E. coli Shiga Toxin-producing (STEC) Infections

Summary

Shiga toxin-producing *E. coli* (STEC) are diarrhea-causing strains of a group of bacteria called *Escherichia coli*. *E. coli* O157:H7 is the most well-known type of STEC, but there are many other types that can cause illness in humans. While STEC infection has traditionally been associated with animal products, outbreaks associated with produce have become more common.

Agent

There are many different types of *E. coli*, only some of which are pathogenic to humans. One type of pathogenic *E. coli*, Enterohemorrhagic *E. coli* (EHEC), produces toxins called Shiga toxins (similar to the toxin produced by *Shigella*) and for this reason these *E. coli* are commonly referred to as Shiga toxin-producing *E. coli* (STEC). In addition to *E. coli* O157, there are many other types that can cause illness, such as *E. coli* O26, *E. coli* O45, *E. coli* O103, *E. coli* O111, *E. coli* O121, and *E. coli* O145.

Transmission

Reservoir:

> Cattle are the most important reservoir of STEC. Humans may also serve as a reservoir for person-to-person transmission. Other animals including deer, sheep, and goats may also carry STEC.

Mode of transmission:

> Occurs mainly by ingestion of contaminated food; most often due to inadequately cooked beef (especially ground beef), but also raw milk and fruit or vegetables contaminated with cattle or other animal feces. Transmission also occurs directly from person to person via fecal-oral routes, such as in families, restaurants, child care centers, and custodial institutions. Waterborne transmission has also been documented in swimmers in lakes and rivers and outbreaks have implicated petting zoos.

Period of communicability:

> For the duration of excretion of the pathogen, this is typically for a week or less in adults but is three weeks in one third of children. Prolonged carriage is uncommon.

Clinical Disease

Incubation period:

> Variable; for O157:H7 usually 3-4 days with a range of 1-8 days.

Illness:

> STEC strains cause diarrhea, hemorrhagic colitis, hemolytic-uremic syndrome (HUS) which causes destruction of red blood cells and possible kidney failure and post diarrheal thrombotic thrombocytopenic purpura (TTP). Illness caused by STEC often begins as non-bloody diarrhea but usually progresses to diarrhea with visible or occult blood. Severe abdominal pain is typical; fever occurs in less than one third of cases. Hemorrhagic colitis is the most severe intestinal infection caused by *E. coli.*

Laboratory Diagnosis

- *E. coli* O157:H7 can be identified presumptively or specifically by appropriate stool cultures. Clinical laboratories can screen for *E. coli* O157:H7 by using MacConkey agar base with sorbitol substituted for lactose. Approximately 90% of human intestinal *E. coli* strains rapidly ferment sorbitol, whereas *E. coli* O157:H7 strains do not. These sorbitol-negative *E. coli* then can be serotyped, using commercially available antisera, to determine whether they are O157:H7.
- Screening tests for *E. coli* O157 cannot be used to identify other types of STEC. An enzyme immunoassay (EIA) test is available that allows labs to directly test stool specimens for the presence of Shiga toxins, and therefore screen for all types of STEC. However, the Shiga-toxin EIA test only tests for the presence of Shiga-toxin in stool and does not require culturing of the *E. coli* organism. If only the EIA test is performed, there will be no isolate available for serotyping and pulsed-field gel electrophoresis (PFGE). Since serotype and PFGE information are crucial to the public health investigation of STEC and the identification of clusters and outbreaks, culture confirmation of specimens positive for Shiga-toxin by EIA tests is recommended.
- Culture Independent Diagnostic Testing (CIDT) is becoming a common method for diagnoses. CIDT is a PCR test with approximately 1-hour turnaround time, which makes it appealing, however, the PCR is run as a GI panel and often results in detection of several conditions. Investigations and reflex culture are required to confirm these results
- Clinical laboratories that detect a diarrhea-associated STEC strain (whether an isolated case or in an outbreak situation) should send the isolate and/or Shiga-toxin EIA positive broth to the NMDOH Scientific Laboratory Division (SLD) for isolate confirmation and serotype identification.
- Hemolytic-Uremic Syndrome (HUS). For all patients with HUS, stool specimens should be cultured for *E. coli* O157:H7 and, if results are negative, for other STEC serotypes. However, the absence of STEC in feces does not preclude the diagnosis of STEC-associated HUS, since HUS typically is diagnosed a week or more after onset of diarrhea when the organism may no longer be detectable.

