



Cyanobacterial Blooms and Associated Illnesses

A Clinician Toolbox for Physicians and Healthcare Providers

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Learning Objectives

After this training, participants should be able to:

- ✓ Understand how to identify cyanobacterial blooms.
- ✓ List signs and symptoms associated with cyanobacterial bloom-associated illnesses.
- ✓ Describe how to diagnose cyanobacterial bloom-associated illnesses, including cyanotoxin exposures.
- ✓ Know where to find cyanobacterial bloom advisories.
- ✓ Explain the importance of reporting cyanobacterial bloom-associated illnesses to the state health agency.



Module 1

INTRODUCTION TO CYANOBACTERIAL BLOOMS

Harmful Blooms and their Toxins

- Certain environmental conditions can cause the rapid growth of algae or phytoplankton in water bodies, forming blooms.
- Some blooms can be harmful to animals, people, and the environment.
- Health effects from harmful algal bloom are associated with a variety of toxins.
- While some of the information in these modules will address blooms in general, this training will focus on **cyanobacteria**, which are typically found in fresh water.



Source: [CDC Public Health Image Library](#).

What are Cyanobacteria?

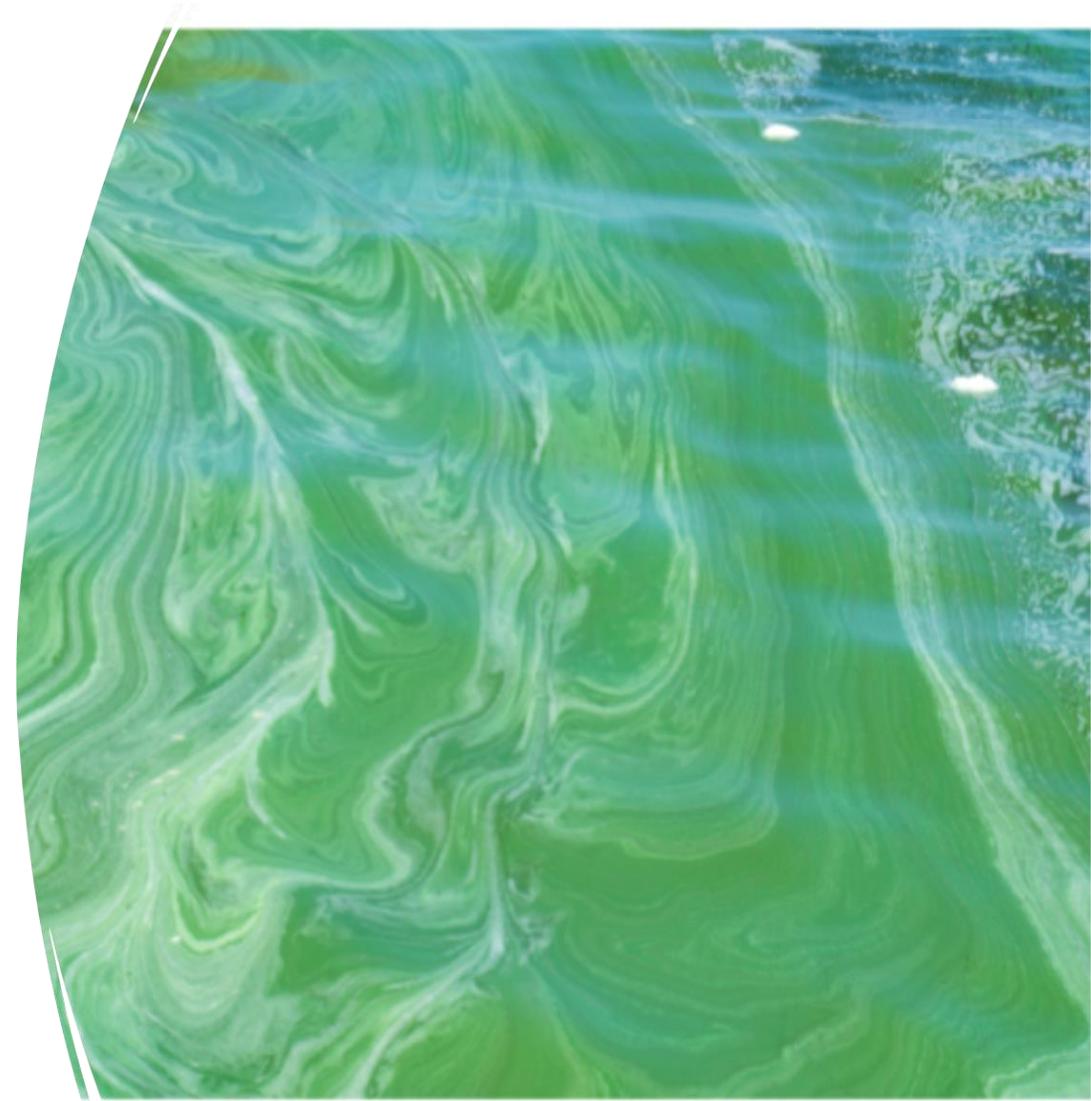
- In fresh water, such as lakes and rivers, harmful blooms are commonly caused by **cyanobacteria**, which are sometimes referred to as blue-green algae.
- **Cyanobacteria** are simple organisms that conduct photosynthesis and generate blooms in water that is warm, slow-moving, and nutrient-rich. Although they are called bacteria, cyanobacteria are not infectious in themselves, but can become harmful when they bloom.
- **Cyanobacterial blooms** can look like foam, scum, mats, or paint floating on the surface of the water.



