Frequently Asked Questions and Answers on Water Safety and Botulism

With all this talk about possible chemical agents, just how safe is our water? Should I be disinfecting my water just in case?
The United States public water supply system is one of the safest in the world. The general public should continue to drink and use water just as they would under normal conditions. Your local water treatment supplier and local governments are on alert for any unusual activity and will notify you immediately in the event of any public health threat. At this point, we have no reason to believe that additional measures need to be taken.

As a wastewater plant operator, what should I look for in terms of possible chemical contamination in the water? Will our disinfection procedures take care of all agents?
Just like other utility plant operators, wastewater plant operators must use extra diligence in monitoring and securing their facilities. If you observe any unusual activity or unauthorized entries to your facility, contact your local authorities and public health officials immediately. They will be able to advise and assist you.

Questions and answers on botulism

Whom should a physician notify if he or she suspects a patient has botulism?
Health care providers who suspect they have a patient with botulism should contact their state health department epidemiology offices. The Foodborne and Diarrheal Diseases Branch of CDC (FDDB/DBMD/NCID/CDC) can provide emergency consultation and support to public health authorities.

If a commercial food product is a suspected vehicle for botulism, USDA or the Food and Drug Administration should be notified.

How can Clostridium botulinum be identified in the laboratory?
C. botulinum organisms are straight to slightly curved, gram-positive (in young cultures), motile, anaerobic rods, 0.5 – 2.0 micrometers in width, and 1.6 – 22.0 micrometers in length, with oval, subterminal spores.

How are C. botulinum spores killed?
The spores are resistant to heat. Although some strains will not survive at 80° C, spores of many strains require temperatures above boiling to ensure destruction. The thermal resistance of spores also increases with higher pH and lower salt content of the medium in which they are suspended.

Where is botulism found in the United States?
Cases of food borne botulism have been reported in 46 states, Puerto Rico, and Washington, D.C., through 1996. Only four states have never reported any foodborne botulism: Delaware, New Hampshire, South Carolina, and Vermont. Five western states have accounted for more
than half (53.8%) of all reported food borne outbreaks since 1950 (California, Washington, Colorado, Oregon, and Alaska). Alaska alone accounts for 16.2% of outbreaks nationwide. This is because of the distinctive public health problem among the Alaska Native population, in which botulism cases have been associated with improper preparation and storage of Alaska Native foods. Information from http://www.cdc.gov/ncidod/srp/drugservice/immuodrugs.htm

What is in the botulinum antitoxin?
Botulinum Antitoxin (Equine), trivalent (types A, B, and E) is a refined and concentrated preparation of horse globulins modified, by enzymatic digestion. It is a licensed product supplied in 10-mL multi-dose vials.

Each vial contains the following:
- Type A-7,500 International Units, equivalent to 2381 U.S. Units
- Type B-5,500 International Units, equivalent to 1839 U.S. Units
- Type E-8,500 International Units, equivalent to 8500 U.S. Units

Where is the antitoxin stored?
In the United States the antitoxin is available from the CDC. The antitoxin is released only for suspected or actual cases of botulinum toxin poisoning. All suspected cases of botulinum poisoning and the subsequent request for antitoxin must be initiated through state or local health departments. The decision to dispense the antitoxin is made by CDC medical epidemiology staff after discussion with the treating physician. This allows CDC and the state health departments to maintain effective botulism surveillance and to detect outbreaks as soon as possible.

Is there a botulinum toxoid?
Pentavalent (ABCDE) botulinum toxoid is a combination of aluminum phosphate-adsorbed toxoid derived from formalin-inactivated type A, B, C, D, and E botulinum toxins, with formaldehyde and thimerosal used as preservatives. Botulinum toxoid is not licensed by the Food and Drug Administration; it is distributed by the CDC under an Investigational New Drug (IND) protocol. The toxoid is used to protect individuals from accidental exposure to botulinum toxins. It should be administered only to individuals working in high-risk laboratories that are actively working or expect to be working with cultures of C. botulinum or the toxins.

What are the characteristics of wound botulism?
Wound botulism is a rare disease resulting from the growth of C. botulinum in a contaminated wound with in vivo toxin production. Neurologic findings are indistinguishable from those seen in food borne botulism; however, gastrointestinal symptoms do not occur. Wounds might not be obvious or grossly infected. Since 1980, wound botulism cases have occurred in persons who used illicit drugs, these were associated with needle puncture sites or with nasal or sinus lesions due to chronic cocaine sniffing. From 1986 to 1996, 78 cases of wound botulism were reported in the United States; most were linked to injecting drug use, particularly with black-tar heroin.

What are the clinical symptoms of botulism?
Dryness of the mouth, inability to focus to a near point (prompting the patient to complain of “blurred vision”), and diplopia are usually the earliest neurologic complaints. If the disease is
mild, no other symptoms may develop and the initial symptoms will gradually resolve. The person with mild botulism may not come to medical attention. In more severe cases, however, these initial symptoms may be followed by dysphonia, dysarthria, dysphagia, and peripheral-muscle weakness. If illness is severe, respiratory muscles are involved, leading to ventilatory failure and death unless supportive care is provided. Recovery follows the regeneration of new neuromuscular connections. A 2- to 8-week duration of ventilatory support is common, although patients have required ventilatory support for up to 7 months before the return of muscular function. Death occurs in 5%–10% of cases of foodborne botulism; early deaths result from a failure to recognize the severity of disease or from secondary pulmonary or systemic infections, whereas death after 2 weeks are usually from the complication of long-term mechanical ventilatory management.