Treatment

- Dehydration and electrolyte abnormalities should be corrected. Orally administered solutions usually are adequate. Antimotility agents should not be administered to children with inflammatory or bloody diarrhea. Careful follow-up of patients with hemorrhagic colitis (including complete blood cell count with smear, platelet count, blood urea nitrogen level, and creatinine level) is recommended to detect changes suggestive of HUS. If patients have no laboratory evidence of hemolysis, thrombocytopenia, or nephropathy by three days after resolution of diarrhea, their risk of developing HUS is low.
- The role of antimicrobial therapy in patients with hemorrhagic colitis caused by STEC is uncertain. Antibiotic therapy is associated with HUS development. Azithromycin may effectively relieve symptoms. Fluoroquinolones can be used in persons over 18 years and rifaximin may be used for persons over 12 years.

Surveillance

Case Definition:

Laboratory criteria – Isolation of 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.

Confirmed case – A case that meets the laboratory criteria.

Probable case – 1) a case with isolation of STEC from a clinical specimen, pending confirmation of H7 or Shiga-toxin production or; 2) a clinically compatible case that is epidemiologically linked to a confirmed or probable case or; 3) identification of an elevated antibody titer to a known Shiga toxin-producing *E. coli* serotype from a clinically compatible case, 4) a case that is positive by CIDT methods without culture

Suspect case – 1) A case of postdiarrheal HUS or TTP or 2) identification of Shiga-toxin in a specimen from a clinically compatible case without the isolation of the Shiga toxin-producing *E. coli*.

Reporting:

Report all suspected or confirmed cases of STEC to the Epidemiology and Response Division (ERD) at 505-827-0006. Information needed includes: patient's name, age, sex, race, ethnicity, home address, home phone number, occupation, and health care provider.

Case Investigation:

Complete the NMDOH STEC Questionnaire and send to the Epidemiology and Response Division, P.O. Box 26110, Santa Fe, New Mexico 87502-6110, or fax to 505-827-0013. Investigation information should also be entered into NM-EDSS per established procedures.

Control Measures

Control measures for CIDT cases that tested positive for more than one condition should be prioritized as follows: Vibrio> STEC> Cryptosporidium> Salmonella> Shigella> Campylobacter> Cyclosporidium> Giardia.

For a summary of work and daycare exclusion criteria for all enteric pathogens see Appendix 8.

1. Case management

1.1. Isolation:

1.1.a During acute illness, implement contact precautions. During outbreaks, contact precautions for infants with diarrhea caused by STEC should be maintained until cultures of stool are negative.

1.1.b Infected patients should not handle food or provide direct child or patient care in their place of employment until two successive negative stool cultures are obtained greater than 24 hours apart and at least 48 hours after last dose of antimicrobial therapy.

1.1.c On a case-by-case basis, infected patients may return to work with modified duties that do not include handling food or providing direct child or patient care before two successive negative stool cultures are obtained. Decisions to allow patients to return to work will be made in consultation with ERD, local/regional public health staff, employee and employer.

2. Contact management

2.1. Isolation:

2.1.a Investigation of contacts should generally be limited to food handlers, staff and children in child care centers and other situations where spread of infection is particularly likely.

2.1.b Symptomatic contacts should be excluded from handling food and providing direct child or patient care until one negative stool culture has been obtained. If the symptomatic contact is taking antibiotics, the specimen should be obtained 48 hours after the last dose of antimicrobial therapy is taken.

2.1.c On a case-by-case basis, symptomatic contacts may return to work with modified duties that do not include handling food or providing direct child or patient care before two successive negative stool cultures are obtained. Decisions to allow contact to return to work will be made in consultation with ERD, local/regional public health staff, employee and employer.

2.1.d Thorough hand washing after using the bathroom and before food handling or child or patient care should be emphasized for all contacts.

2.2. Prophylaxis: Not applicable.

3. Prevention

3.1. Heat beef adequately (to 160 degrees) during cooking, especially ground beef.

3.2. Emphasize good hand hygiene practices (i.e., proper hand washing after using the toilet, changing diapers, and before and after handling food).