Source: [CDC Public Health Image Library](#).

Cyanobacteria

- Cyanobacterial blooms may affect people, animals, and/or the environment.
- They can negatively impact drinking and recreational water quality, air quality, and food.
- Some, but not all, cyanobacteria produce toxins, called **cyanotoxins**.



Source: stock.adobe.com

Cyanobacteria

- While many **cyanobacterial blooms** have a bright green color, they can also be blue-green, brown, or yellow depending upon the type of cyanobacteria present.
- When organisms in a bloom die and decompose, they may have a pungent sewage-like smell, and dead cells may release toxins into the water.



Source: stock.adobe.com

Benthic Cyanobacteria

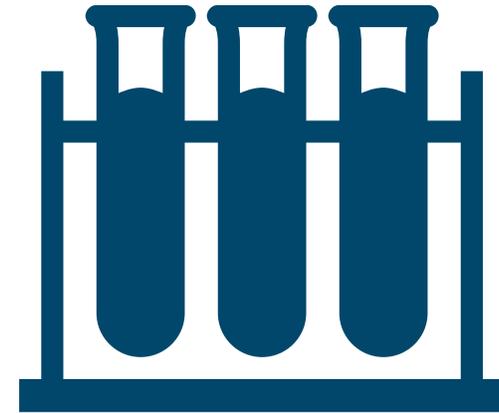
- **Some cyanobacterial blooms are not visible at the surface of the water.**
- *Benthic cyanobacteria* attach to surfaces under water and can appear as mats attached to rocks, logs, and the sediment.
- Disturbing these mats may risk releasing toxins to the water, so it is important for people to be aware of their surroundings when swimming or wading in water.



Source: stock.adobe.com

Testing is the Only Way to Identify Toxins

- You cannot tell if a bloom is harmful just by looking at it, so patients should be advised to be cautious and avoid swimming in fresh water that is discolored.
- A bloom needs to be tested to know if toxins are present.
- A bloom's size or thickness is not an indication of the amount of toxin that can be produced.



Common Cyanotoxins

Below are cyanotoxins commonly found in the United States, along with their class of toxin:

- ***Microcystins***: Hepatotoxins and dermatotoxin
- ***Cylindrospermopsin***: Hepatotoxin and nephrotoxin
- ***Anatoxins***: Neurotoxins
- ***Saxitoxin***: Neurotoxin (best known for causing paralytic shellfish poisoning)
- ***Nodularins***: Hepatotoxins
- ***Lyngbyatoxin***: Cytotoxin and dermatotoxin
- ***Lipopolysaccharides*** in cell walls of cyanobacteria: Dermatotoxin

Module 1 Recap

- Algae and cyanobacteria can be harmful.
- Cyanobacteria are found primarily in fresh water.
- Cyanobacterial blooms can change how water looks and smells.
- Cyanobacterial blooms that produce cyanotoxins are not always visible.
- Testing is the only way to identify toxins. You cannot tell if a bloom is harmful just by looking at it.



