

**SHIGA TOXIN-PRODUCING ENTEROHEMORRHAGIC *E. COLI* (STEC) AND  
HEMOLYTIC UREMIC SYNDROME (HUS)  
(*E. coli* O157:H7)**

**REPORTING INFORMATION**

- **Class B:** Report by the close of the next business day after the case or suspected case presents and/or a positive laboratory result to the local public health department where the patient resides. If patient residence is unknown, report to the local public health department in which the reporting health care provider or laboratory is located.
- Reporting Form(s) and/or Mechanism: The Ohio Disease Reporting System (ODRS) should be used to report lab findings to the Ohio Department of Health (ODH). For healthcare providers without access to ODRS, you may use the [Ohio Confidential Reportable Disease form](#) (HEA 3334).

**STEC cases:**

- [Ohio Enteric Case Investigation Form](#) may be useful in the local health department follow-up of cases. Do not send this form to the Ohio Department of Health (ODH); information collected from the form should be entered into ODRS where fields are available and the form should be uploaded in Administration section of ODRS.
- The [hypothesis-generating questionnaire](#) may be helpful when investigating cases involved in multistate or multicounty clusters.
- [Ohio Department of Health \(ODH\) Ground Beef Supplemental Form](#) for Ohio Cases of Shiga Toxin Positive *E. coli* is available for use to assist in local health department investigation of ground beef exposures. Do not send this form to the Ohio Department of Health (ODH); information collected from the form should be entered into ODRS where fields are available and the form should be uploaded in Administration section of ODRS.

**HUS cases:**

- Individuals diagnosed with HUS should be entered in ODRS. Separate HUS and STEC case reports should be entered in ODRS when an individual is reported with both conditions.

**AGENT**

*E. coli* O157:H7 and other enterohemorrhagic *E. coli* also known as Shiga toxin-producing *E. coli* (STEC) is the causative agent. *E. coli* is normally considered non-pathogenic, normal flora of the human gut. STEC, however, are pathogenic strains of *E. coli*.

**Infectious Dose**

The infectious dose is very small, perhaps as few as 1-10 organisms.

A case of hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP) might or might not have a laboratory-confirmed finding of STEC. However, it should be noted that in children, STEC is the leading cause of HUS; therefore, a high index of suspicion of STEC is warranted among the contacts of an HUS patient, especially in the child care setting.

**CASE DEFINITION FOR SHIGA TOXIN-PRODUCING ENTEROHEMORRHAGIC *E. COLI* (STEC)**

**Clinical Description**

An infection of variable severity characterized by diarrhea (often bloody) and abdominal cramps. Illness may be complicated by hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP). Asymptomatic infections also may occur and the organism may cause extraintestinal infections.

## Laboratory Criteria for Diagnosis

### *Laboratory confirmed*

- Isolation of Shiga toxin-producing *E. coli* (STEC) from a clinical specimen. *E. coli* O157:H7 isolates may be assumed to be Shiga toxin-producing. For all other *E. coli* isolates, Shiga toxin production or the presence of Shiga toxin genes must be determined to be considered STEC.
- Both asymptomatic infections and infections at sites other than the gastrointestinal tract, if laboratory confirmed, are considered confirmed cases that should be reported.

### *Supportive laboratory results*

- A case with isolation of *E. coli* O157 from a clinical specimen, without confirmation of H antigen or Shiga toxin production.
- Identification of an elevated antibody titer to a known STEC serotype from a clinically compatible case.
- Identification of Shiga toxin or STEC DNA in a clinical specimen using a culture-independent diagnostic testing (CIDT) without the isolation of STEC.

### *Confirmation testing*

- Clinical laboratories should send STEC isolates as well as reflex specimens testing positive for the presence of Shiga toxin(s) or STEC DNA in a clinical specimen using a culture-independent diagnostic testing (CIDT) to Ohio Department of Health Laboratory for culture confirmation testing and pulsed-field gel electrophoresis (PFGE) analysis.

