

Facts About Marine Harmful Algal Blooms (HABs) for Poison Center Professionals

This fact sheet provides an overview of marine HAB exposures in humans and animals. It covers associated illnesses, routes of exposures, signs and symptoms, laboratory testing, management, as well as contact resources.

What are the main forms of marine harmful algal bloom (HAB)-related exposures in humans?

- A. Foodborne exposures
- B. Inhalational exposures
- C. Skin exposures

A. Foodborne exposures

I. Neurotoxic shellfish poisoning (NSP)

1. What causes NSP?

Brevetoxins produced by the dinoflagellate *Karenia brevis* that accumulate in bivalve shellfish (scallops, clams, mussels, oysters) cause NSP. Humans are exposed by swallowing contaminated water or eating contaminated bivalve shellfish.

2. Where might NSP occur?

NSP has been reported in temperate areas worldwide, including the southeastern coast of the United States, the Gulf of Mexico, the Caribbean, and New Zealand.

3. What are the signs and symptoms of NSP?

- Gastrointestinal: nausea, vomiting, diarrhea
- Cardiovascular: arrhythmia, hypertension, or hypotension
- Neurological: paresthesia of the lips, tongue, or throat; dizziness; reversal of hot-cold sensations
- Other effects: muscular aches, skin rash

Signs and symptoms usually appear 30 minutes to 3 hours after eating toxic shellfish.

4. What laboratory tests might help diagnose brevetoxin-induced NSP?

Confirmatory testing by liquid chromatography-mass spectrometry (LC-MS) may be performed to measure brevetoxin metabolites, but not brevetoxin, in human urine, if indicated. Bioassays, enzyme-linked immunosorbent assay (ELISA), and high performance LC-MS/mass chromatography (HPLC-MS/MC) techniques have been used to detect brevetoxin in meal remnants.

5. What are NSP treatment options?

Treatment is supportive and symptom-directed. Illness is usually self-limiting. For respiratory symptoms, provide respiratory support, antihistamines, and bronchodilators. Intravenous (IV) mannitol can be considered, but with questionable efficacy.

II. Ciguatera fish poisoning (CFP)

1. What causes CFP?

Ciguatoxins produced by epiphytic and benthic dinoflagellates that accumulate in reef fish (barracuda, grouper, red snapper, and amberjack) cause CFP. Humans are exposed by eating these contaminated fish.

2. Where might CFP occur?

Tropical coral reefs in the Caribbean, South Pacific and Indian Oceans, tropical Atlantic Ocean, and Gulf of Mexico are considered high-risk areas for exposure to toxic fish. Seafood and tropical fish imported from those areas also are potential sources of exposure.

3. What are the signs and symptoms of CFP?

Signs and symptoms vary according to the time since oral exposure and according to the geographic location of the exposure source. Caribbean CFP presents with GI symptoms first, followed by neurologic symptoms. In contrast, Pacific CFP presents with neurologic symptoms, with or without subsequent GI symptoms.

- 1–6 hours after exposure: gastrointestinal (nausea, vomiting, diarrhea, abdominal pain) and neurologic symptoms (paresthesia of palms of hands/feet, lips, and mouth; reversal of hot-cold sensation, dental pain, metallic taste, and/or weakness). Respiratory symptoms (shortness of breath, respiratory depression) can also occur. Other symptoms include arthralgia, myalgia, and blurry vision. Severe symptoms, including seizures and respiratory paralysis, are rare, but have occurred in persons who eat the whole fish, including viscera.
- 1–5 days after exposure: cardiovascular (bradycardia, hypotension, T-wave abnormalities)
- Months to years after exposure: fatigue and paresthesia

4. What laboratory tests might help diagnose CFP?

A rapid qualitative immunoassay is available to detect ciguatoxin in fish products.

5. What are CFP treatment options?

Treatment is supportive and symptom-directed. IV mannitol can be used within 48–72 hours after exposure, with variable evidence regarding its efficacy. Avoid foods that trigger pruritis (alcohol, chocolate, nuts, caffeine). Tricyclic antidepressants can be used for chronic neurologic symptoms, with variable efficacy.