Module 2

**ROUTES OF EXPOSURE AND SYMPTOMS RELATED TO
CYANOBACTERIAL BLOOM-ASSOCIATED ILLNESSES**

Exposure to Cyanobacteria, Cyanotoxins, and Symptoms

Potential Exposure Route	Scenario	Possible Signs and Symptoms
Oral <i>Differential diagnosis:</i> Other hepatotoxin poisoning or microbial infections or toxins.	<ul style="list-style-type: none">• Swallowing water with high concentrations of cyanotoxins.• Ingesting shellfish with bioaccumulated cyanotoxins.• Consuming contaminated blue-green algae supplements.	Hepatotoxins and nephrotoxins (e.g., microcystins, cylindrospermopsin): <ul style="list-style-type: none">• Nausea, vomiting, or diarrhea• Bad taste in mouth• Blisters in mouth• Acute jaundice and/or hepatitis• Blood in urine or dark urine• Malaise, lethargy• Headache and fever• Loss of appetite• Elevated liver enzymes• Kidney damage• Anorexia

Exposure to Cyanobacteria, Cyanotoxins, and Symptoms

Potential Exposure Route	Scenario	Possible Signs and Symptoms
<p>Oral</p> <p><i>Differential diagnosis:</i> Other hepatotoxin poisoning or microbial infections or toxins.</p>	<ul style="list-style-type: none"> Swallowing water with high concentrations of cyanotoxins. Ingesting shellfish with bioaccumulated cyanotoxins. Consuming contaminated blue-green algae supplements. 	<p>Neurotoxins (e.g., anatoxin-a, guanitoxin, saxitoxin):</p> <ul style="list-style-type: none"> Tingling, burning, and numbness in extremities Dizziness Drowsiness Incoherent speech Tremor Fasciculations Hypersalivation Diarrhea Ataxia Motor weakness Respiratory and muscular paralysis



Exposure to Cyanobacteria, Cyanotoxins, and Symptoms

Potential Exposure Route	Scenario	Possible Signs and Symptoms
Dermal <i>Differential diagnosis:</i> Other dermal allergens, non-allergic urticaria, or photosensitivity reactions.	<ul style="list-style-type: none">• Skin contact with cells from the bloom.• Skin contact with toxin.	<ul style="list-style-type: none">• Allergic dermatitis (including red, raised self-limiting rash, itching, and blisters) in sensitive populations• Conjunctivitis• Dermal lesions, seaweed dermatitis (swimmer's itch-type rash)
Inhalation <i>Differential diagnosis:</i> Other airborne allergens, upper respiratory infection, or flu.	<ul style="list-style-type: none">• Breathing droplets or aerosols contaminated with cyanotoxins.	<ul style="list-style-type: none">• Upper respiratory irritation (e.g., wheezing, coughing, chest tightness, and shortness of breath)• Other cold-like symptoms, such as a runny nose or sore throat• Rhinitis• Bronchospasm• Pneumonia

Treatment for Exposure to Cyanotoxins

- Symptoms in people are generally self-limiting, going away within 72 hours.
- However, when symptoms persist, most people will seek medical attention.
- While supportive care treatment is generally sufficient, oral exposure may require more intensive care in severe cases.

In 2014, Ohio's governor issued a "Do not drink" advisory because a class of toxins called microcystins were detected in Toledo's water supply. After the advisory ended, the Ohio Department of Health conducted a Community Assessment for Public Health Emergency Response to learn about the community's experiences during the two-day advisory. They found that over 50% of households reported drinking the water, and about 16% of households reported physical symptoms, such as nausea, diarrhea, stomach pain, vomiting, headache, skin irritation, eye irritation or pain, respiratory illness, and/or coughing.

Source: CDC [HABs](#).

Module 2 Recap

- Individuals can be exposed to cyanotoxins through:
 - Ingestion,
 - Skin contact, and/or
 - Inhalation.
- Symptoms in humans are generally self-limiting, going away within 72 hours.



