

Shiga toxin- producing *E. coli* (STEC) including *E. coli* O157:H7

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Escherichia coli (*E. coli*) O157:H7 is one of over a hundred different serotypes belonging to the group of gram negative bacteria *Escherichia coli*, the majority of which cause no human illness. *E. coli* O157:H7 and several other serotypes (e.g. O26, O111) produce potent cytotoxins, called Shiga toxins. All *E. coli* that produce Shiga toxin are categorized as Shiga toxin-producing *E. coli*, or STEC. *E. coli* O157:H7 and non-O157 STEC are also referred to as enterohemorrhagic *E. coli* (EHEC). *E. coli* O157 has been better studied than non-O157 STEC, which is considering an emerging pathogen.

B. Clinical Description

Infection with *E. coli* O157:H7 or other STEC may present with a wide spectrum of clinical manifestations. An individual may be asymptomatic, have mild non-bloody diarrhea, or have bloody diarrhea. Abdominal cramps, nausea and vomiting may also be present. Fever is usually absent. *E. coli* O157:H7 infection in young children may lead to complications such as hemolytic uremic syndrome (HUS) in up to 20% of cases. HUS appears to be less common among persons with non-O157 infections, however it does occur.

C. Reservoirs

Cattle are a reservoir of significant public health importance; however, other animals, such as deer, elk, goats and sheep are also known to carry STEC. In addition, humans may also serve as a reservoir.

D. Modes of Transmission

E. coli O157:H7 and other STEC are transmitted via the fecal-oral route through food, drinking water or recreational water contaminated with human or animal feces that contain *E. coli* O157:H7 or other STEC. The infectious dose is very low. Transmission also occurs from person-to-person, especially in group settings like child care centers, and from contact with infected animals and their environments, such as petting zoos and other animal exhibits. STEC infection has been associated with consumption of contaminated ground beef, unpasteurized apple juice and cider, unpasteurized milk and other dairy products, raw vegetables, and dried meats (e.g. jerky).

E. Incubation Period

The incubation period is 2 to 10 days; most commonly 3 to 4 days.

F. Period of Communicability or Infectious Period

E. coli O157:H7 is shed in stool while a person has diarrhea and then for a variable amount of time after diarrhea has resolved. Adults typically shed for a week or less, however, the bacteria are shed

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for up to 3 weeks in about one-third of infected children, and some children can shed for even longer. Prolonged carriage is uncommon. Less is known about the duration of shedding of non-O157 STEC.

G. Epidemiology

E. coli O157:H7 was first identified in 1982 in an outbreak in the United States. Sporadic cases of STEC infection occur throughout the year with a peak during the summer months. During 2007-2011 approximately 150-200 cases of STEC infection were reported each year in Colorado. Of these ¼ to ½ of reported STEC cases were *E. coli* O157. The most common non-O157 STEC serotypes reported in Colorado during 2007-2011 were O26, O103, O111, and O121.

Colorado Statistics are available at the CDPHE website:

www.colorado.gov/cs/Satellite/CDPHE-DCEED/CBON/1251607755473

2) CASE DEFINITION

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

- Isolation of Shiga toxin-producing *Escherichia coli* from a clinical specimen.
- *Escherichia 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. (Note: Shiga toxin testing can include EIA or PCR tests. Testing does not need to be performed at the state laboratory to meet laboratory criteria for diagnosis.)

Case Classification

Suspect:

- Identification of Shiga toxin in a specimen from a clinically compatible case without the isolation of the Shiga toxin-producing *E. coli*, or
- A case of postdiarrheal HUS or TTP (see HUS case definition)

Probable:

- A case with isolation of *E. coli* O157 from a clinical specimen, without confirmation of H7 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 in a clinically compatible case.

Confirmed: A case that meets the laboratory criteria for diagnosis

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When an STEC case is first entered into CEDRS, it is typically entered as a “suspect” case until further laboratory testing can be conducted on the clinical specimen/isolate by the CDPHE Microbiology Laboratory.