The major manifestations of infant botulism are poor feeding, diminished suckling and crying ability, neck and peripheral weakness (floppy baby), and ventilatory failure. Constipation is often seen in infants with botulism, and in some, has preceded the onset of neurologic abnormalities by many days. Loss of facial expression, extraocular muscle paralysis, dilated pupils, and depression of deep tendon reflexes have been reported more frequently with type B than with type A infant botulism. Treatment with aminoglycoside antimicrobial agents may promote neuromuscular weakness in infant botulism and has been associated with an increased likelihood of the requirement of mechanical ventilation. Fewer than 2% of reported cases of infant botulism result in death.

How is botulism diagnosed?
Toxicity testing of serum specimens, culture of tissues debrided from a wound, and toxicity testing plus culture of stool specimens or epidemiologically incriminated foods or both are the best methods for confirming the diagnosis of botulism. The administration of the antitoxin is the only specific therapy for botulism, and evidence suggests that it is effective only if given very early in the course of neurologic dysfunction. Diagnosis of this illness cannot await the results of studies that may be long delayed and may be confirmatory only in some cases. The diagnosis should be made on the basis of the case history and physical findings.

When should botulism be suspected?
Botulism should be suspected in any adult with a history of acute onset of gastrointestinal, autonomic (e.g., dry mouth, difficulty focusing), and cranial nerve (diplopia, dysarthria, dysphagia) dysfunction or in any infant with poor feeding, diminished sucking and crying ability, neck and peripheral muscle weakness, and/or ventilatory distress. The demonstration of bilateral cranial nerve findings and the documentation of neurologic progression (descending peripheral muscle weakness, ventilatory compromise) increase the level of suspicion. The diagnosis is even more likely if an adult patient has recently eaten home-canned foods or if family members are similarly ill, or both. If the typical syndrome is seen and a wound is identified, the wound should be explored and specimens taken for culture and toxicity testing even if the wound appears clean.

What is the treatment for botulism?
Antitoxin therapy is more effective if undertaken early in the course of illness. The equine antitoxin neutralizes only toxin molecules that are unbound to nerve endings. Before
administration of antitoxin, skin testing should be performed to test for sensitivity to serum or antitoxin.

Administration of one 10-mL vial of trivalent botulism antitoxin by the intravenous route results in serum levels of type A, B, and E antibodies capable of neutralizing serum toxin concentrations many-fold in excess of those reported for botulism patients. Therefore, after skin testing for sensitivity, contrary to the antitoxin package insert, administration of one vial of antitoxin intravenously is recommended and antitoxin need not be repeated since the circulating antitoxins have a half-life of 5 to 8 days.

For foodborne and wound botulism
1. Administration of botulinum antitoxin in an attempt to prevent neurologic progression of a moderate, slowly progressive illness
2. Careful monitoring of respiratory vital capacity and aggressive respiratory care for those with ventilatory insufficiency (monitoring of respiratory vital capacity should be performed as soon as diagnosis of botulism is made).
3. Meticulous and intensive care for the duration of the often prolonged paralytic illness

For Infant botulism:
Equine antitoxin is rarely used in infant botulism because of the risk of inducing lifelong hypersensitivity to equine antigens and lack of evidence of its benefit. Also, few infants have been given the product because of early concerns that anaphylactic reaction with the equine-derived product might be more severe in infants. However, a human-derived botulism antitoxin, “botulism immune globulin,” has been prepared, and a clinical trial of its efficacy when given early in the course of illness is in progress.

**Laboratory confirmation of botulism**

**How can botulism be confirmed in the laboratory?**
Botulism is confirmed in the laboratory by identifying botulinum neurotoxin in the serum, feces, vomitus, or gastric contents of the patient and/or in the remnants of a food eaten by the patient. The only currently acceptable method for detection and identification of botulinum neurotoxin is the mouse toxicity and neutralization bioassay.

Isolation of *C. botulinum* from the patient’s feces or gastric specimen also provides good confirmatory evidence, since this organism is rarely, if ever encountered in human specimens in the absence of botulism.

The identity of the organism is established based on
- Lipase reaction
- Gram stain, observation of spores
- Determining anaerobic requirement for growth
- Demonstration of toxicity
- Identification of toxin by specific neutralization
What safety precautions should laboratorians take when handling suspected botulism samples?

Botulinum toxins are extremely poisonous for humans. Minute quantities acquired by ingestion, inhalation, or by absorption through the eye or a break in the skin can cause profound intoxication and death.

All materials suspected of containing botulinum toxin must be handled with caution, and only by experienced personnel, preferably people immunized with the botulinum toxoid. For more information about this toxoid contact the National Botulism Surveillance and Reference Laboratory at CDC (404) 639-3867.