Module 3

HEALTH AND DIAGNOSTIC INFORMATION FOR CYANOTOXINS

Health Impacts of Cyanotoxins

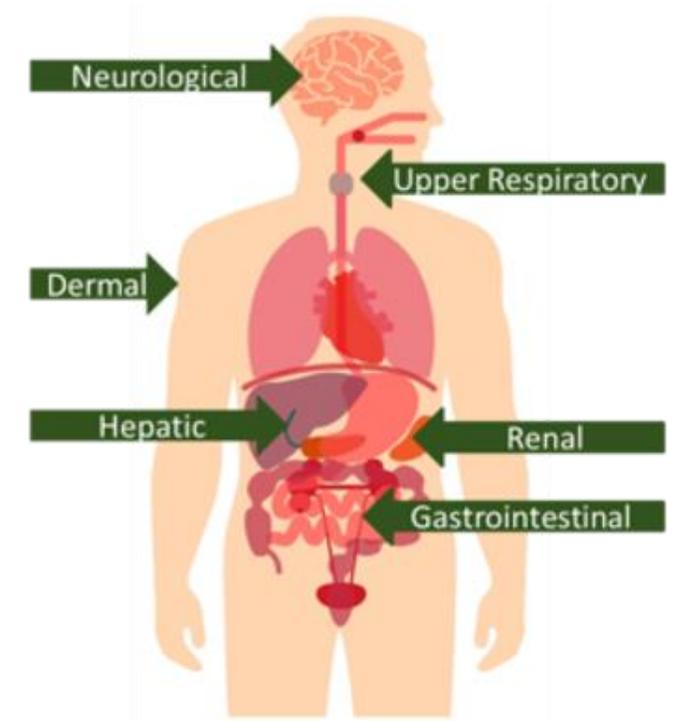
- Patients may become ill from exposure to cyanotoxins through ingestion, inhalation, or direct skin contact.
- There are no known antidotes or specific treatments for exposure to these toxins, and medical care is generally supportive.
- Although there have been no documented human deaths due to cyanotoxin exposure in the United States, people can become ill from coming into contact with cyanobacteria.

GI symptoms from oral exposure usually begin 3-5 hours after exposure, and may last for 1-2 days.

Source: [CDC](#)

Health Impacts of Cyanotoxins

- Illness and symptoms can vary depending on the route of exposure, the length of exposure, toxin dose, and the specific cyanotoxin present.
- According to [CDC](#), cyanotoxin exposure may cause minor issues such as nausea or rashes.
- Health effects depend on the type of toxin.
- At this time, except in the extreme case of dialysis with microcystin-contaminated water, cyanobacterial bloom exposure has not been shown to cause serious injury or death in [humans](#).



Source: Wisconsin Department of Health. "Harmful Algal Blooms Program Newsletter."
Available at <https://content.govdelivery.com/accounts/WIDHS/bulletins/23db5df>.