3) REPORTING CRITERIA

What to Report to the Colorado Department of Public Health and Environment (CDPHE) or local health agency

- Confirmed, probable and suspected *E.coli* O157:H7 or other STEC cases.
- STEC cases should be reported within 7 days of diagnosis or a positive laboratory test.
- Cases should be reported using the Colorado Electronic Disease Reporting System (CEDRS), fax or telephone. See below for phone and fax numbers.
- Suspected foodborne/enteric disease outbreaks should be reported to CDPHE or the local health department within 24 hours, even if the causative agent has not yet been identified.

Purpose of Surveillance and Reporting

- To identify cases for investigation and potential outbreaks
- To monitor trends in disease incidence, including severity of illness.

Important Phone Numbers and Web Resources

- CDPHE Communicable Disease Epidemiology Program
 - Phone: 303-692-2700 or 800-866-2759
 - Fax: 303-782-0338
 - After hours: 303-370-9395
- CDPHE Microbiology Laboratory: 303-692-3480
- Communicable Disease (CD) Manual website
<http://www.colorado.gov/cs/Satellite/CDPHE-DCEED/CBON/1251607755419>

4) STATE LABORATORY SERVICES

Laboratory Testing Services Available

*The services listed below are for public health purposes; clinical laboratories are **not** charged for these services.*

- The CDPHE Laboratory requests all *E. coli* O157 isolates and Shiga toxin positive specimens from clinical laboratories be submitted for confirmation.
- The CDPHE Microbiology Laboratory will test bulk stool or rectal swab specimens for the presence of *E.coli* O157:H7 or other STEC for public health follow-up purposes or outbreak investigations.
- Pulsed Field Gel Electrophoresis (PFGE) testing (i.e., molecular typing) is routinely performed on all STEC isolates.
- For more information contact the CDPHE Microbiology Laboratory.
- Note: Authorization from the CDPHE Communicable Disease Program is required before submitting bulk stool, rectal swabs, or implicated food items to the CDPHE Laboratory.
- See Section 6 (E)--Environmental Measures, for more information about food testing.

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5) CASE INVESTIGATION

Interview all suspect, probable and confirmed STEC cases, including symptomatic contacts of confirmed cases and others whose symptoms are suspected to be caused by *E. coli* O157:H7 or other STEC to determine:

- Potential source of infection, and implement control measures as appropriate
- If others are ill (i.e. Could this be an outbreak?)
- If case may be a source of infection for others (e.g. a high-risk worker or a diapered child), and if so, prevent further transmission

Interviews should be conducted and appropriate control measures implemented as soon as reasonably possible after the case is reported. They should not be delayed until laboratory testing is completed at the state public health lab. Local public health agencies have primary responsibility for interviews of sporadic cases in their jurisdictions. Smaller agencies should consult with regional epidemiologists to establish primary responsibility for interviews of sporadic cases.

A. Case Investigation / Forms

For single cases, complete the CDPHE [E. coli O157 / STEC Case Investigation Form](#), or a similar local health agency form. Local health departments are encouraged to use the standard CDPHE investigation form. Following patient interviews, complete the CEDRS record for all confirmed, probable and suspect cases and fax the form to CDPHE. If an outbreak is suspected, outbreak-specific interview forms should be used. Please contact CDPHE for assistance.

For agencies that choose to use their own case investigation forms, the following information should be collected:

- *Demographics (including address, date of birth, ethnicity and race)*
- *Occupation (**High risk occupations include: food service, child care, and health care**)*
- *Child care or School Attendance*
- *Symptoms and Onset Date*
- *Laboratory (date of specimen collection)*
- *Hospitalization and Medical Treatment Received*
- *Food History (during 2–7 days prior to onset)*
- *Restaurant History (include food items and date consumed)*
- *Farm or Animal Exposure*
- *Travel History (locations and dates)*
- *Drinking Water Source*
- *Recent Group Activities*
- *Contacts with Persons with Gastrointestinal Illness*

B. Identify and Evaluate Contacts

1. Symptomatic Contacts

- Contacts of a confirmed case who have diarrhea, are probable cases and are treated the same as confirmed cases for disease control purposes. See Section 6--Disease Control Measures.