III. Amnestic shellfish poisoning (ASP)

1. What causes ASP?

Domoic acid produced by diatoms (*Pseudo-Nitzschia* spp) that accumulate in bivalve shellfish (scallops, mussels, razor clams [*Siliqua patula*], oysters, Dungeness crab viscera) causes ASP. Humans are exposed by eating contaminated shellfish.

2. Where might ASP occur?

Contaminated shellfish are mostly found in temperate waters of North America, South America, and Northern Europe.

3. What are the signs and symptoms of ASP?

- Gastrointestinal: nausea, vomiting, diarrhea, abdominal cramps
- Cardiovascular: arrhythmias, hypotension, or hypertension
- Neurological: paresthesias, reversal of hot-cold sensation, burning in the teeth or extremities, confusion, memory loss, disorientation, and seizures/coma in severe cases, although rare.
- Amnesia can persist chronically.
- Respiratory: shortness of breath, excessive secretions, pulmonary edema, and possibly paralysis

Signs and symptoms vary by organ system and severity of illness. They usually occur within 24 hours.

4. What laboratory tests might help diagnose ASP?

Confirmatory testing of domoic acid in human urine is available. Food samples can be also tested for domoic acid using bioassays, ELISA, and chromatographic techniques.

5. What are ASP treatment options?

Treatment is supportive and symptom-directed. Provide respiratory support if required.

IV. Diarrheic shellfish poisoning (DSP)

1. What causes DSP?

Okadaic acid, dinophysistoxins, or pectenotoxins produced by dinoflagellates (*Dinophysis*, *Prorocentrum lima* spp.) that accumulate in bivalve shellfish (scallops, mussels, clams, and oysters) cause DSP. Humans are exposed by eating these contaminated shellfish.

2. Where might DSP occur?

Contaminated shellfish are found worldwide, but especially in Europe and Japan.

3. What are the signs and symptoms of DSP?

Signs and symptoms include nausea, vomiting, diarrhea, abdominal pain, chills, fever, and headache. Symptoms are usually mild and occur within 2 hours after exposure. Onset and severity of illness are based on the amount of toxin ingested. Symptoms are self-limited and resolve in 3–4 days.

4. What laboratory tests might help diagnose DSP?

Biologic and HPLC tests can measure the toxins (okadaic acid, dinophysistoxins, and pectenotoxins) in shellfish. No test is available for human samples.

5. What are DSP treatment options?

Treatment is supportive and symptom-directed (antiemetics, fluids, and electrolyte replacement, if needed).

V. Paralytic shellfish poisoning (PSP)

1. What causes PSP?

Saxitoxin and neosaxitoxins from marine dinoflagellates cause PSP. Sources include scallops, mussels, clams, oysters, cockles, whelks, pufferfish, herbivorous fish, blue-ringed octopus, Atlantic thorny lobster, Australian xanthid crab, and eggs of the horseshoe crab. Some cyanobacteria produce saxitoxins, which can accumulate in freshwater organisms.

Tetrodotoxin can also cause PSP when humans eat the gonads/viscera of pufferfish, blue-ringed octopus, salamanders, crab, sea worms, starfish, gastropod mollusks, or goby.

2. Where might PSP occur?

The likely geographic distribution for contaminated shellfish and fish include temperate areas worldwide (East and West coasts of the United States and Canada, Japan, Taiwan, southern Norway to Spain, Australia, British Columbia, South Africa, Guatemala, and Patagonia).

3. What are the signs and symptoms in PSP?

- **Gastrointestinal:** nausea and vomiting, mainly resulting from pufferfish poisoning
- **Cardiovascular:** arrhythmias, hypotension, hypertension, or chest pain
- **Neurologic:** paresthesia, numbness (lips, tongue, neck, face, extremities), headache, dizziness, ataxia, dysphagia, dysphonia, tongue immobilization, loss of gag reflex, nystagmus, temporary blindness, iridoplegia, jaw and facial muscle incoordination, or flaccid paralysis. Muscle weakness and muscle incoordination can be chronic.
- **Respiratory:** shortness of breath, respiratory failure and paralysis within the first 12 hours if severe

Symptoms usually occur within minutes to hours (<24 hours) after eating contaminated food and can last days to weeks.