## Case Classification

### Suspect:

- A case of post-diarrheal HUS or TTP (See below for HUS case definition); *OR*
- Identification of Shiga toxin in a specimen from a clinically compatible case without the isolation of the Shiga toxin-producing *E. coli*.; *OR*
- Detection of Shiga toxin-producing *E. coli* (STEC) in a clinical specimen using a culture-independent diagnostic testing (CIDT).

### Probable:

- A case with isolation of *E. coli* O157 from a clinical specimen, without confirmation of H antigen or Shiga toxin production; *OR*
- A clinically compatible case that is epidemiologically linked to a confirmed or probable case; *OR*
- Identification of an elevated antibody titer to a known Shiga toxin-producing *E. coli* serotype from a clinically compatible case.

Confirmed: A case that is laboratory culture-confirmed. When available, O and H antigen serotype characterization should be reported. Both asymptomatic infections and infections at sites other than the gastrointestinal tract, if laboratory-confirmed, are considered confirmed cases that should be reported.

Not a Case: This case status will not generally be used when reporting a case, but may be used to reclassify a report if investigation revealed it was not a case.

### **Comment**

Confirmation is based on laboratory findings and clinical illness is not required. Health departments are encouraged to act upon a finding of STEC; culture and antigen confirmation can be delayed.

## CASE DEFINITION FOR HEMOLYTIC UREMIC SYNDROME, POSTDIARRHEAL

### Clinical Description

Hemolytic uremic syndrome (HUS) is characterized by the acute onset of microangiopathic hemolytic anemia, renal injury and low platelet count. Thrombotic thrombocytopenic purpura (TTP) also is characterized by these features, but can include central nervous system (CNS) involvement and fever and may have a more gradual onset. Most cases of HUS (but few cases of TTP) occur after an acute gastrointestinal illness (usually diarrheal).

### Laboratory Criteria for Diagnosis

- Anemia (acute onset) with microangiopathic changes (i.e. schistocytes, burr cells, helmet cells) on peripheral blood smear *AND*
- Renal injury (acute onset) evidenced by either hematuria, proteinuria or elevated creatinine level (i.e.  $\geq 1.0$  mg/dL in a child aged  $< 13$  years or  $\geq 1.5$  mg/dL in a person aged  $\geq 13$  years or  $\geq 50\%$  increase over baseline).

**Note:** A low platelet count can usually, but not always, be detected early in the illness, but it may then become normal or even high. If a platelet count obtained within 7 days after onset of the acute gastrointestinal illness is not  $< 150,000/\text{mm}^3$ , other diagnoses should be considered.

### Case Classification

#### Probable:

- An acute illness diagnosed as HUS or TTP that meets the laboratory criteria in a patient who does not have a clear history of acute or bloody diarrhea in preceding 3 weeks; *OR*
- An acute illness diagnosed as HUS or TTP that has onset within 3 weeks after onset of an acute or bloody diarrhea and meets the laboratory criteria except that microangiopathic changes are not confirmed.

Confirmed: An acute illness diagnosed as HUS or TTP that both meets the laboratory criteria and began within 3 weeks after onset of an episode of acute or bloody diarrhea.

Not a Case: This status will not generally be used when reporting a case, but may be used to reclassify a report if investigation revealed that it was not a case.

### Comment

Some investigators consider HUS and TTP to be part of a continuum of disease. Therefore, criteria for diagnosing TTP on the basis of CNS involvement and fever are not provided because cases diagnosed clinically as post-diarrheal TTP also should meet the criteria for HUS. These cases are reported as post-diarrheal HUS.

Most diarrhea-associated HUS is caused by Shiga toxin-producing *Escherichia coli*, most commonly *E. coli* O157. If a patient meets the case definition for both Shiga toxin-producing *E. coli* (STEC) and HUS, the case should be reported for each of the conditions.

## SIGNS AND SYMPTOMS

### STEC (*E. coli* O157:H7)

Infection may be asymptomatic or produce diarrheal illness ranging from mild to severe. Fever and vomiting are usually not present.

### HUS

A potential complication following infection with STEC (*E. coli* O157:H7). Characterized by kidney failure often necessitating transfusion and dialysis.