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- Complete a case investigation form on all epidemiologically-linked individuals having symptoms compatible with *E.coli* O157:H7 or STEC.
- Refer symptomatic individuals who have not previously been tested (especially if they are high-risk workers or attend child care) to their health care providers for stool testing, including Shiga toxin testing. If testing will be performed by CDPHE, refer to the [Food and Stool Specimen Collection Instructions](#) on the Infectious Disease Guidelines and Resources website.
- CDPHE recommends that people who are experiencing symptoms submit stool specimens through their health care provider rather than to the state laboratory for several reasons:
 - The patient will receive appropriate medical care for the illness, including antimicrobial therapy, if appropriate.
 - Results will be known more quickly if stool is tested by a commercial laboratory than if tested at the state laboratory.
- Symptomatic contacts should be entered into CEDRS as probable STEC cases. (It is helpful if you enter the CEDRS ID numbers of the lab-confirmed cases to whom probable cases are epi-linked in the CEDRS case notes.)
- If a common source of infection is suspected, please notify CDPHE.

2. Asymptomatic Contacts

- Ask about sensitive occupations, food handling, child care, and/or school.
- Provide information about symptoms and preventive measures. See Section 6 (C)-- Education.
- Counsel asymptomatic high-risk workers (e.g., food handlers). Stress importance of good handwashing, personal hygiene, and that they should not work and should notify their supervisor whenever they have a diarrheal illness.
- If an asymptomatic contact who is a food handler works at an establishment with questionable hygienic practices (e.g. based on prior environmental health inspections), consider obtaining stool specimens for testing.
- If an asymptomatic contact who is a high-risk worker develops diarrhea, exclude her/him from work, obtain a stool sample, and notify the worker's supervisor.
- Consult with Environmental Health staff and recommend a glove order if necessary.

C. Reported Incidence Is Higher than Usual/Outbreak Suspected

If the number of reported cases of STEC in your jurisdiction is higher than usual, or if an outbreak is suspected, investigate to determine the source of infection and mode of transmission. Consult with a CDPHE Communicable Disease Epidemiologist. CDPHE staff can assist local public health agencies to investigate outbreaks and determine a course of action to prevent further cases, and can coordinate surveillance of cases that cross county lines.

6) DISEASE CONTROL MEASURES

An [STEC fact sheet](#) is available on the CDC website.

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A. Treatment

Antibiotics are generally not indicated for treatment of *E. coli* O157:H7 or other STEC because they may be implicated in developing HUS. Antimotility agents should not be administered to children with inflammatory or bloody diarrhea. Careful follow-up of patients with hemorrhagic colitis is recommended to detect changes suggestive of HUS.

B. Prophylaxis

No prophylactic treatment of close contacts is recommended.

C. Education

- Cook all ground beef and hamburger thoroughly.
- If served an undercooked hamburger or other ground beef product in a restaurant, send it back for further cooking.
- Avoid consuming unpasteurized milk or other unpasteurized dairy products.
- Educate case and household contacts on proper hand washing techniques.
- Always wash hands thoroughly with soap and water before eating or preparing food, after using the toilet, after changing diapers, and after touching pets or other animals.
- After changing diapers, wash your hands AND the child's hands.
- In a child care setting, dispose of stool and soiled diapers in a sanitary manner.
- Cases should not prepare food for other individuals until symptoms resolve.
- Keep food that will be eaten raw, such as vegetables, from becoming contaminated by animal-derived food products.
- Avoid sexual practices that may permit fecal-oral transmission. Latex barrier protection should be emphasized as a way to prevent spread to sexual partners as well as being a way to prevent the exposure to and transmission of other pathogens.
- Educate case on healthy swimming practices, including not swimming while symptomatic with diarrhea.

