Facts About Marine Harmful Algal Blooms for Poison Center Professionals

Accessible link: https://www.cdc.gov/habs/materials/factsheet-marine-habs.html

People and animals can be exposed to marine algal toxins through food, inhalation, and skin contact. Learn more about illnesses, routes of exposures, signs and symptoms, laboratory testing, and management.

Dinoflagellates and diatoms cause most marine algal blooms of public health concern

Two types of microalgae, dinoflagellates and diatoms, cause most harmful algal blooms in marine waters. Dinoflagellates and diatoms are most often found in salt water (such as oceans or bays) or brackish water (such as estuaries) and can produce algal toxins. Overgrowths, or blooms, of dinoflagellates or diatoms can make the water appear red, brown, golden, orange, or yellow.

Shellfish can become contaminated with algal toxins when they filter and concentrate water that contains toxins. Reef fish can become contaminated through the food web.

Foodborne exposures

Neurotoxic shellfish poisoning (NSP)

Brevetoxins cause NSP

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

NSP occurs in temperate areas

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.

Signs and symptoms

- **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 contaminated shellfish.

Laboratory tests to help diagnose NSP

- **Human urine:** Confirmatory testing by liquid chromatography-mass spectrometry (LC-MS) may be performed to measure brevetoxin metabolites, but not brevetoxin, in human urine.
- **Human serum/plasma:** Enzyme-linked immunosorbent assay (ELISA) has been used to detect brevetoxin in serum following ingestion of contaminated shellfish.
- **Meal remnants:** Bioassays, ELISA, and high-performance LC-MS/mass chromatography (HPLC-MS/MC) techniques have been used to detect brevetoxin in meal remnants.

Treatment of NSP

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 its efficacy might be limited.

Ciguatera fish poisoning (CFP)

Ciguatoxins cause CFP

Ciguatoxin precursors produced by dinoflagellates that accumulate as ciguatoxin in reef fish (including barracuda, grouper, red snapper, and amberjack) cause CFP. Humans are exposed by eating these contaminated fish.

Contaminated seafood and fish are most often from tropical coral reefs

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

Signs and symptoms

The effects of CFP can vary based on the time since the fish was eaten and the geographic location where the seafood or fish was harvested. Reports suggest that Caribbean CFP presents with gastrointestinal symptoms first, followed by neurologic effects. In contrast, Pacific CFP presents with neurologic symptoms first, with or without subsequent gastrointestinal distress.

- **1–6 hours after exposure:**
  - **Gastrointestinal:** nausea, vomiting, diarrhea, abdominal pain
  - **Neurologic:** paresthesia of palms of hands and feet, lips, and mouth; enhanced or reversed temperature sensations; dental pain; sensation of loose teeth; metallic taste; and/or weakness
  - **Respiratory:** shortness of breath, respiratory depression
  - **Other symptoms:** arthralgia, myalgia, and blurry vision
  - **Severe signs:** seizures and respiratory paralysis are rare, but have occurred in people who ate a whole fish, including viscera
- **1–5 days after exposure:** cardiovascular manifestations (bradycardia, hypotension, T-wave abnormalities)
- **Months to years after exposure:** potentially persistent fatigue and paresthesia

Laboratory tests to help diagnose CFP

Routine laboratory test results for people with CFP might reflect the effects of fluid loss, such as elevated blood urea nitrogen (BUN) and creatinine. Muscle tissue breakdown can result in mild elevation of creatinine phosphokinase (CPK) and lactate dehydrogenase (LDH).

A rapid qualitative immunoassay is available to detect ciguatoxin in fish products. Specialized laboratories at the Food and Drug Administration (FDA) can test fish samples for ciguatoxins.

Treatment of CFP

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

Amnesic shellfish poisoning (ASP)

Domoic acid 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.

Contaminated shellfish are most often from temperate waters

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

Signs and symptoms

- **Gastrointestinal:** nausea, vomiting, diarrhea, abdominal cramps
- **Cardiovascular:** arrhythmias, hypotension, or hypertension
- **Neurological:** paresthesias, enhanced hot and cold sensations, burning in the teeth or extremities, confusion, memory loss (potentially chronic amnesia), disorientation, and seizures/coma in severe cases, although rare
- **Respiratory:** shortness of breath, excessive secretions, pulmonary edema, and possibly paralysis

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

Laboratory tests to help diagnose ASP

Human urine can be tested for domoic acid. Food samples can also be tested for domoic acid using bioassays, ELISA, and chromatographic techniques.

Treatment of ASP

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

Diarrheic shellfish poisoning (DSP)

Okadaic acid, dinophysistoxins, or pectenotoxins cause 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.

Contaminated shellfish are most often from Europe and Japan

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

Signs and symptoms

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

Laboratory tests to 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.

Treatment of DSP

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

Paralytic shellfish poisoning (PSP)

Saxitoxin, neosaxitoxins, and tetrodotoxin cause 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.

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

Contaminated shellfish are most often from temperate areas

The likely geographic distribution for contaminated shellfish and fish includes 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).

Signs and symptoms

- **Gastrointestinal:** nausea and vomiting, mainly resulting from pufferfish poisoning
- **Cardiovascular:** arrhythmias, hypotension, hypertension, or chest pain
- **Neurologic:** paresthesia; numbness of the lips, tongue, neck, face, or 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

Signs and symptoms usually occur within minutes to less than 24 hours after eating contaminated food and can last days to weeks.

Laboratory tests to help diagnose 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. For saxitoxins, urine specimens can be analyzed with LC-MS, or ELISA in whole blood can be used.

Treatment of PSP

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

Azaspiracid shellfish poisoning (AZP)

Azaspiracid toxins cause 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.

Contaminated shellfish are most often from Europe and Japan.

Signs and symptoms

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.

Laboratory tests to diagnose AZP

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

Treatment of AZP

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

Inhalation exposures

Brevetoxins

People 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.

Skin exposures

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

Exposure in animals

Routes of exposure

Animals can be exposed to marine algal toxins through the same routes as humans: by inhalation of aerosolized marine toxins, eating contaminated shellfish and fish, and swimming in contaminated water.

Signs of marine algal toxin exposure in animals

In animals, exposure to marine algal toxins can be fatal. The first sign can be dead fish and animals along shores. Marine seabirds and mammals (dolphins, sea lions, whales, and manatees) have died from exposure to these toxins, as have dogs. Signs can 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.

Laboratory tests can be used to confirm marine algal toxin exposure in animals

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

Treatment for animals exposed to marine algal toxins

Animals exposed to marine algal toxins should be managed by clinical veterinarians. Veterinarians should be aware of harmful algal bloom events in their area and consider exposure as a likely cause of signs. Treatment is supportive and sign 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.

More Information

- Harmful Algal Bloom-Associated Illnesses
- Diseases and conditions caused by eating seafood contaminated with algal toxins
- One Health Harmful Algal Bloom System
- Health Department Directories
- Visiting Oceans, Lakes, and Rivers