmental testing services available, ordering, pricing, and shipping; testing for water utilities)

D. Blue-Green Algae Coordinator, Wisconsin DNR: 608-221-5377 or 608-264-8955 (to report blooms without associated illnesses and for inquiries related to cyanobacterial ecology, distribution, management, and remediation strategies)

E. Chief, Public Water Supply Section, Wisconsin DNR: 608-264-9229 (for drinking water concerns)

VI. RELATED REFERENCES

A. World Health Organization. Chorus, I. and J. Bartram, eds. *Toxic Cyanobacteria in Water: A Guide to Their Public Health Consequences, Monitoring, and Management*. London, 1999.

B. DPH Blue-Green Algae Website: https://www.dhs.wisconsin.gov/water/bg-algae/index.htm

C. CDC Physician Reference Card: https://www.cdc.gov/habs/materials/reference-cards.html

D. CDC Veterinarian Reference Card: https://www.cdc.gov/habs/materials/reference-cards.html

E. Wisconsin DNR Blue-Green Algae website: http://dnr.wi.gov/lakes/bluegreenalgae/

F. Wisconsin DNR Blue-Green Algae Drinking Water Concerns website: http://dnr.wi.gov/lakes/bluegreenalgae/Default.aspx?show=drinking

G. CDC Harmful Algal Bloom-Associated Illness website: https://www.cdc.gov/habs/index.html

VII. SURVEILLANCE CASE AND CRITERIA DEFINITIONS

The following are case and criteria definitions DPH HAB Program investigators use to assess cases and assign appropriate resolution statuses for surveillance purposes:

Case Classification	Assessment Criteria							
	Exposure[1]	Clinically compatible illness[2]	Observational or environmental data[3]	Laboratory-based environmental data[4]	Professional medical diagnosis[5]	Negative review of alternative diagnoses[6]	Clinical laboratory evidence[7]	Public health assessment[8]
Suspect	Required	Required						Required
Probable	Required	Required	Required to have one					Required
Probable	Required	Required	+/-		Required	+/-		Required
Confirmed	Required	Required	+/-	Required	Required to have one			Required
Confirmed	Required	Required	+/-	+/-	Required to have one		Required	Required

[1]**Exposure**: Defined as having exposure (i.e., physical contact, inhalation, ingestion) to water, algae, seafood, or dietary supplements, or being in close physical proximity to water experiencing a blue-green algae bloom (if non-gastrointestinal illness).

[2]**Clinically compatible illness:** Reported symptoms and clinical signs are consistent with those reported after cyanoHAB exposure in the scientific literature, including both in incubation period and duration, as well as with the route(s) of exposure reported.

[3]**Supportive observational or environmental data**: Observational (e.g., scum, algae, water color change, sheen, photographic evidence, Secchi disk depth, satellite data) or environmental data (e.g., pH, chlorophyll, nutrient levels, trophic index) from a water body to supporting the presence of an algal bloom.

[4]**Supportive laboratory-based environmental evidence:** Laboratory detection of cyanobacteria or other potentially toxin-producing algae, (e.g., microscopic confirmation or DNA analyses) or algal/cyanobacterial toxins (e.g., bioassay, HPLC) in a water body, finished drinking water supply, seafood or dietary supplements.

[5]**Professional medical diagnosis**: Medical diagnosis of cyanotoxicosis/cyanobacterial poisoning provided by a medical practitioner (e.g., doctor, nurse, physician assistant) based on his or her medical assessment of the patient's symptoms, medical history, and exposure.

[6]**Negative review of alternative diagnoses:** No other more likely cause of illness identified through review of patient-reported pre-existing conditions and medical history or, if patient visited a medical provider, diagnosed by physical exam, clinical laboratory testing, or imaging conducted by healthcare provider.

[7]**Supportive clinical laboratory evidence:** Laboratory detection/identification of cyanobacteria, other potentially toxin-producing algae, or algal/cyanobacterial toxins in a clinical specimen (e.g., stomach contents, feces, vomitus).

[8]**Supportive public health assessment:** Defined as the cumulative result of compiling all available clinical, exposure, environmental, and laboratory testing data (including measured cyanobacteria/cyanotoxin concentrations, etc.) and evaluating the likelihood the illness in question is HAB-related. The public health assessment can only be performed by trained DPH HAB Program staff. If the assessment indicates a relatively low likelihood illness is HAB-related (e.g., cyanobacteria/cyanotoxin concentrations insufficient, some symptoms not compatible), but it is still possibly HAB-related, the case may be classified as suspect. If assessment indicates illness is not likely HAB-related, it should be classified as not a case. Illnesses assessed as being likely due to HAB exposure should then be classified according to the case definition table by DPH staff.