## **DIAGNOSIS**

*E. coli* O157:H7 is diagnosed by means of a stool culture. Sorbitol-MacConkey agar is used by laboratories to screen for *E. coli* O157:H7. Clinical laboratories are asked to send all isolates to the ODH Laboratory for pulsed-field gel electrophoresis typing. Clinical labs that do not culture for *E. coli* O157:H7, and only test for shiga toxin should send toxin positive broths to the ODH Laboratory for confirmation testing. HUS and TTP are diagnosed by the findings described above. Patients with HUS and TTP should be cultured for enteric pathogens, including *E. coli* O157:H7. Failure to recover the organism is common, since HUS generally occurs several days after the diarrheal illness and the patient might no longer be shedding the pathogen. The ODH Laboratory performs testing for *E. coli* O157:H7. In some circumstances testing can be done at ODH Laboratory without charge. To obtain the fee exemption and to arrange for receipt of the stool transport kit, contact the ODH Outbreak Response and Bioterrorism Investigation Team (ORBIT) at 614-995-5599 with the names of the persons for whom this testing is being requested.

## **EPIDEMIOLOGY**

### **Source**

Humans and cattle are the primary reservoirs of STEC (*E. coli* O157:H7). Bodies of water or food contaminated by animal or human waste can serve as a source of infection.

### **Occurrence**

STEC (*E. coli* O157:H7) occurs worldwide. In Ohio, more cases occur in the summer than in any other season. More cases are recognized in children than in any other age group, but all ages are at risk.

### **Mode of Transmission**

Direct person-to-person transmission via the fecal-oral route occurs, as well as direct animal-to-person transmission, especially from sick calves. Infection can also be acquired from contaminated beef (especially ground beef) which is undercooked, or when raw meat juices contaminate cooked food or food to be eaten raw (e.g. fruits, vegetables). Swimming in contaminated recreational water is another means by which transmission has occurred.

### **Period of Communicability**

STEC (*E. coli* O157:H7) is present in the stool during the acute illness and possibly for a couple of weeks afterward. The carrier state in humans does not generally develop.

### **Incubation Period**

The incubation period is 10 hours to 8 days, usually 3-4 days.

## **PUBLIC HEALTH MANAGEMENT**

### **Case**

#### Investigation

All cases reported to the local health department should initially be followed up with a telephone call to obtain demographic and epidemiologic data. Please complete the Ohio Enteric Case Investigation Form for Ohio cases of Shiga-toxin positive *E. coli*. No further work-up is recommended if neither the case nor any household member is employed in a sensitive occupation (direct food handling, direct patient care, employee in a child care center who handles food or directly cares for children) or attends a child care center, unless there is evidence that the case is part of an outbreak.

## Treatment

No effective antibiotic therapy is recognized for STEC (*E. coli* O157:H7). Some studies suggest that treatment with trimethoprim-sulfamethoxazole can lead to HUS. Anti-diarrheal medications should be avoided.

## Isolation and Follow-up Specimens

Ohio Administrative Code (OAC) 3701-3-13 (J) states:

"*Escherichia coli* (*E. coli*) O157:H7, other enterohemorrhagic (Shiga toxin-producing) *E. coli* or hemolytic uremic syndrome (HUS): a person with *Escherichia coli* (*E. coli*) O157:H7, other enterohemorrhagic (Shiga toxin-producing) *E. coli* or hemolytic uremic syndrome (HUS) who attends a child care center or works in a sensitive occupation shall be excluded from the child care center or work in the sensitive occupation and may return after his or her diarrhea has ceased and after two consecutive follow-up stool specimens are negative for *E. coli* O157:H7 or other enterohemorrhagic (Shiga toxin-producing) *E. coli*."

Obtain the first specimen at least 48 hours after cessation of diarrhea or, if being treated, at least 48 hours after completion of antibiotic therapy. Obtain the remaining specimen(s) at least 24 hours apart.