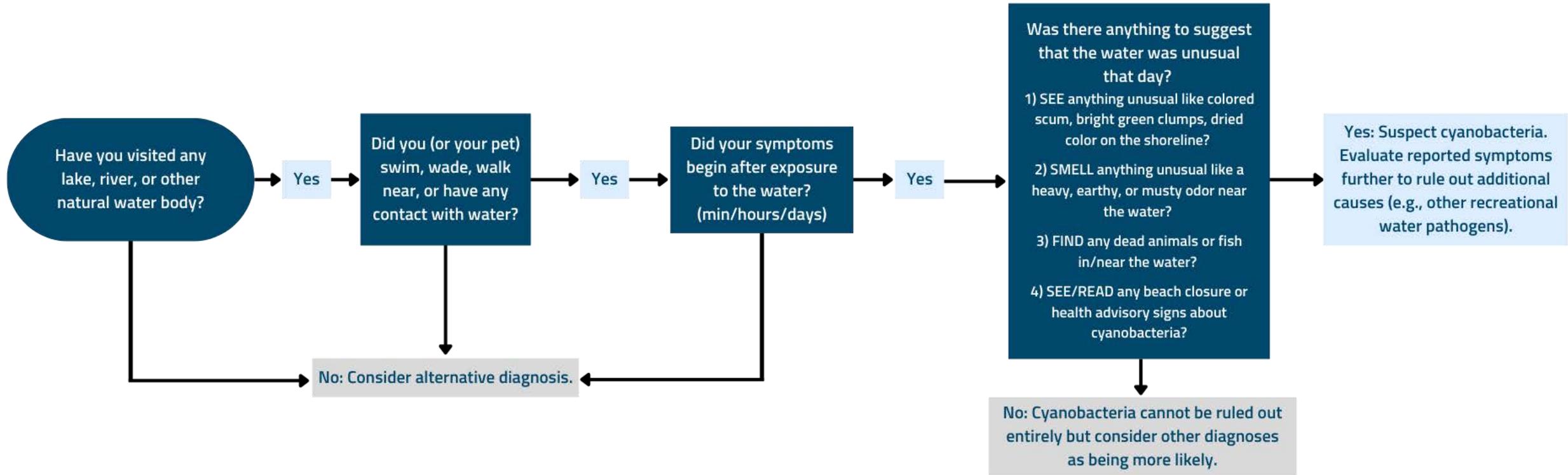
Cyanobacteria and BMAA

- 95% of cyanobacteria can produce an amino acid called Beta-N-methylamino-L-alanine, or [BMAA](#). Some research involving animals showed that BMAA has harmful effects on the brain.
- More research is needed to understand the possible [link](#) between BMAA and brain diseases in humans, such as ALS, Alzheimer's, Parkinson's and dementia.
- In 2017, EPA published a [critical review](#) that looked at the suspected role of BMAA in brain diseases in people. It concluded that “the hypothesis of a causal BMAA neurodegenerative disease relationship is not supported by existing data.”

Diagnosing Potential Cyanotoxin Exposure

- Cyanotoxin exposure should be considered if a patient presents with nausea, vomiting, and a rash 24 hours after swimming in a freshwater lake during the summer.
- Healthcare providers should ask patients who present with these common symptoms about recent recreational activities to help determine if the symptoms are related to a potential cyanotoxin exposure.
- The following screening tool and follow-up questions can aid with diagnoses.

Screening Tool: Identifying Suspected Cases of Cyanobacterial Bloom-Associated Illness (Recreational Visits to Freshwater Lakes and Rivers)



Follow up: Cases with Suspected Cyanobacterial Bloom Exposure

Case-Specific Questions

- When were you at the natural water body (specify time of exposure, or time range if possible)?
- How long were you at the natural water body?
- What did you do while at the natural water body (what was the potential route of exposure)?
 - For example, skin contact vs. swallowing water accidentally while swimming.
- If there were signs posted at the site, what did they say?
 - Some terms to listen for are: *cyanobacteria*, *cyanotoxins*, *blue-green algae*, *harmful algal bloom*.
- When did the symptoms start (time of onset)?
- How long did your symptoms last? Are any of them still occurring?

Follow up: Cases with Suspected Cyanobacterial Bloom Exposure

Questions About Pets and Other people (if applicable)

- Did anyone else in your group become ill?
 - If so, did they seek medical attention?

- Did your pet drink the water, eat anything in the water, or lick its fur after getting out of the water?

- Did any pets become ill? How are they now?

- Did your pet(s) see a veterinarian? If so, what was the diagnosis?
 - If no diagnosis, what was ruled out?

Additional Resources for Healthcare Providers

Source	Resource
Hamilton County Public Health Sheet	Factsheet: “Blue-Green Algae/Cyanobacteria Harmful Algal Bloom (HABs) Physician Reference”
Ohio Department of Health	Web page: Harmful Algal Blooms “Information for Physicians”
Minnesota Pollution Control Agency and Minnesota Department of Health	Factsheet: “Harmful Algal Blooms”
Vermont Department of Health	Factsheet: “Cyanobacteria Frequently Asked Questions”
Wisconsin Department of Health Services	Toolkit: “Harmful Algal Blooms Toolkit”
Oregon Health Authority	Toolkit: “Cyanobacteria (Harmful Algae) Bloom Guidance: A resource for local public health authorities”
California Cyanobacteria and HAB Network	Web page: “California Harmful Algal Blooms (HABs) Portal”

Diagnosing Potential Cyanotoxin Exposure

- Healthcare providers often use differential diagnoses to identify cyanotoxin exposure since these symptoms can align with other conditions that are not cyanobacterial toxin-mediated. Further, the diagnosis is typically one of exclusion.
- The toxicological effects in humans may go undiagnosed due to a lack of definitive, readily available diagnostic tests for cyanotoxins.

According to 2019 surveillance data from CDC, the most frequently reported signs or symptoms of cyanobacterial bloom exposure were *gastrointestinal symptoms and general symptoms, such as headache and fever.*

Coding for Suspected Cyanobacterial Bloom-Associated Illnesses

- The following [2020 ICD-10-CM diagnosis codes](#) are available:
 - Z77.121** for “contact with and [suspected] exposure to harmful algae and algae toxins”.
 - T65.82** for “toxic effect of harmful algae and algae toxins”.

Note: These codes are not specific to cyanobacterial blooms or a single exposure route. They may be used for other types of blooms as well as multiple exposure scenarios.

Source: CDC. [Cyanobacterial Bloom-Associated Illness](#).

