

# *E. coli* -Pathogenic

## Potential Bioterrorism Agent: Category B

### Responsibilities:

**Hospital:** Report by IDSS, facsimile, mail or phone

**Lab:** Report by IDSS, facsimile, mail or phone, send isolate to SHL - (319) 335-4500

**Physician:** Report by facsimile, mail or phone

**Local Public Health Agency (LPHA):** Follow-up required

### Iowa Department of Public Health

**Disease Reporting Hotline: (800) 362-2736**

**Secure Fax: (515) 281-5698**

## 1) THE DISEASE AND ITS EPIDEMIOLOGY

Five major categories of *Escherichia coli* strains cause diarrhea:

- 1) Shiga toxin-producing *E. coli* (STEC) including Enterohemorrhagic *E. coli* (EHEC)
- 2) Enterotoxigenic (*Individual cases are not reportable*)
- 3) Enteroinvasive (*Individual cases are not reportable*)
- 4) Enteropathogenic (*Individual cases are not reportable*)
- 5) Intestinal *E. coli* infection-Other (enteroaggregative *E. coli* and diffuse-adherent *E. coli*) (*Individual cases are not reportable*)

### A. Agent

*Escherichia coli* includes over a hundred different serotypes belonging to the group of gram-negative bacteria. Most serotypes are harmless and live in the intestines of healthy humans and animals.

- Shiga toxin-producing *E. coli* (STEC) include O157:H7, O26, O111, O103, O45, and O121. EHEC produce potent cytotoxins called Shiga toxin 1 and 2.
- Enterotoxigenic (ETEC) category includes *E. coli* O6,08,O15, O020, O25, O27, O49, O63, O78, O128ac, O148, O153, O159, 167, and O169. This category of *E. coli* is a major cause of travelers' diarrhea in people from industrialized countries who visit developing countries.
- Enteroinvasive (EIEC) category includes O28ac, O29, O112, O124, O0136, O143, O144, O152, O164, and O167. The inflammatory disease of the gut mucosa and submucosa caused by EIEC strains of *E. coli* closely resembles that produced by *Shigella*.
- Enteropathogenic (EPEC) category includes O55:NM, O55:H6, O55:H7, O86:NM, O86:H34, O111:NM, O111:H2, O111:H12, O111:H21, O114:NM, O127:H6, O127:H9, O127:H21, O128:H2, O128:H7, O128:H12, O142:H6, and O157:H45. Diarrheal disease in this category almost always occurs in children aged less than one year.
- Intestinal *E. coli* infection – Other Enteroggregative (EAEC) category includes O3:H2 and O44:H18. This category of diarrhea-producing *E. coli* is increasingly recognized as a cause of both acute and persistent diarrhea among children and adults. However, there is some debate about whether all strains of EAEC cause diarrhea.  
Diffuse-adherence (DAEC) category. DAEC is the least well-defined category of diarrhea-causing *E. coli*. Little is known at present about the reservoir, modes of transmission, host risk factors, or period of communicability of DAEC.

**Only cases of Shiga toxin-producing *E. coli* are reportable in Iowa. Individual cases of other types of *E. coli* do not require public health investigation. However, all outbreaks of any type of *E. coli* are reportable to IDPH.**

### B. Clinical Description

Infection with pathogenic *E. coli* may present with a wide spectrum of clinical manifestations. An individual may be asymptomatic, have mild non-bloody diarrhea, or have grossly bloody diarrhea. Most diagnosed cases develop bloody diarrhea 6 to 48 hours after the onset of non-bloody diarrhea. Abdominal cramps, nausea and vomiting may also be present. Fever is usually absent. In severe cases, the patient may progress to develop other clinical syndromes such as hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP). Hemolytic uremic syndrome (HUS) is characterized by the acute onset of microangiopathic hemolytic anemia, renal injury, and low platelet count. Thrombotic thrombocytopenic purpura (TTP) is characterized by anemia and low platelet counts but can include central nervous system (CNS) involvement and fever.