## **Contacts**

If the case or any household member is employed in a sensitive occupation or is a child care center attendee, **all** household members should be cultured for *E. coli* O157:H7. The purpose of this is to identify asymptomatic infected individuals who could serve as a continuing source of infection to others. See sections below on sensitive occupations and child care contacts.

## **Prevention and Control**

Ground beef and hamburger should be well-cooked; using a food thermometer is the only sure way of knowing if your food has reached a high enough temperature to destroy bacteria. Ground beef products should be cooked to an internal temperature of 160° F. Color is not a reliable indicator that ground beef patties have been cooked to a temperature high enough to kill harmful bacteria such as *E. coli* O157:H7.

Avoid cross-contamination of other foods, especially raw produce, with raw meat juices. Wash fruits and vegetables thoroughly. Children under 5 years of age, immunocompromised persons and the elderly should avoid eating fresh sprouts until their safety can be assured. Drink only pasteurized milk, juice or cider. Drink only water that has been treated and is safe for drinking. Avoid swallowing lake or pool water while swimming. Wash hands thoroughly after bowel movements and after changing diapers. This is especially important for persons with diarrhea. Anyone with diarrhea should avoid swimming in public pools or lakes and preparing food for others.

## Food Handlers

Symptomatic persons should be excluded from work. As detailed in Isolation, above, foodhandlers who are laboratory-confirmed cases may only return to work after diarrhea has ceased and two consecutive stool samples are negative.

Food Service Operation rules also pertain to this situation. *E. coli* O157:H7 is a disease which can be transmitted through food. Persons infected with a disease that is communicable by food are not permitted to work as a food handler. For additional information, refer to Ohio Administrative Code (OAC) Chapter 3717-1 (Ohio Uniform Food Safety Code) Section 02.1, Management and Personnel: Employee Health.

### Healthcare Workers, Child Care Workers and Children who Attend Child Care Centers

Symptomatic persons should be excluded from work. As detailed in Isolation above, persons in these sensitive occupations who are laboratory-confirmed cases, and children who attend child care centers may return when diarrhea has ceased and two consecutive stool samples are negative.

### Child Care Center Outbreak Control

When a case of *E. coli* O157 or HUS occurs in a person who works in or attends a child care center, that person is excluded until diarrhea has ceased and two consecutive stools are negative per OAC 3701-3-13. In these situations, there should be a high index of suspicion of *E. coli* O157:H7 should any cases of diarrhea be reported among children or staff of the entire child care center. Also, it is **recommended** that all classroom contacts (children and adults) of the laboratory-confirmed case be screened with one stool sample using Cary-Blair medium, whether or not they are symptomatic. The purpose of this screening is to detect asymptomatic carriers who might be serving as a source of infection to others. Child care center workers or attendees with diarrhea (of infectious or unknown cause) are not permitted to attend the child care center per OAC 3701-3-13.

### **Special Information**

Persons with diarrhea of infectious or unknown cause (e.g. confirmed or suspect cases of *E. coli* O157:H7) are not permitted to work in sensitive occupations, according to OAC 3701-3-13 (H) which states: "Diarrhea, infectious or of unknown cause: a person with diarrhea, of infectious or unknown cause, who attends a child care center or works in a sensitive occupation shall be excluded from the child care center or work in the sensitive occupation and may return only after diarrhea has ceased. A person with infectious diarrhea of known cause shall be isolated in accordance with the provisions of the rule set forth for the specified disease."

" 'Sensitive occupation' means direct food handling, direct patient care, the handling of food or provision of direct care to children in a child care center, or any other occupation which provides significant opportunity for an infected individual to transmit infectious disease agents" per OAC 3701-3-01 (Y).

## SAMPLE LETTER TO PARENTS/GUARDIAN

Dear Parents/Guardian:

A case of Shiga toxin-producing *E. coli* (STEC), *E. coli* O157:H7, and/or hemolytic uremic syndrome (HUS) has occurred in your child's classroom. This bacterium, *E. coli* O157:H7, can cause intestinal infection consisting of severe bloody diarrhea and abdominal cramps. Usually little or no fever is present, and the illness resolves in 5 to 10 days.