3.3. General guidelines for preventing foodborne illness include:

- Thoroughly cook raw food from animal sources.
- Wash raw vegetables.
- Avoid unpasteurized dairy products.
- Wash hands, knives, and cutting boards after handling uncooked foods.

3.4. Immunization: Not applicable.

Management of STEC diarrhea in Child Care Centers

1. In an outbreak of diarrhea due to STEC and/or HUS in a child care facility, immediate involvement of public health authorities is critical. Infection by STEC is reportable, and rapid reporting of cases can lead to intervention to prevent further disease.

2. Management of isolated case

2.1. Infected child care center attendees should be excluded until two successive negative stool cultures are obtained greater than 24 hours apart and at least 48 hours after antimicrobial therapy is completed, if used.

2.2. Infected child care center staff members should not handle food or provide direct child care until two successive negative stool cultures are obtained greater than 24 hours apart and at least 48 hours after antimicrobial therapy is completed, if used.

2.2.a On a case-by-case basis, infected child care center staff members may return to work with modified duties that do not include handling food or providing direct child

care before two successive negative stool cultures are obtained. Decisions to allow the staff member to return to work will be made in consultation with ERD, local/regional public health staff, employee and employer.

2.3. Per child care licensing regulations, a center should notify parents or guardians in writing of a case of STEC in the facility (Subsection D of 8.16.2.20 NMAC). See Appendix 7 for a template of a notification letter.

2.4. Stool specimens from other symptomatic attendees and staff members should be cultured.

2.4.a Symptomatic attendees should be excluded until two successive negative stool cultures are obtained greater than 24 hours apart and 48 hours after last dose of antimicrobial therapy.

2.4.b Symptomatic child care center staff members should not handle food or provide direct child care until two successive negative stool cultures are obtained greater than 24 hours apart and 48 hours after last dose of antimicrobial therapy.

2.4.c On a case-by-case basis, symptomatic child care center staff members may return to work with modified duties that do not include handling food or providing direct child care before two successive negative stool cultures are obtained. Decisions to allow the staff member to return to work will be made in consultation with Epidemiology and Response Division (ERD), local/regional public health staff, employee and employer.

3. The child care center should review its infection control protocols with staff, and emphasize the following:

- Standard precautions should be followed. Strict hand washing routines for staff and children, and routines for handling fecally contaminated materials.
- Frequently mouthed objects should be cleaned and sanitized daily. Items should be washed with dishwashing detergent and water, and then rinsed in freshly prepared (daily) household bleach solution (dilute 1 cup bleach in 9 cups of water).
- Food-handling and diaper changing areas should be physically separated and cleaned daily.
- Diaper changing surfaces should be nonporous and cleaned with a freshly prepared (daily) household bleach solution (dilute 1 cup bleach in 9 cups of water). Cleaning of diaper changing surfaces after each use is required; diapers should be disposed of properly. If available, nonporous gloves should be worn when changing diapers.
- Animals in the child care center with diarrhea should be isolated from children and taken to a veterinarian for diagnosis and treatment.

4. The day care operator should be instructed to call the local public health office (PHO) or ERD (depending on collaborative plan developed for surveillance and follow up) immediately if new cases of diarrhea occur. The day care center should be called or visited once *each* week for two weeks after onset of the last case to verify that surveillance and appropriate hygienic measures are being carried out.

5. Outbreak

5.1 If an outbreak of STEC diarrhea (i.e., two or more cases) is suspected in a child care facility, ERD should be notified immediately. Outbreaks of STEC in this situation would ordinarily be controlled by exclusion and evaluation of symptomatic children and staff.

References

American Academy of Pediatrics. In: Kimberlin, DW, et al eds. Red Book: 2018 Report of the Committee on Infectious Diseases. 31st ed. Itasca, IL: American Academy of Pediatrics; 2018.

Heymann, DL, ed. Control of Communicable Diseases Manual. 19th edition. Washington, DC: American Public Health Association; 2008.

See *E. coli* Shiga Toxin-producing (STEC) Infections Fact Sheets (English) (Spanish).