### C. Reservoirs

- STEC: Cattle appear to be a reservoir of significant public health importance; however, other animals, such as deer, are also known to carry STEC. In addition, humans serve as a reservoir.
- ETEC: Humans; although also occurs in animals people are the reservoir for strains causing diarrhea in humans.
- EIEC and EPEC: humans

### D. Modes of Transmission

- STEC and ETEC transmission occurs fecal-orally via contaminated food, drinking water or recreational water. Transmission may also occur directly from person-to-person; and can include certain types of sexual contact. The infectious dose for *E. coli* O157:H7 is very low (about 100 organisms). *E. coli* O157:H7 has been associated with the consumption of undercooked contaminated ground beef, unpasteurized apple juice and cider, unpasteurized milk and other dairy products, raw fruits and vegetables, and salami.
- EIEC: Scant available evidence suggests that it is transmitted by contaminated food.
- EPEC transmission has occurred through contaminated infant formula and weaning foods. In infant nurseries, transmission by fomites and contaminated hands can occur. Outbreaks due to contaminated rice and water have been reported.

### E. Incubation Period

- STEC: The incubation ranges from 2 - 10 days with a median of 3 - 4 days.
- ETEC: The incubation ranges from 10 to 72 hours.
- EIEC: The incubation period of 10 to 18 hours have been observed
- EPEC: Incubations periods as short as 9 to 12 hours have been observed in adult studies

### F. Period of Communicability or Infectious Period

- STEC: One week or less in adults but up to 3 weeks in about one-third of infected children. Prolonged carriage is uncommon.
- ETEC and EPEC: for duration of excretion of the pathogen, which may be prolonged.
- EIEC: for the duration of the pathogen excretion.

### G. Epidemiology

- STEC was first identified in 1982 in an outbreak in the United States. Since then, infections have been recognized as an important cause of bloody diarrhea in North America, Europe, Japan, Australia and southern South America. As with other enteric illnesses, the young and old are usually more severely ill when infected. Infection in young children may lead to complications such as HUS in about 5 to 10% of cases. Sporadic cases of *E. coli* O157:H7 infections occur throughout the year with a peak in the incidence of disease during the summer months. Outbreaks in the United States have been associated with undercooked ground beef, unpasteurized milk and apple cider, and other food products. Most cases are due to inadequately cooked ground beef.
- ETEC: This category of *E. coli* is a major cause of travelers' diarrhea in people from industrialized countries who visit developing countries. ETEC is also a major cause of dehydrating diarrhea in infants and children in developing countries, especially among children less than 2 years of age. It has been estimated that globally ETEC causes as many as 380,000 deaths annually in children under five.

- EIEC infections are endemic in developing countries and cause about 1%-5% of diarrheal episodes among people visiting treatment centers. Rarely, infection and outbreaks of EIEC diarrhea have been reported in industrialized countries.
- EPEC: The oldest recognized category of diarrhea-producing *E. coli*, implicated in outbreaks in the 1940's and 1950's. Diarrheal disease in this category is virtually confined to children aged less than one year. It is rarely seen in North America and Europe but remains a major agent of infant diarrhea in many developing area, including South America sub-Saharan Africa, and Asia.
- EAEC: This category of diarrhea-producing *E. coli* is increasingly recognized as a cause of both acute and persistent diarrhea among children and adults. EAEC associated with infant diarrhea have been reported from Latin America, Asia, and sub-Saharan Africa and may be responsible for a proportion of diarrheal disease in developed countries. EAEC associated diarrhea has also been associated with HIV-infected adults and international travelers to developing countries.

## H. Bioterrorism Potential

**Category B Agent:** *E. coli* has been identified as a potential category B bioterrorism agent as a food safety threat.

## 2) DISEASE REPORTING 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, child care attendee or food handler) and if so, to prevent further transmission.
- To identify sources of public health concern (e.g., a contaminated food source or recreational water) and to stop transmission from such a source.