Module 3 Recap

- When caring for a patient with potential cyanobacterial bloom-associated illness:
 - Identify symptoms.
 - Assess potential exposures.
- Cyanotoxin exposure may cause minor issues such as nausea or rashes. Severe liver and kidney damage is possible when exposed via dialysis (although this is very rare).
- Symptoms are generally self-limiting, and often go away within 72 hours.
- Following the provided screening tool can help providers determine if a patient's recent exposures and symptoms are related to a potential cyanobacterial bloom event.



Module 4

CHECKING FOR HEALTH ADVISORIES AND BEACH CLOSURES

Check for Recreational and Drinking Water Health Advisories



State or local authorities may post health, recreational, or do not drink advisories and/or beach closures for water bodies with known bloom events producing cyanotoxins.



Beach closures may occur **with or without** a health advisory and may be issued for the presence of a visible bloom or high toxin concentrations.

CLOSURE
TOXIC ALGAE PRESENT
Lake is **CLOSED**

Until further notice:
DO NOT swim or recreate in water
DO NOT water ski, jet ski, or paddle board
DO NOT drink water
Keep all pets, livestock, and horses away from water
Fishing not advised
Boating not advised

Call your doctor or veterinarian immediately if you or your animals have sudden or unexplained sickness or signs of poisoning

Report new algae blooms to: hab.mt.gov or 1-888-849-2938
Sign posted by: _____

DEQ Division of Environmental Quality MONTANA DPHHS

Source: Montana Department of Public Health and Human Services

EPA Drinking Water Advisory Levels

- EPA issued drinking water health advisories for only two cyanotoxins:
 - **Microcystin L-R**
 - **Cylindrospermopsin**
- While some states post advisories for any level of toxin found, others only issue advisories when toxins are found to be above these advisory levels.



Source: [CDC Public Health Image Library](#).

Utilize State Health Advisories to Aid with Diagnoses

- If you suspect cyanobacterial bloom-associated illness, you can check the state [website](#) for health advisories to aid with your diagnosis
- Available information is updated as often as weekly throughout the peak bloom season, which is **May - October**.
- However, cyanobacterial blooms can also occur during any month of the year and vary by jurisdiction.

In the summer of 2016, Utah Lake experienced the largest cyanobacterial bloom state officials had ever encountered.

There was an increase in calls to poison centers about possible exposure to the blooms, and Utah state officials decided to close the lake due to the risk of cyanobacteria and cyanotoxin exposure to swimmers.

State Cyanobacterial Bloom Web Pages

Common information included on state webpages include:



Name and location of the water body sampled.



Type of advisory (human or environmental).



Date of monitoring



Type and level of cyanotoxins or cyanobacterial cell counts.

Remember: Only a fraction of all water bodies in Oregon are visually monitored or sampled due to limited physical and monetary resources. A water body with no recreational health advisory is not an indication that a bloom is not present. You are your own best advocate when ensuring your safety, and that of your family and pets. **Be aware and "when in doubt, stay out."**

🚩 = Advisory in effect 🟢 = Advisory has been lifted 📍 = Permanent advisory

Waterbody	Status	Link	County	Toxin	Data (ppb)
Malheur Reservoir	🚩 Recreational Use Advisory ISSUED	July 9, 2021	Malheur	Anatoxin-a	8.59
Ross Island Lagoon and Holgate Channel of Willamette River	🚩 Recreational Use Advisory ISSUED	August 31, 2021	Multnomah	Microcystin	138
Upper Klamath Lake (ENTIRE LAKE)	🚩 Recreational Use Advisory EXPANDED	September 10, 2021	Klamath	Microcystin	910
JC Boyle Reservoir	🚩 Recreational Use Advisory ISSUED	September 10, 2021	Klamath	Microcystin	18
South Umpqua River and mainstem Umpqua River	📍 Permanent Recreational Use Advisory	Posted Sign	Douglas		

Source: Oregon Health Authority: [Current Cyanobacteria Advisories](#)
PREPARED BY Oregon Health Authority: [Cyanobacteria Advisories](#)
around the state as extreme heat continues