In some persons, particularly children under 5 years of age and the elderly, the bacterial infection produces a toxin which can cause a complication called hemolytic uremic syndrome (HUS). HUS affects the kidneys and blood clotting system. HUS occurs in approximately 2%-7% of the patients with *E. coli* O157:H7 infection. HUS often requires extensive hospitalization and therapy.

Persons can become infected with *E. coli* O157:H7 by ingesting the bacteria in undercooked beef, especially hamburger. Spread can occur easily among groups of small children because of their close contact and lack of well-developed personal hygiene skills. Frequent and thorough hand washing, especially after using the toilet and before eating, is important in preventing spread of this disease.

Due to the serious nature of HUS, arrangements have been made with the Ohio Department of Health for free screening for *E. coli* O157:H7 in your child's classroom. We highly recommend and urge you to take advantage of this opportunity.

In order to find out if your child has *E. coli* O157:H7, a stool specimen must be collected. The materials needed to do this are included with this letter. You should have a screw-capped tube partially filled with liquid.

Directions:

1. Make sure the patient information section on the side of the vial is completed.
2. Pass the stool into a clean, dry, container such as a margarine tub, wide mouth jar, milk carton with the top cut off, or if available a bedpan.
3. Use the collection spoon built into the lid of the vial to place small scoops of the stool into the vial until the contents of the vial rise to the "FILL LINE" on the vial label.
4. For best results, select areas of the stool that appear bloody or watery. If the stool is formed (hard), sample small amounts from each end and the middle.
5. When sufficient stool added to raise the level to the "FILL LINE", replace and twist the cap onto the vial to tightly close.
6. Once the cap is tight, shake the vial vigorously until the contents are well mixed.
7. Wash your hands thoroughly after collection of the specimen.
8. Place properly labeled vial into a zip-lock plastic specimen bag or other leak-proof container. Do not place the specimen paperwork unprotected within the same zip-lock bag or container with the vial to prevent contamination should the sample leak.
9. Return the sample and paperwork immediately to your local health department or location as instructed when you were given the collection kit.
10. Store and transport at room temperature.

Thank you for your cooperation. If you have any questions, please contact (RN) at the (local) Health Department, (telephone number).

Sincerely,

**What is *Escherichia coli* O157:H7 (STEC)?**

*E. coli* O157:H7 (STEC) is one of hundreds of strains of the bacterium *Escherichia coli*. Although most strains are harmless and live in the intestines of healthy humans and animals, this strain produces a powerful toxin and can cause severe illness. The combination of letters and numbers in the name of the bacterium refers to the specific markers found on its surface and distinguishes it from other types of *E. coli*. It was first recognized as a cause of illness in 1982 during an outbreak of severe bloody diarrhea; the outbreak was traced to contaminated hamburgers. Since then, most infections have come from eating undercooked ground beef.

**How is *E. coli* O157:H7 (STEC) spread?**

The organism can be found on a small number of cattle farms and can live in the intestines of healthy cattle. Meat can become contaminated during slaughter, and organisms can be thoroughly mixed into beef when it is ground. Bacteria present on the cow's udders or on equipment may get into raw milk. Eating meat, especially ground beef that has not been cooked sufficiently to kill *E. coli* O157:H7 can cause infection. Contaminated meat looks and smells normal. Although the number of organisms required to cause disease is not known, it is suspected to be very small.

Drinking unpasteurized milk and swimming in or drinking sewage-contaminated water can also cause infection.

Bacteria in diarrheal stools of infected persons can be passed from one person to another if hygiene or handwashing habits are inadequate. This is particularly likely among toddlers who are not toilet trained. Family members and playmates of these children are at high risk of becoming infected. Young children typically shed the organism in their feces for a week or two after their illness resolves. Older children rarely carry the organism without symptoms.

**What illness does *E. coli* O157:H7 (STEC) cause?**

*E. coli* O157:H7 (STEC) infection often causes severe bloody diarrhea and abdominal cramps; sometimes the infection causes non-bloody diarrhea or no symptoms. Usually little or no fever is present, and the illness resolves in 5 to 10 days.