### B. Laboratory and Healthcare Provider Reporting Requirements

Iowa Administrative Code 641-1.3(139) stipulates that the laboratory and the healthcare provider must report. The preferred method of reporting is by utilizing the Iowa Disease Surveillance System (IDSS). However, if IDSS is not available, the reporting number for IDPH Center for Acute Disease Epidemiology (CADE) is (800) 362-2736; fax number (515), 281-5698, mailing address:

IDPH, CADE  
Lucas State Office Building, 5<sup>th</sup> Floor  
321 E. 12<sup>th</sup> St.  
Des Moines, IA 50319-0075

[Disease reporting form](#)

### Laboratory Testing Services Available

The University of Iowa State Hygienic Laboratory (SHL) tests stool specimens for the presence of pathogenic *E. coli* and will confirm and serotype isolates obtained from clinical specimens at other laboratories. Additionally, all laboratories in Iowa are required to submit pathogenic *E. coli* isolates for typing to aid in the public health surveillance necessary to prevent transmission of this disease. For more information on submitting specimens call SHL at (319) 335-4500 or visit [www.shl.uiowa.edu/](http://www.shl.uiowa.edu/).

SHL will test implicated food items from a cluster or outbreak of disease. Food is submitted through local public health departments.

### C. Local Public Health Agency (LPHA) Reporting and Follow-Up Responsibilities

#### Case Investigation

All cases of Shiga toxin-producing *E. coli* require public health follow-up, excluding urinary tract infections caused by normal bowel flora *E. coli*.

- a. It is the LPHA responsibility to complete an *E. coli* Pathogenic disease investigation by interviewing the case and others who may be able to provide pertinent information.

- b. Use the following guidelines to assist in completing the investigation:
- 1) Record the demographic information, date of symptom onset, symptoms, and medical information.
  - 2) When asking about exposure history (food, travel, activities, etc.), use the incubation range for *E. coli* (10 hrs –10 days). Specifically, focus on the period beginning a minimum of 10 hours prior to the case's onset date back to no more than 10 days before onset. If the person ate ground meat, ask how well the meat was cooked.
  - 3) If possible, record any restaurants at which the case ate, including food item(s) and date consumed. If it is suspected that the case became infected through food, refer to the [Iowa's Foodborne Illness Outbreak Investigation Manual](#).
  - 4) Ask questions about water supply because pathogenic *E. coli* may be acquired through water consumption.
  - 5) Household/close contact, pet or other animal contact, child care, and food handler questions are designed to examine the case's risk of having acquired the illness from, or potential for transmitting it to, these contacts. Determine whether the case attends or works at a child care facility and/or is a food handler.
  - 6) If several attempts have been made to obtain case information, but have been unsuccessful (e.g., the case or healthcare provider does not return calls or respond to a letter, or the case refuses to divulge information or is too ill to be interviewed), enter into IDSS as much information as has been gathered. Please explain in the notes section in IDSS the reason why the investigation could not be completed. If using IDSS, select the appropriate reason under the Event tab in the Event Exception field.

After completing the interview enter the information into IDSS. If IDSS is not available, fax [(515), 281-5698] the investigation form or mail to:

IDPH, CADE  
Lucas State Office Building, 5<sup>th</sup> Floor  
321 E. 12<sup>th</sup> St.  
Des Moines, IA 50319-0075

- c. Institution of disease control measures is an integral part of case investigation. It is the LPHA responsibility to understand, and, if necessary, institute the control guidelines listed below in 4) Controlling Further Spread.

## 4) CONTROLLING FURTHER SPREAD

### A. Isolation and Quarantine Requirements

In the healthcare setting patients should be placed in contact isolation for the duration of the diarrhea.

In homes, persons with diarrhea should not cook food for others and must use good handwashing technique after using the toilet.

Cases must be instructed on proper handwashing, especially after-toilet use.

### B. Managing Special Situations

#### Foodhandlers

Contacts with diarrhea who are food handlers shall be considered a case and handled in the same fashion.

Food handlers with pathogenic *E. coli* must be excluded from work. A food handler is any person directly preparing or handling food. This can include a patient-care or child-care provider.

No foodservice worker, healthcare or child care provider should be at work while experiencing active diarrhea.

After diarrhea has resolved, food-handling employees may only return to food handling after producing two negative stool tests taken at least 24 hours apart. If a case has been treated with an antimicrobial, the stool specimens shall not be submitted until at least 48 hours after cessation of therapy. Food handling employees may be reassigned to

tasks where they do not handle food once they have had no diarrhea for 24 hours while awaiting the two negative stool tests.