D. Managing Special Situations

1. Food Handlers

- When a known or suspected case of *E. coli* O157:H7 or other STEC occurs in a food handler, **immediate involvement of public health authorities is critical.**
- **All** food handlers must be **excluded** from work until at least 24 hours after diarrhea has resolved and adequate hygiene can be maintained, ideally as verified by environmental health. "Exclude" means to prevent a person from working as an employee in a food establishment or entering a food establishment as an employee.
- Food handlers who work in an establishment not serving a highly susceptible population must then be **restricted** until the food handler has had two consecutive negative stool specimens taken at least 24 hours apart. "Restrict" means to limit the activities of a food employee so that there is no risk of transmitting a disease that is transmissible through food and the food employee does not work with exposed food, clean equipment, utensils, linens, or unwrapped single-service or single-use articles.
- Food handlers who work in a food establishment serving a highly susceptible population must be **excluded** until the food handler has had two consecutive negative stool specimens taken at least 24 hours apart.

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- “Highly Susceptible Population” means persons who are more likely than other people in the general population to experience foodborne disease because they are immunocompromised, preschool age children, or older adults; and they obtain food at a facility that provides services such as custodial care, health care, or assisted living, such as a child or adult day care center, kidney dialysis center, hospital or nursing home, or nutritional or socialization services such as a senior center.
- Please consult with your local environmental health specialist for questions about whether a facility is classified as serving a highly susceptible population.
- If a case has been treated with an antibiotic, the stool specimen should not be collected until at least 48 hours after cessation of therapy.
- A letter or memo should be sent to the food service facility documenting the requirements for the infected food handler.

2. Child care/Preschool

When a case of *E. coli* O157:H7 or other STEC occurs in a child care center, including preschools which may or may not have diapered children, **immediate involvement of public health authorities is critical**. Refer child care providers to the CDPHE [Infectious Disease in Child Care and School Settings](#) guidelines for an overview of *E. coli* O157:H7 and non-O157 STEC infections.

- Ill children should not be permitted to re-enter the child care center until at least 24 hours after diarrhea has resolved. Children may then return to child care based on the following criteria:

Type of STEC infection	Criteria to return to child care
O157:H7 infection	Two consecutive stool specimens negative for <i>E. coli</i> O157:H7 or Shiga toxin taken at least 24 hours apart.
Non-O157 STEC infection with Shiga toxin 2+ or Shiga toxins 1&2 are positive by PCR testing at CDPHE lab	Two consecutive stool specimens negative for <i>E. coli</i> O157:H7 or Shiga toxin taken at least 24 hours apart.
Non-O157 STEC infection where Shiga toxin results by PCR test are not known or not available (i.e., a specimen or isolate was never sent to the CDPHE lab)	Two consecutive stool specimens negative for <i>E. coli</i> O157:H7 or Shiga toxin taken at least 24 hours apart.
Non-O157 STEC infection where only Shiga toxin 1+ (and Shiga toxin 2 negative) by PCR testing at CDPHE lab	May return to child care without further testing (if an outbreak is occurring in the center, this recommendation may change to require negative stool testing, depending on the situation)

- If the child has received antibiotics, the specimens must be collected at least 48 hours after completion of antibiotics.
- Parents of cases should be counseled not to take their children to another child care center during this period of exclusion.
- When a case of *E. coli* O157:H7 or non-O157 STEC is identified in a child attending a child care center, determine whether additional children have or have recently had diarrhea.

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- If the case is the only child in the classroom or center who has been ill, no further action is indicated for other children in that classroom or center.
- Other children with recent or current diarrhea should be excluded, should be seen by their physician, and should submit stool for testing. If more than one child is diagnosed with *E. coli* O157:H7 or non-O157 STEC in a child care center, an outbreak could be occurring and additional stool testing of children and staff may be warranted. Consult with CDPHE if this occurs.
- Since many child care center staff assist with food preparation and/or feeding children, those with *E. coli* O157:H7 or non-O157 STEC infection should be excluded from work until at least 24 hours after diarrhea has resolved and they have two consecutive negative stool tests taken at least 24 hours apart (and submitted at least 48 hours after cessation of antibiotics, if antibiotics are given). In this situation it is important for Environmental Health staff to work closely with the center to ensure that affected staff are excluded until cleared by public health. See Section 6 (D1)--Food Handlers above. Staff with no role in food preparation or feeding (e.g. office staff) may return to work after diarrhea has been resolved for at least 24 hours. Stool testing will not be required for these workers. If the staff person ill with *E. coli* O157:H7 or non-O157 STEC infection is the only worker in the center who has been ill, no further action is indicated for other staff or children in the center.
- Reinforce the importance of meticulous handwashing, proper sanitizing and disinfection, and proper diaper changing technique with child care center staff.

