

Shiga Toxin-Producing Organisms

(Also known as *E. coli* O157:H7, Shiga Toxin-Producing *E. coli* [STEC], Verotoxin Producing *E. coli* [VTEC], Enterohemorrhagic *E. coli* [EHEC], and *Shigella dysenteriae* type 1)



Section 1:

ABOUT THE DISEASE

A. Etiologic Agent

Shiga toxins 1 and 2 (also called verotoxins and previously called Shiga-like toxins) are potent cytotoxins elaborated by enterohemorrhagic strains of *E. coli* and *Shigella dysenteriae* type 1. These cytotoxins are released when toxin-producing bacteria reproduce in the gastrointestinal tract, and they destroy intestinal epithelial cells.

B. Clinical Description

Infection with *E. coli* O157:H7, as well as with other Shiga toxin-producing organisms, can result in a wide spectrum of manifestations. An individual may be asymptomatic, may have mild non-bloody diarrhea, or may have grossly bloody diarrhea. Most diagnosed cases present with bloody diarrhea 6–48 hours after the onset of non-bloody diarrhea. Abdominal cramps, nausea, and vomiting may also be present. Fever is usually absent. In some cases, the patient may progress to hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP), which can result in renal failure and death. Refer to chapters on HUS, *E. coli* O157:H7, and shigellosis for more detailed descriptions.

C. Vectors and Reservoirs

While cattle appear to be the most significant reservoir for *E. coli* O157:H7 and other EHEC strains, other animals, such as deer, are also known to carry these bacteria. In contrast, humans are the only known reservoir for *S. dysenteriae* type 1.

D. Modes of Transmission

See the chapters on *E. coli* O157:H7 and shigellosis for modes of transmission for each organism.

E. Incubation Period

The incubation period for disease due to Shiga toxin-producing organisms is variable. For most *E. coli* strains, it ranges from 10 hours to 6 days; for *E. coli* O157:H7, the incubation period is usually 3–4 days, but it ranges from 1–10 days; for *S. dysenteriae* type 1, the incubation period can be up to 1 week.

F. Period of Communicability or Infectious Period

Refer to the chapters on *E. coli* O157:H7 and shigellosis for information on infectious periods.

G. Epidemiology

The most common Shiga toxin-producing organism causing disease in North America is *E. coli* O157:H7. This serotype is believed to account for nearly 90% of all diarrhea-associated HUS cases. For more detailed information on the epidemiology of infection due to specific bacteria, refer to the chapters on HUS, *E. coli* O157:H7, and shigellosis.

H. Bioterrorist Potential

E. coli O157:H7 and shigellosis are listed by the CDC as Category B bioterrorist agents. For information on *E. coli* O157:H7 and shigellosis, refer to the chapters on these organisms.



Section 2:

REPORTING CRITERIA AND LABORATORY TESTING

A. What to Report to the Massachusetts Department of Public Health (MDPH)

Report any of the following:

- ◆ Isolation of *E. coli* O157:H7 from a clinical specimen;
- ◆ Isolation of Shiga toxin-producing *E. coli* from a clinical specimen;
- ◆ Isolation of *S. dysenteriae* type 1; or
- ◆ The onset of acute renal insufficiency within three weeks of acute bloody or non-bloody diarrhea.

B. Laboratory Testing Services Available

The MDPH State Laboratory Institute (SLI), Enteric Laboratory will test stool specimens for the presence of Shiga toxin-producing organisms and will also perform confirmatory testing and speciation (and serotyping when possible) on isolates from clinical specimens submitted by other laboratories. In addition, the SLI Enteric Laboratory requests submission of all isolates of Shiga-toxin-producing organisms for typing for disease surveillance purposes.

For more information on specimen testing, contact the SLI Enteric Laboratory at (617) 983-6609.

The SLI Food Microbiology Laboratory, at (617) 983-6610, will test food items implicated in case clusters or outbreaks for Shiga toxin-producing organisms. See Section 4D for more information.



Section 3:

REPORTING RESPONSIBILITIES AND CASE INVESTIGATION**A. Purpose of Surveillance and Reporting**

- ◆ To identify whether the case may be a source of infection for other persons (e.g., a diapered child, daycare attendee, or food handler), and if so, to prevent further transmission.
- ◆ To identify transmission sources of public health concern (e.g., a restaurant or a commercially contaminated food product), and to stop transmission from such sources.
- ◆ HUS is an important sequela of infection with *E. coli* O157:H7. Because HUS cases generally come to medical attention, surveillance for HUS can serve as a marker for *E. coli* O157:H7 activity in the community and may lead to the identification of outbreaks at the state or the local level. HUS is also an important indicator of morbidity caused by *E. coli* O157:H7 infection.