### **Households:**

Enteric diseases spread easily through households because both close, personal contact and foodborne modes of transmission can be involved. The case interview should provide valuable information about the household that can give clues to the most likely source of the illness. This will also help identify possible vehicles for transmission to other family/household members.

Person-to-person transmission of enteric disease among household members (or household-like contacts) occurs very readily. The potential for transmission is greater if any of the following risk factors are present in the household:

- Diapered children, especially toddlers.
- Crowded, unsanitary conditions.
- Lack of adequate handwashing facilities.
- A fecally incontinent adult who is cared for by other household members.
- Any activity in which contact with feces is likely.
- Situations where enteric diseases can be sexually transmitted (e.g. homosexual males)

The steps in assessment of the household are:

1. Try to determine whether the source of the illness was in the household (either via person-to-person transmission or a common source, such as food).
2. Teach about foodborne and person-to-person transmission patterns, which can occur within the household. Provide fact sheets.
3. If other household members are ill, determine if they are at high risk for transmission outside the household (child care, food establishment, patient care). (See guidelines for specific high-risk setting.)
4. Make recommendations for exclusion from work and/or cohorting/exclusion from child care if indicated. (See guidelines for specific high-risk setting.)
5. Report case(s) to CADE; IDSS is the preferred method for this.
6. If household contacts are in high-risk settings, and are having symptoms, they should be excluded from the high-risk situation and a stool test done. If the household contacts are in high risk settings, but have no symptoms, instruct them on good hygiene, and warn if symptoms develop they should exclude themselves immediately from the high risk situation and have a stool test done.

### **Child Care**

The role that child care centers play in the transmission of enteric diseases has been well documented. Because young children lack hygiene skills, are not always fecally continent (in diapers), and are highly mobile, they serve as very efficient "spreaders" of enteric organisms. Child care employees may also contribute to the spread of enteric diseases if they care for other children or prepare food without properly washing their hands after changing diapers. However, food and water are rarely vehicles for transmission in child care centers. Enteric diseases are commonly spread from person to person as a result of the combination of poor hygiene and highly infectious enteric pathogens. Since *E. coli* may be transmitted person-to-person through fecal-oral transmission, it is important to follow up on cases of pathogenic *E. coli* in a child care setting carefully. General recommendations include:

- Children with pathogenic *E. coli* should be excluded until two negative stool cultures taken more than 24 hours apart are obtained. If a case has been treated with an antimicrobial, the stool specimens shall not be submitted until at least 48 hours after cessation of therapy.
- Staff with diarrhea due to pathogenic *E. coli* should not return to food handling work or direct child care until they have had 2 negative stool cultures taken at least 24 hours or apart and not sooner than 48 hours following the discontinuation of antibiotics.
- Staff of child care programs are considered food handlers. No one should be at work with active diarrhea.

### School

Since *E. coli* may be transmitted person-to-person through fecal-oral transmission, it is important to follow up on cases of pathogenic *E. coli* in a school setting carefully. General recommendations include:

- Students or staff with *E. coli* infection who have diarrhea should be excluded until their diarrhea is gone.
- Students or staff with *E. coli* who do not have diarrhea or vomiting and do not handle food may remain in school if proper hygienic practices are maintained.
- Students or staff who handle food and have *E. coli* infection (symptomatic or not) should not prepare food until their diarrhea is gone and they have had two negative stool tests (submitted at least 48 hours after completion of antibiotic therapy, and at least 24 hours apart, if antibiotics are given).

### Patient Care Settings

Reports of enteric disease in patient-care settings should be followed up as soon as possible, since outbreaks among the ill and elderly may cause significant morbidity and mortality. When a case of shiga-toxin producing *E. coli* occurs in a patient-care setting, the local public health agency (LPHA) may be called upon to assess the potential for transmission and to recommend interventions to prevent further transmission to patients/residents or other staff members.