Laboratory coats, disposable surgical gloves, face shields, or bench top plexiglass shields should be used when handling specimens. Safety pipettes are recommended for transferring liquids. A biological safety cabinet (BSC) should be used when preparing extracts of the tissue and solid foods to prevent the release of aerosols into the laboratory. All specimen containers, culture tubes, flasks, or other items containing botulinum toxin should be placed in leakproof, unbreakable containers during storage or incubation to prevent spills.

What do I do if the toxin or specimen spills in the laboratory?

If spills occur, the toxin can be neutralized by the use of a strong alkaline solution such as 0.1 M sodium hydroxide. *C. botulinum* is inactivated with a 1:10 dilution of household bleach. The appropriate disinfectant solution must be in contact with the toxin or the organism for 15 to 20 minutes to ensure effective inactivation. If the material is suspected to contain both toxin and organisms, the spill must be sequentially treated with bleach and sodium hydroxide.

What do I need to do if someone is exposed?

1. Determine the likelihood of exposure.
2. Observe the person for the next 2 to 4 days. That person should be made aware of the early symptoms of botulism (e.g., blurred or double vision, dry mouth, slurred speech, and peripheral muscle weakness).
3. If any of the symptoms appear, the person should be hospitalized immediately and the case handled as possible botulism.

When investigating possible cases of botulism, what kinds of specimens should be collected?

Suitable materials for examination for botulinum toxin and *C. botulinum* in foodborne outbreaks include serum, feces, vomitus, gastric contents and suspected foods; in wound infections, serum, feces, exudate, debrided tissue, or swab samples from wounds of patients; and in infants with botulism, feces and serum samples. In some instances, examination of environmental specimens for *C. botulinum* can aid in establishing the probable source of the organism (e.g., in infant botulism).

How should specimens be collected?
All specimens except those from wounds should be refrigerated, preferably not frozen, and examined as quickly as possible after collection.

**Wound specimens** should be placed in anaerobic transport devices such as Port-A-Cul tubes or vials (BioQuest Div., Becton, Dickinson & Co., Cockeysville, Maryland), and sent to the appropriate laboratory without refrigeration for attempted isolation of *C. botulinum*.

**Foods** should be left in their original containers if possible or placed in sterile unbreakable containers and labeled carefully. Empty containers with remnants of suspected foods can sometimes be examined. The date specimens are collected from patients should be indicated on the labels.

**Serum samples** must be taken before antitoxin treatment to demonstrate the presence of botulinum toxin. Post treatment serum specimens are sometimes obtained, although uncommonly, to verify disappearance of the toxin, to determine the amount of antitoxin in circulating blood of the patient after treatment, and to determine how long antitoxin persists.

**How much needs to be collected for analysis?**

**Serum:** Ideally, 10 to 15 mL of serum should be obtained for laboratory tests. This quantity permits specific identification of the botulinum toxin involved, injection of higher volumes of serum, and repeat tests if necessary. Since it is impractical to obtain this much serum from some patients, especially from infants, as little as 0.5 ml can be sufficient to confirm botulism, although in many cases, volumes less than 3 ml will provide inconclusive results.

**Feces:** Ideally, 25 to 50 g of feces should be collected, preferably before antitoxin treatment. However, confirmatory evidence of botulism has been obtained from much smaller quantities, and *C. botulinum* has been isolated from stools following antitoxin treatment. Botulism has been confirmed in infants with only “pea-sized” stools. If an enema must be given because of constipation, a minimal amount of fluid (preferably sterile nonbacteriostatic water) should be used to obtain the specimen so the toxin will not be unnecessarily diluted. If the patient has been taking any medication that might interfere with toxin assays or culturing of the stool, the laboratory should be notified. For example, anticholinesterase drugs given orally to patients for myasthenia gravis can interfere with mouse botulinum toxin assays of stool extracts.

**How should specimens be shipped?**

Specimens sent to a distant laboratory should be placed in sterile leakproof containers, then in insulated shipping containers with refrigerant, labeled **MEDICAL EMERGENCY, BIOLOGICAL HAZARD, REFRIGERATE ON ARRIVAL** and should be shipped by the most rapid means available. Cardboard containers are not suitable for stool specimens. Most of the major airlines have a special package handling service for expedited shipments. The receiving laboratory should be notified in advance by telephone as to when and how specimens will be shipped, and when they will arrive. If an unavoidable delay of several days is anticipated, the specimens (serum or stool) should be kept frozen and then packed in an insulated container with dry ice and proper cushioning material for shipment. Freezing does not affect the ability to detect botulinum toxin in specimens, but it does affect the ability to detect *C. botulinum*.
Before shipment to CDC, please contact the National Botulism Surveillance and Reference Laboratory at (404) 639-3867. CDC form 50.34 (formerly 3.203) should be completed and submitted with the specimens if completion of the form does not delay shipment (see Appendix). All specimens must include an individual’s name and telephone number to contact for the preliminary report. Preferably, the names of both the attending physician and the state health department contact should be given.

How should specimens be examined for botulinum toxin?

How should *C. botulinum* be isolated?