In some persons, particularly children under 5 years of age and the elderly, the infection can also cause a complication called hemolytic uremic syndrome (HUS), in which the red blood cells are destroyed and the kidneys fail. About 2%-7% of infections lead to this complication. In the United States, hemolytic uremic syndrome is the principal cause of acute kidney failure in children, and most cases of HUS are caused by *E. coli* O157:H7.

**How is *E. coli* O157:H7 (STEC) infection diagnosed?**

Infection with *E. coli* O157:H7 (STEC) is diagnosed by detecting the bacterium in the stool. Most laboratories that culture stool do not routinely test for *E. coli* O157:H7 (STEC), so it is important to request that the stool specimen be tested for this organism. All persons who suddenly have bloody diarrhea should get their stool tested for *E. coli* O157:H7 (STEC).

**How is the illness treated?**

Most persons recover without antibiotics or other specific treatment in 5-10 days. There is no evidence that antibiotics improve the course of disease, and it is thought that treatment with some antibiotics may precipitate kidney complications. Antidiarrheal agents, such as loperamide (Imodium), should also be avoided.



Hemolytic uremic syndrome (HUS) is a life-threatening condition usually treated in an intensive care unit. Blood transfusions and kidney dialysis are often required. With intensive care, the death rate for hemolytic uremic syndrome is 3%-5%.

### **What are the long-term consequences of infection?**

Persons who only have diarrhea usually recover completely. About one-third of persons with hemolytic uremic syndrome (HUS) have abnormal kidney function many years later, and a few require long-term dialysis. Another 8% of persons with hemolytic uremic syndrome have other lifelong complications, such as high blood pressure, seizures, blindness, paralysis, and the effects of having part of their bowel removed.

### **What can be done to prevent the infection?**

*E. coli* O157:H7 (STEC) will continue to be an important public health concern as long as it contaminates meat. Preventive measures may reduce the number of cattle that carry it and the contamination of meat during slaughter and grinding. Research into such prevention measures is ongoing.

### **What can I do to prevent *E. coli* O157:H7 (STEC) infection?**

- Cook all ground beef and hamburger thoroughly. Because ground beef can turn brown before disease-causing bacteria are killed, use a digital instant-read meat thermometer to ensure thorough cooking. Ground beef should be cooked until a thermometer inserted into several parts of the patty, including the thickest part, reads at least 160° F. Persons who cook ground beef without using a thermometer can decrease their risk of illness by not eating ground beef patties that are still pink in the middle.
- If you are served an undercooked hamburger or other ground beef product in a restaurant, send it back for further cooking. You may want to ask for a new bun and a clean plate, too.
- Avoid spreading harmful bacteria in your kitchen. Keep raw meat separate from ready-to-eat foods. Wash hands, counters, and utensils with hot soapy water after they touch raw meat. Never place cooked hamburgers or ground beef on the unwashed plate that held raw patties. Wash meat thermometers in between tests of patties that require further cooking.
- Drink only pasteurized milk, juice, or cider. Commercial juice with an extended shelf-life that is sold at room temperature (e.g. juice in cardboard boxes, vacuum sealed juice in glass containers) has been pasteurized, although this is generally not indicated on the label. Juice concentrates are also heated sufficiently to kill harmful bacteria.
- Wash fruits and vegetables thoroughly, especially those that will not be cooked. Children under 5 years of age, immunocompromised persons, and the elderly should avoid eating alfalfa sprouts until their safety can be assured. Methods to decontaminate alfalfa seeds and sprouts are being investigated.
- Drink municipal water that has been treated with chlorine or other effective disinfectants.
- Avoid swallowing lake or pool water while swimming.
- Make sure that persons with diarrhea, especially children, wash their hands carefully with soap and water after bowel movements to reduce the risk of spreading infection, and that persons wash hands after changing soiled diapers. Anyone with a diarrheal illness should avoid swimming in public pools or lakes, sharing baths with others, and preparing food for others.