#### A. Assessment of Potential for Transmission by a Health-care Worker (HCW)

1. Obtain and review a description of the HCW duties.
2. Determine the presence of acute diarrhea.

#### B. Prevention of Transmission

1. If the HCW does have contact with the patient, the patient's environment or food and has diarrhea, exclude from work until diarrhea is resolved and two stool cultures collected at least 24 hours apart and at least 48 hours after discontinuation of antibiotics are negative. Once they have had no diarrhea for 24 hours they can be assigned to duties not involving contact with patient, patient environment or food while awaiting negative stool testing.
2. If the person with a shiga-toxin producing *E. coli* disease is a patient or resident in a hospital, nursing home or other residential care facility, Contact Precautions should be followed until the patient is free of diarrhea. Standard Precautions should be used at all times.

#### C. Contact Precautions

1. Gowns and gloves should be worn when handling the patient's feces or fecally soiled items such as the patient's bed linens, towels, washcloths and clothing. In addition, wear gowns when entering the room if it is anticipated that clothing will have substantial contact with environmental surfaces, items in the environment, or if the patient is incontinent.
2. If rinsing is necessary, fecally soiled clothing and linens should be rinsed only in a commode or hopper sink designed for this purpose. Never rinse in a handwashing sink!
3. The patient's soiled clothing and linens should be bagged in bags that do not leak through for transport to the laundry.
4. If at all possible, use disposable diapers for incontinent patients.
5. Articles used to care for the patient should be used only for that patient until diarrhea is resolved. This would include blood pressure cuff, stethoscope, thermometer, etc.
6. As always, hands should be washed thoroughly after caring for each patient. Patient's hands should also be washed.

### Community Residential Programs

Actions taken in response to a case of pathogenic *E. coli* in a community residential program will depend on the type of program and the level of functioning of the residents.

In long-term care facilities, residents with pathogenic *E. coli* should be placed on Contact Precautions until their symptoms subside.

Staff members who give direct patient care that includes oral contact (e.g., feed patients, give mouth or denture care, or give medications) are considered food handlers and are subject to food handler restrictions, meaning they should not return to those duties until they have 2 negative stool cultures taken at least 24 hours apart and not sooner than 48 hours following the discontinuation of antibiotics. Once they have had no diarrhea for 24 hours they can be assigned to duties other than patient care or food handling. In addition, staff members with *E. coli* infection who are not food handlers should not work until their diarrhea is gone.

In residential facilities for the developmentally disabled, staff and clients with *E. coli* should refrain from handling or preparing food for other residents until their diarrhea has subsided and they have had 2 negative stool cultures taken at least 24 hours apart and not sooner than 48 hours following the discontinuation of antibiotics. In addition, staff members with *E. coli* infection who are not food handlers should not work until their diarrhea is gone.

### **Household Contacts Employed In High Risk Occupations**

Household contacts should be questioned about their employment in high-risk occupations such as food handling, direct patient care, or child care establishments. All household contacts should be educated about the symptoms of the disease and about hygienic methods to avoid further transmission. Proper hand hygiene should be stressed. If they have symptoms, a stool test should be done.

Household contacts that are symptomatic and employed as food handlers, child care workers, or persons responsible for direct patient care should be excluded from their duties until their diarrhea ceases. Household contacts with pathogenic *E. coli* should not return to food handling or direct child or patient care until they have had 2 negative stool cultures taken at least 24 hours apart and not sooner than 48 hours following the discontinuation of antibiotics. Once they have had no diarrhea for 24 hours they can be assigned to duties other than patient care or food handling. They should all be educated on good hygiene, not to work if they become ill, and if diarrhea develops they should be tested and the guidelines above followed regarding returning to work.

No one should be at work with active diarrhea.

### **Reported Incidence Is Higher than Usual/Outbreak Suspected**

Consult with the epidemiologist on-call at CADE, (800) 362-2736. CADE can help determine a course of action to prevent further cases and can perform surveillance for cases that may cross several county lines and therefore may be difficult to identify at a local level.

If the number of reported cases in any city or county is higher than usual, or if an outbreak is suspected, investigate clustered cases in an area or institution to determine the source of infection and mode of transmission. A common vehicle (such as water, food or association with a child care center) should be sought and applicable preventive or control measures should be instituted. Control of person-to-person transmission requires special emphasis on personal cleanliness and sanitary disposal of feces.

