ENTEROHEMORRHAGIC *E. coli* (INCLUDING *E. coli* O157:H7) INFECTIONS AND HEMOLYTIC UREMIC SYNDROME (HUS) SURVEILLANCE PROTOCOL

Public Health Action

1. Educate providers and the public about transmission and prevention of Enterohemorrhagic *Escherichia coli* (EHEC).

2. Educate providers and laboratories to report EHEC infections from any site to the local health department in the patient's county of residence within 24 hours of diagnosis.

3. Educate laboratories to submit all EHEC isolates to the Office of Laboratory Services (OLS) for serotyping and Pulsed Field Gel Electrophoresis (PFGE).

4. Educate laboratories about appropriate testing and referral of EHEC, to include one of the following options:
   a. Screen stools with sorbitol MacConkey (SAMC) agar and an O157 latex agglutination test. Sorbitol negative, O157 latex agglutination positive isolates should be presumptively identified as *E. coli* O157:H7 and referred to OLS for confirmation and PFGE; or
   b. By special arrangement, OLS may accept broth/slant from laboratories that run an EIA test and identify Shiga toxin producing *E. coli*. Contact the Office of Laboratory Services at (304) 558-3530 to make arrangements.

5. Conduct an appropriate investigation as follows:
   a. *For sporadic cases of* EHEC: Complete the Supplemental Enteric Disease Case Report Follow-up Form and attach it to the yellow card. Laboratory results should also be attached. Use of the Supplemental Enteric Disease Case Report Follow-up Form will prompt the local health department to complete an appropriate investigation, including but not limited to: 1) a two- to eight-day food history; 2) identification of high-risk persons or symptomatic individuals for further investigation; and 3) identification of specific behaviors that may be associated with EHEC.
   b. *For small outbreaks (three or more epi-linked cases):* Do not wait for serotyping to begin the epi investigation as in 5a above; initiate active surveillance. Consult the Infectious Disease Epidemiology Program (IDEP). Take special care to assure that isolates are rapidly sent to the OLS for serotyping and PFGE.
   c. *For large outbreaks (five or more epi-linked cases):* Consult IDEP immediately. Take special care to assure that isolates are rapidly sent to OLS for serotyping and PFGE.

6. Identify other cases including probable cases (symptomatic persons who are epidemiologically linked to a culture-confirmed case), and investigate completely as in 5a above. Take care to collect stool samples and forward them to OLS.

7. Identify persons with *E. coli* O157:H7 who are employed in high-risk professions:
    a. Exclude symptomatic individuals who are involved in food handling, and from direct care of infants, elderly, immunocompromised, institutionalized patients, and children enrolled in day care.
    b. Exclude asymptomatic individuals with questionable hygiene.
    c. Excluded individuals should only be returned to work after two consecutive negative stool cultures are collected at least 24 hours apart and 48 hours after the last dose of antibiotics.

8. Identify household contacts of culture-confirmed cases. Culture the stools of any household or close contacts who are involved in food handling, direct patient care, or care of young children or the elderly in institutional settings.

Disease Control Objectives

To reduce the risk of secondary or additional cases by:
    a. Early identification and appropriate exclusion of infected persons from high risk situations (day care, food handling, health care).
    b. Rapid and complete investigation of outbreaks so that any common source can be identified and removed.

Disease Prevention Objectives

To reduce the risk of infection from *E. coli* by:
    a. Education of the general public about hand washing as a primary means of preventing person-to-person transmission of *E. coli*.
    b. Education of the general public about proper food handling, including thorough cooking of ground meat and washing of fruits and vegetables prior to consumption, and avoidance of cross-contamination.
    c. Education of the general public to avoid unsafe foods such as unpasteurized milk, cheese, juice, cider, and untreated water.

Surveillance Objectives

1. To determine the incidence of *E. coli* in West Virginia.

2. To identify demographic characteristics of persons with *E. coli*.

3. To identify behavioral risk factors associated with *E. coli*.

4. To facilitate outbreak identification and investigation by running PFGE at OLS on all isolates.

Public Health Significance

Each year there are approximately 73,000 cases and 61 deaths due to EHEC in the United States. Infected individuals usually have bloody diarrhea, and some may experience kidney failure due to hemolytic uremic syndrome (HUS). The most common cause of transmission of *E. coli* O157:H7 is from the consumption of undercooked

contaminated ground beef. Person to person contact in families and day care centers can also transmit the bacteria. One can also obtain the bacteria after drinking raw milk and swimming in or drinking sewage-contaminated water.