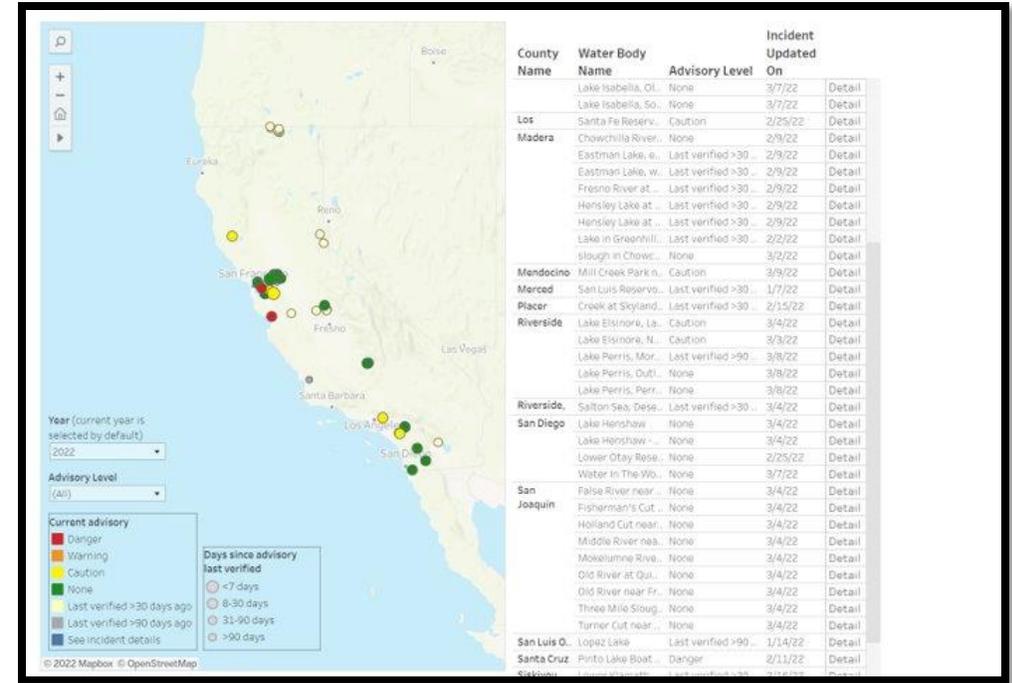
Utilize State Health Advisories to Aid with Diagnoses



Some web pages have GIS maps linked to identified blooms that allow public users to search by location.



Other state webpages grade advisories by the level of severity.



Source: [California Water Quality Monitoring Council](#)

Module 4 Recap

- Many [states](#) post health advisories for cyanobacterial bloom events at public water bodies on their state HAB webpages.
- Checking for health advisories in the state where the waterbody in question is may help aid with diagnosis.
- EPA has [issued](#) a recreational water advisory level for two cyanotoxins in recreational and drinking water
 - **Microcystin L-R**
 - **Cylindrospermopsin**



Module 5

**REPORTING CYANOBACTERIAL BLOOM-ASSOCIATED ILLNESSES
TO THE STATE HEALTH AGENCY**

Reporting a Case of Exposure



If you determine a potential cyanotoxin exposure, it is recommended that you report it to your local or [state/territorial](#) health agency using the case-reporting form.



Reporting cases can alert appropriate agencies to investigate potential illnesses and may result in additional water testing for impacted water bodies.



This also helps your health agency determine whether to issue a health advisory or beach closure to protect public health.

Sample Case Report Form

A case reporting form typically asks for:

- ✓ Date of the report.
- ✓ Contact information for the person filing the form.
- ✓ Patient's symptoms, including how long after exposure they began, how long they have lasted, and what treatment the patient has received for the symptoms.
- ✓ Possible route of exposure (ingestion, dermal, inhalation).
- ✓ If the report is for a person, an animal, or both.
- ✓ Other characteristics of the case or exposure that may be important to note.
- ✓ Name and location of the impacted water body, and if the water body is on public or private land.
- ✓ Manager or responsible party (e.g., waterbody manager or group) for the water body.

State Human Case Report Form Examples



[Kansas](#)
[Department of Health and Environment](#)



[Tennessee](#)
[Department of Health](#)



[Wisconsin](#)
[Department of Health Services](#)

Harmful Algae Bloom (HAB) Illness or Sighting Survey (F-02152)

Section 2: Human Illness

14. Are you the person who was ill? Note: If more than one person was ill, please choose only one person to report on now. There will be an opportunity to provide additional information at the end of the survey.