*Note:* Refer to [Iowa's Foodborne Illness Outbreak Investigation Manual](#) for comprehensive information on investigating foodborne illness complaints and outbreak.

## **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 CADE. CADE can help coordinate pickup and testing of food samples. If a commercial product is suspected, CADE will coordinate follow-up with relevant outside agencies. If waterborne spread is suspected, contact the county environmental health office and IDPH Division of Environmental Health at (515) 281-7726.

- Environment, such as countertops and bathrooms should be cleaned with an EPA approved disinfectant.
- Follow recommended procedures for fecal coliform testing of recreational water supplies (e.g., pools, lakes).

The general practice of the SHL is to only test food samples implicated in suspected outbreaks; not single cases. The LPHA may suggest that the holders of food implicated in single case incidents locate a private laboratory, which will test food or store the food in their refrigerator for a period of time in case additional reports are received. *Note:* Refer to the [Iowa's Foodborne Illness Outbreak Investigation Manual](#) for comprehensive information in investigating foodborne illness complaints and outbreak.

### Preventive Measures/Education

To avoid exposure, advise individuals:

- To always wash their hands thoroughly with soap and water before eating or preparing food, after using the toilet and after changing diapers. (After changing diapers, wash the child's hands also.)
- In all settings, especially child care, dispose of feces in a sanitary manner.
- When caring for someone with diarrhea, the care giver should wash their hands with plenty of soap and water after helping the person use the toilet, changing diapers, cleaning the bathroom, soiled clothes or soiled sheets. The patient's hands should be washed also.
- Avoid sexual practices that may permit fecal-oral transmission. Latex barrier protection should be emphasized as a way to prevent the spread of *E. coli* to a case's sexual partners as well as being a way to prevent the exposure to and transmission of other pathogens.
- If diagnosed with pathogenic *E. coli*, seek medical attention if symptoms compatible with hemolytic uremic syndrome (HUS) occur. (See chapter on HUS.)
- Keep food that will be eaten raw, such as fruits and vegetables, from becoming contaminated by animal-derived food products. (Wash thoroughly, especially those that will not be cooked.)
- If served an undercooked hamburger or other ground beef product in a restaurant, send it back for further cooking.
- Cook all ground meats thoroughly.
- Drink only pasteurized milk, juice, or cider.

## 4) ADDITIONAL INFORMATION

The Council of State and Territorial Epidemiologists (CSTE) surveillance case definitions for pathogenic *E. coli* can be found at: [www.cdc.gov/osels/ph\\_surveillance/nndss/phs/infdis.htm#top](http://www.cdc.gov/osels/ph_surveillance/nndss/phs/infdis.htm#top)

CSTE case definitions should not affect the investigation or reporting of a case that fulfills the criteria in this chapter. (CSTE case definitions are used by the state health department and the CDC to maintain uniform standards for national reporting.)

## REFERENCES

American Academy of Pediatrics. *2006 Red Book: Report of the Committee on Infectious Diseases, 27<sup>th</sup> Edition*. Illinois, Academy of Pediatrics, 2003.

CDC Website. *Escherichia coli* O157:H7. [www.cdc.gov/ecoli/index.html](http://www.cdc.gov/ecoli/index.html)

Heymann, D.L., ed. *Control of Communicable Diseases Manual, 20<sup>th</sup> Edition*. Washington, DC, American Public Health Association, 2015.

Iowa Administrative Code (641) Chapter 1 Notification & Surveillance of Reportable Communicable & Infectious Diseases, Poisonings & Conditions.

## Resources

Centers for Disease Control and Prevention: [www.cdc.gov/](http://www.cdc.gov/)

Iowa Department of Public Health: [www.idph.state.ia.us/](http://www.idph.state.ia.us/)

Center for Acute Disease Epidemiology

Bureau Of Environmental Health

Iowa Department of Inspections and Appeals, Food Inspections: [www.state.ia.us/government/dia/index.html](http://www.state.ia.us/government/dia/index.html)

Iowa Department of Natural Resources: [www.iowadnr.com/](http://www.iowadnr.com/)

University of Iowa State Hygienic Laboratory: [www.shl.uiowa.edu/](http://www.shl.uiowa.edu/)