4. What laboratory tests might help in the diagnosis of PSP?

Bioassay, ELISA, cell receptor assay, HPLC-FL, and LC-MS can be used to confirm the presence of toxins in remnant food. For tetrodotoxin specifically, urine or blood clinical specimens can be used with HPLC. Urine HPLC can be used for testing up to 5 days after exposure.

5. What are PSP treatment options?

Treatment is supportive and symptom-directed. Provide respiratory support in the event of neurotoxicity and respiratory paralysis.

VI. Azaspiracid shellfish poisoning (AZP)

1. What causes AZP?

Azaspiracid toxins produced by *Protoperidinium* spp. that accumulate in bivalve shellfish (scallops, mussels, clams, and oysters) cause AZP. Humans are exposed by eating these contaminated shellfish.

2. Where might AZP occur?

Most AZP exposures have occurred in Europe and Japan.

3. What are signs and symptoms of AZP?

Signs and symptoms include nausea, vomiting, diarrhea, abdominal pain, chills, headache, and fever. These usually start within 24 hours after exposure and last for days.

4. What laboratory tests can be used to diagnose AZP?

Biologic and HPLC can be used to confirm the presence of toxins in contaminated fish.

5. What are AZP treatment options?

Treatment is supportive and symptom-directed. No specific antidote is available.

B. Inhalation exposures

Humans can develop a specific syndrome referred to as aerosolized red tide respiratory irritation (ARTI), after breathing in aerosolized brevetoxins produced by *Karenia brevis* during Florida red tides. This can lead to serious health effects, including shortness of breath, asthma exacerbation, bronchoconstriction, bronchitis, and pneumonia.

C. Skin exposures

Humans who swim in contaminated ocean water and contact with waterborne brevetoxins during Florida red tides can develop skin and mucous membrane irritation.

Marine HABs toxicity in animals

1. How are animals exposed to marine HABs?

Animals can be exposed to marine HABs through the same routes as in humans, by inhalation of aerosolized marine toxins or eating contaminated shellfish and fin fish.

2. What are the signs and symptoms of marine HAB exposure?

In animals, exposure to marine toxins can be fatal. The first sign of a Florida red tide event can be dead fish and animals along shores. Marine seabirds and mammals (dolphins, sea lions, whales, manatees) have died from exposure to these toxins, as have dogs. Symptoms include ataxia, inability to fly, seizures, abortion, stillbirth, premature birth, reluctance to fly, nasal discharge, excessive tearing, diminished reflexes, dyspnea, weakness, respiratory paralysis, and death.

3. What laboratory tests can be used to confirm marine toxin exposure in animals?

Specialized laboratories at the National Oceanic and Atmospheric Administration (NOAA) and the Food and Drug Administration (FDA) can test tissue samples and stomach contents of affected animals for marine HAB toxins.

4. What are treatment options for symptomatic animals exposed to marine HABs?

Animals should be managed by clinical veterinarians. Veterinarians should be aware of HAB events in their area and consider exposure as a likely cause of symptoms. Treatment is supportive and symptom-directed. If available, brevenal, a natural inhibitor of brevetoxin action in sodium channel receptor binding assays, can be used to treat marine mammals exposed to brevetoxins.

Can we expect changes to coding and guidelines for capturing information about exposure to marine HABs?

The American Association of Poison Control Centers (AAPCC) and the Centers for Disease Control and Prevention (CDC) are working to develop coding guidelines about marine HAB exposure and related illness. This information will be released and distributed to poison centers when it is finalized.

For more information

- Visit <https://www.cdc.gov/habs>
- Call CDCInfo: 800-CDC-INFO (800-232-4636)
- Contact your local or state health department
- Call the Poison Information Center (800-222-1222)