- No
- Yes

15. What is the date of birth of the person who was ill? *

16. What is the gender of the person who was ill?

- Male
- Female
- Transgender
- Unknown

17. Which racial group or groups best describe the person who was ill? Select all that apply.

- White
- Black or African American
- Asian
- Native Hawaiian or other Pacific Islander
- Other
- Unknown

Source: [Wisconsin Dept of Health Services](#)

Module 5 Recap

- Reporting suspected or confirmed cases of cyanobacterial bloom-associated illness or cyanotoxin exposure to the state health agency is strongly recommended (and in some states, it may be required).
- Case report forms ask about:
 - Exposure history
 - Symptoms
 - Recent water body(s) visited.

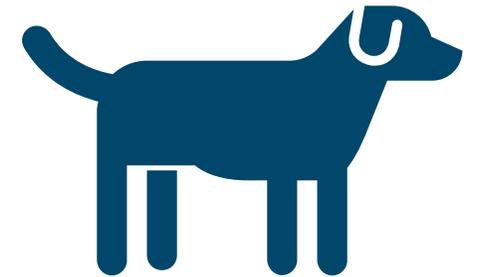


Module 6

REPORTING CASES OF ANIMAL SYMPTOMS

Cyanotoxin Risk to Humans and Animals

- Both humans and animals are at risk of exposure to cyanotoxins during recreational activities.
- Animals can be considered sentinels for people, as they may be exposed before swimmers or others using a water body for recreation and may present with symptoms before their owners.
- Dogs are especially at [risk](#) of cyanotoxin poisoning due to behaviors that increase the dose of toxins, such as swimming in and drinking contaminated waters or licking cyanobacteria or scum from their fur after swimming.



Detailed Animal Risk to Cyanotoxins and Why it Matters

- Animal illnesses and symptoms can vary depending on the route of exposure, length of exposure, cyanotoxin present, method of exposure for the individual, and length of exposure.
- Cyanotoxins can cause serious symptoms in animals, such as too much salivation, weakness, staggered walking, difficulty breathing, convulsions, or even death.
- Animals can die within an hour of exposure to a neurotoxin (such as anatoxin) and within hours to a couple of days if exposed to a hepatotoxin (such as microcystin) or nephrotoxin (such as cylindropermopsin).

Identifying suspected cyanotoxin illnesses in animals can offer increased confidence in any human diagnosis if similar exposure has been suspected in companion animals or livestock at the same water body.

One Health

- The One Health approach recognizes that the health of people is closely connected to the health of animals and our shared environment.
- Using this approach, the health agency may also reach out to the state animal board of health, the American Veterinary Medical Association, or the state department of agriculture to see if other suspected cases have been reported and if there is a need to sample a water body.



Source: CDC. [HABs Images](http://www.cdc.gov/habs).

One Health Harmful Algal Bloom System (OHHABS)

- CDC's [OHHABS](#) is a voluntary reporting mechanism that collects data on human and animal illnesses from known or suspected harmful algal bloom-associated exposures.
- Not all states and territories are reporting to OHHABS, but many do utilize this system. Information on cyanobacterial bloom events and environmental parameters, such as toxin concentrations, is also reported in the system.
- OHHABS aims to support the understanding of cyanobacterial blooms and the prevention of cyanobacterial bloom-associated illnesses across the United States.

Healthcare providers don't report directly to OHHABS; you still report to the state, which then reports to OHHABS.



Reporting Suspected Animal Cases as Part of One Health



To better inform patient care and possibly reduce the risk to others in the state, there are a few other steps you can take for a suspected human cyanobacterial bloom-associated illness where there is also a known or suspected pet exposure case.



At a minimum, report it to the state, local, territorial, or tribal health department. **This might help to alert officials to a potential cyanobacterial bloom, initiate toxin testing, and alert key stakeholders, including the veterinary community, to a potential exposure risk.**

Module 6 Recap

- Identifying suspected cyanobacterial bloom-associated illnesses in animals can offer increased confidence in any human diagnoses if similar exposure has been suspected in animals at the same water body.
- Reporting suspected animal cases can also be helpful to the state health department's One Health investigations for cyanobacteria.



Summary

If Cyanobacterial Bloom-Associated Illness is Suspected:

Identify

- Identify symptoms related to cyanobacterial bloom-associated illness.

Ask

- Ask the patient to describe unusual environmental conditions seen or encountered during exposure.

Check

- Check your local, state, territorial, or tribal websites for relevant health advisories or beach closures.

Report

- Report all suspected and confirmed cases to the local, state, territorial, or tribal health agency.



Source: [CDC Public Health Image Library](#).