B. Laboratory and Health Care Provider Reporting Requirements

Infection with any Shiga toxin-producing organism is reportable to the local board of health (LBOH). The MDPH requests that health care providers immediately report to the LBOH in the community where the case is diagnosed, all confirmed or suspect cases of infection with a Shiga toxin-producing organism, as defined by the reporting criteria in Section 2A.

Laboratories performing examinations on any specimens derived from Massachusetts residents that yield evidence of infection with a Shiga toxin-producing organism shall report such evidence of infection directly to the MDPH within 24 hours.

C. Local Board of Health (LBOH) Reporting and Follow-up Responsibilities*Reporting Requirements*

MDPH regulations (*105 CMR 300.000*) stipulate that infection with a Shiga toxin-producing organism is reportable to the LBOH and that each LBOH must report any confirmed case of infection with a Shiga toxin-producing organism or suspect case of infection with a Shiga toxin-producing organism, as defined by the reporting criteria in Section 2A. Cases should be reported to the MDPH Bureau of Communicable Disease Control, Office of Integrated Surveillance and Informatics Services (ISIS) using a MDPH *Hemolytic Uremic Syndrome Case Report Form* or a MDPH *Enteric Disease Case Report Form* (found at the end of chapters on HUS, *E. coli* O157:H7, and shigellosis), whichever is indicated based on the case presentation and the organism identified. Refer to the *Local Board of Health Timeline* at the end of this manual's *Introduction* section for information on prioritization and timeliness requirements of reporting and case investigation.

Case Investigation

1. It is the responsibility of the LBOH to complete a MDPH *Hemolytic Uremic Syndrome Case Report Form* or a MDPH *Enteric Disease Case Report Form* (found at the end of specific chapters on HUS, *E. coli* O157:H7, and shigellosis)—whichever is indicated based on the case presentation and the organism identified—by interviewing the case and others who may be able to provide pertinent information. Much of the information required on the form can be obtained from the health care provider or from the medical record. You may ask the health care provider to complete the case information for the case report form.

2. Refer to specific chapters on HUS, *E. coli* O157:H7, and shigellosis for detailed information on completing the case report forms.
3. After completing the form, attach laboratory report(s) and fax or mail (in an envelope marked "Confidential") to ISIS. The confidential fax number is (617) 983-6813. Call ISIS at (617) 983-6801 to confirm receipt of your fax. The mailing address is:

MDPH, Office of Integrated Surveillance and Informatics Services (ISIS)
305 South Street, 5th Floor
Jamaica Plain, MA 02130
Fax: (617) 983-6813

4. Institution of disease control measures is an integral part of case investigation. It is the responsibility of the LBOH to understand, and if necessary, institute the control guidelines listed in Section 4.



Section 4:

CONTROLLING FURTHER SPREAD

A. Isolation and Quarantine Requirements (*105 CMR 300.200*)

Minimum Period of Isolation of Patient

After diarrhea has resolved, food handling facility employees may only return to work after producing two negative stool specimens. If a case has been treated with an antimicrobial, the stool specimen shall not be collected until at least 48 hours after cessation of therapy.

Minimum Period of Quarantine of Contacts

Contacts with diarrhea who are food handling facility employees shall be considered the same as a case and shall be handled in the same fashion. In outbreak circumstances, asymptomatic contacts who are food handling facility employees shall be required to produce 2 negative stool specimens, collected 24 hours apart. No restrictions otherwise.

Note: A food handler is any person directly preparing or handling food. This can include a patient care or childcare provider. See Glossary (at the end of this manual) for a more complete definition.

B. Protection of Contacts of a Case

None.

C. Managing Special Situations

Refer to specific chapters on HUS, *E. coli* O157:H7, and shigellosis for detailed, disease-specific information on managing special situations.

D. Preventive Measures

Environmental Measures

Implicated food items must be removed from the environment. A decision about testing implicated food items can be made in consultation with the MDPH Center for Environmental Health, Food Protection Program (FPP) or the MDPH Division of Epidemiology and Immunization at (617) 983-6800 or (888) 658-2850. The FPP can help coordinate pickup and testing of food samples. If a commercial product is suspected, the FPP will coordinate follow-up with relevant outside agencies. The FPP can be reached at (617) 983-6712.

Note: The role of the FPP is to establish policy and to provide technical assistance with the environmental investigation, such as interpreting the Massachusetts Food Code, conducting a Hazard Analysis and Critical Control Point (HACCP) risk assessment, initiating enforcement actions, and collecting food samples.

The general policy of the SLI is to test only food samples implicated in suspected outbreaks and to not test single cases (except when botulism is suspected). The LBOH may suggest that the holders of food implicated in single case incidents locate a private laboratory that will test food or store the food in their freezer for a period of time, in case additional reports are received. However, a single, confirmed case with leftover food consumed within the incubation period may be considered for testing.