3. School

Refer school personnel to the CDPHE [Infectious Disease in Child Care and School Settings](#) guidelines for additional *E. coli* O157:H7 and non-O157 STEC information.

- Students or staff with *E. coli* O157:H7 or non-O157 STEC infection should be excluded until at least 24 hours after their diarrhea has resolved.
- If there are concerns about the case's hygiene (e.g. the case has developmental disabilities or behavioral problems) consider obtaining two consecutive negative stool tests at least 24 hours apart before a case returns to class (submitted at least 48 hours after completion of antibiotic therapy, if antibiotics are given).
- Students or staff who handle food and have an *E. coli* O157:H7 or non-O157 STEC infection must not prepare food until at least 24 hours after their diarrhea has resolved and they have two consecutive negative stool tests taken at least 24 hours apart (collected at least 48 hours after completion of antibiotic therapy, if antibiotics are given). See Section 6 (D1)--Food Handlers.

4. Community Residential Programs (facilities serving the developmentally disabled)

Actions taken in response to a case of *E. coli* O157:H7 or non-O157 STEC in a community residential program will depend on the type of program and the level of functioning of the residents. In general:

- Residents with *E. coli* O157:H7 or non-O157 STEC should be placed on contact precautions until at least 24 hours after their symptoms have subsided and two consecutive negative stool tests have been obtained at least 24 hours apart.

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- Residents with *E. coli* O157:H7 or non-O157 STEC must be excluded from handling or preparing food for other residents until at least 24 hours after their diarrhea has resolved and they have two consecutive negative stool tests.
- If case being re-tested has received antibiotics, stool should be collected at least 48 hours after antibiotics are completed.
- For staff members who provide direct patient care (e.g., feed patients, give mouth or denture care, or give medications) follow guidelines for staff in health care facilities below.
- Staff members with *E. coli* O157:H7 or non-O157 STEC infection who are not foodhandlers and do not provide direct patient care should be excluded from work until at least 24 hours after their diarrhea has resolved.

5. Patients and Staff in Health Care Facilities (Hospitals and Long Term Care Facilities)

Hospitals and long term care facilities generally have written infection control policies and procedures for handling cases of communicable disease among patients and staff members.

If a facility does not have such policies in place, provide the following recommendations:

- Patients with *E. coli* O157:H7 or non-O157 STEC should be placed on contact precautions until at least 24 hours after their symptoms subside and they have submitted two consecutive negative stool tests at least 24 hours apart.
- Healthcare workers who provide direct patient care are generally required to provide two consecutive negative stool tests taken 24 hours apart before returning to work providing patient care.
- If case being re-tested has received antibiotics, stool should be collected at least 48 hours after antibiotics are completed.

E. Environmental Measures

- Implicated food items must be removed from the environment.
- A decision about testing suspect/implicated food items must be made in consultation with CDPHE Communicable Disease Program.
- If a commercial product is suspected, CDPHE Communicable Disease Program will coordinate follow-up with the CDPHE Division of Environmental Health and Sustainability and relevant outside agencies.
- Refer to the [Food and Stool Specimen Collection Instructions](#) on the Infectious Disease Guidelines and Resources website.
- The general policy of the CDPHE Laboratory and the Communicable Disease Program is only to test food samples associated with outbreaks, not in single cases.
- For single cases, CDPHE may suggest that the holders of food locate a private laboratory that will test food, or that they store the food in their freezer for a period of time in the event that additional reports are received.
- The CDPHE Laboratory can test food samples associated with isolated cases of illness on a fee-for-service basis. For more information, contact the CDPHE Microbiology Laboratory.

REFERENCES

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http://www.cdc.gov/nndss/document/2012_Case%20Definitions.pdf

CDC Website: <http://www.cdc.gov/> → click on “Diseases and Conditions”.

Heymann DL, ed. *Control of Communicable Diseases Manual, 19th Edition*. Washington, DC, American Public Health Association, 2008.