Note: Refer to the MDPH's Foodborne Illness Investigation and Control Reference Manual for comprehensive information on investigating foodborne illness complaints and outbreak. Copies of this manual have been made available to LBOH. It is also located on the MDPH website in PDF format at www.mass.gov/dph/fpp/refman.htm. For the most recent changes to the Massachusetts Food Code, contact the FPP at (617) 983-6712 or through the MDPH website at www.mass.gov/dph/fpp.

Personal Preventive Measures/Education

To avoid future exposure, advise individuals to:

- ◆ Always wash their hands thoroughly with soap and water before eating or preparing food, after using the toilet, after changing diapers, and after contact with animals, especially cattle.
- ◆ Wash their own hands as well as the child's hands in a sanitary manner after changing diapers.
- ◆ Wash their hands thoroughly and frequently when ill with diarrhea or when caring for someone with diarrhea. Hands should be scrubbed for at least 15–20 seconds after cleaning the bathroom; after using the toilet or helping someone use the toilet; after changing diapers; before handling food; and before eating.
- ◆ Keep food that will be eaten raw, such as vegetables, from becoming contaminated by animal-derived food products. (Wash fruits and vegetables thoroughly, especially those that will not be cooked.)
- ◆ If served an undercooked hamburger or other undercooked ground beef product in a restaurant, send it back for further cooking.
- ◆ Cook all ground beef and hamburgers thoroughly.
- ◆ Drink only pasteurized milk, juice, or cider.

An *E. coli* 0157:H7 Public Health Fact Sheet and a *Shigella* Public Health Fact Sheet are available from the MDPH Division of Epidemiology and Immunization or on the MDPH website at www.mass.gov/dph. Click on the “Publications and Statistics” link, and select the “Public Health Fact Sheets” section under “Communicable Disease Control.”



ADDITIONAL INFORMATION

There is no formal Centers for Disease Control and Prevention (CDC) surveillance case definition for infection caused by a Shiga toxin-producing organism. Refer to the chapters on *HUS*, *E. coli* 0157:H7, and shigellosis for the formal surveillance case definitions for infections caused by these organisms. For reporting to the MDPH, always use the criteria outlined in Section 2A.



REFERENCES

American Academy of Pediatrics. [*Escherichia coli* Diarrhea including Hemolytic-Uremic Syndrome.] In: Pickering L.K., ed. *Red Book: 2003 Report of the Committee on Infectious Diseases, 26th Edition*. Elk Grove Village, IL, American Academy of Pediatrics; 2003: 275–280.

Heymann, D., ed. *Control of Communicable Diseases Manual, 18th Edition*. Washington, DC, American Public Health Association, 2004.

MDPH. *Foodborne Illness Investigation and Control Reference Manual*. Massachusetts Department of Public Health. 1997.
<www.mass.gov/dph/fpp/refman.htm>.

MDPH. *Regulation 105 CMR 300.000: Reportable Diseases, Surveillance, and Isolation and Quarantine Requirements*. MDPH, Promulgated November 4, 2005.



FORMS & WORKSHEETS
Shiga Toxin-Producing Organisms

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LBOH Action Steps

This form does not need to be submitted to the MDPH with the case report form. It is for LBOH use and is meant as a quick-reference guide to case investigation activities for infections caused by shiga toxin-producing organisms.

LBOH staff should follow these steps when infection due to a shiga toxin-producing organism is suspected or confirmed in the community. For more detailed information, including disease epidemiology, reporting, case investigation, and follow-up, refer to the preceding chapter.

- Notify the MDPH Division of Epidemiology and Immunization, at (617) 983-6800 or (888) 658-2850, to report any suspect case(s) of infection caused by a shiga toxin-producing organisms
- Obtain laboratory confirmation.
- For *E. coli* or *S. dysenteriae* type 1 infection suspected to be the result of food consumption, complete a MDPH *Foodborne Illness Complaint Worksheet* and forward to the MDPH Center for Environmental Health, Food Protection Program (FPP).
- Identify potential exposure sources such as food or water, removing any suspect items.
- If recreational water is identified as a potential exposure source, consult the MDPH Community Sanitation Program at (617) 624-5757.
- Consult with the MDPH Division of Epidemiology and Immunization regarding the submission of suspect food items for testing.
- Determine whether the case attends or works at a daycare facility and/or is a food handler.
- Identify other potentially exposed persons.
- Fill out the case report form (attach laboratory results).
- Send the completed case report form (with laboratory results) to the MDPH Bureau of Communicable Disease Control, Office of Integrated Surveillance and Informatics Services (ISIS).