EHEC has been responsible for large and dramatic outbreaks, including the following:

- An EHEC outbreak occurred between 1992 and 1993 which resulted in 500 laboratory confirmed infections and four deaths occurring in four states: Washington, Idaho, California, and Nevada. This outbreak was due to the consumption of undercooked hamburgers from one restaurant chain.
- In 1998, at least 26 children became infected with EHEC resulting in one death after playing at an Atlanta water park that became contaminated due to a fecal accident.
- Between June and July of 1997, simultaneous outbreaks of EHEC occurred in Michigan and Virginia, involving 108 individuals who had eaten alfalfa sprouts.
- An EHEC outbreak in July of 1997 resulted in 20 individuals becoming ill in Colorado. This led to a recall of 25 million pounds of suspected ground beef, which was the largest recall in U.S. history.
- In 1994, 18 summer camp attendees in Virginia became ill with EHEC after the consumption of undercooked ground beef.
- The largest outbreak of EHEC occurred in 1996 in Japan affecting 6,309 school children and 92 school staff members from 62 elementary schools. An additional 160 cases were reported among family members of school children. There was a total of 9,578 cases of EHEC, of which there were 101 cases of HUS which resulted in 11 deaths.

Clinical Description

E. coli O157:H7 usually causes severe bloody diarrhea and abdominal cramps; sometimes the infection causes non-bloody diarrhea or no symptoms. There is usually little or no fever, and the illness resolves in five to 10 days.

For children under five 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. HUS is a combination of microangiopathic hemolytic anemia, thrombocytopenia, and acute renal failure. In the United States, HUS is the principal cause of acute kidney failure in children, and most cases of HUS are caused by *E. coli* O157:H7.

Etiologic Agent

Escherichia coli is a gram negative bacterium which has hundreds of serotypes which are mainly found in intestines of warm-blooded vertebrates. Strains of *E. coli* are grouped by the pathogenic mechanism of disease: enterohemorrhagic, enteroinvasive, enteropathogenic, entertoxigenic, enteroaggregative, and enteroadherent

The most commonly recognized enterohemorrhagic *E. coli* (EHEC) is *E. coli* O157:H7. Enterohemorrhagic strains produce a Shiga toxin which damages endothelial cells. The bacteria are classified by their cell wall (O antigen) and flagella antigen (H antigen).

Reservoir

The main reservoir for *E. coli* O157:H7 is the intestines of healthy cattle. *E. coli* O157:H7 does not cause illness in cattle, but there is still no way to get rid of the bacterium.

Mode of Transmission

E. coli O157:H7 is excreted in feces of infected cattle, humans, and other infected animals. It can be transmitted by a number of routes: foodborne, waterborne, and person-to-person. Undercooked beef (i.e. hamburgers), cross contamination or fecal contamination of food or water, and consumption of raw milk are the most common sources of outbreaks.

Incubation Period

The range is two to eight days, and the median is three to four days.

Infectious Period

E. coli is shed in the stool during the initial period of diarrhea and variably thereafter. Children can shed *E. coli* O157:H7 for two to four weeks after onset. Adults have a shorter infectious period, and it has been reported that they can excrete *E. coli* for up to three months.

Outbreak Recognition

Rapid investigation of single cases and clusters of *E. coli* O157:H7 is critical to early recognition of larger outbreaks. Outbreak recognition and investigation requires timely and complete epidemiological investigation (risk factors, food history, history of exposure to animals, etc.) paired with timely and complete laboratory investigation (serotyping and PFGE). With the use of modern laboratory techniques, outbreaks may be defined as three or more epi-linked cases infected with *E. coli* of the same serotype and PFGE pattern.

Rapid institution of control measures in the early stages of outbreak investigations is critical with this disease. In general, err on the side of aggressive intervention.

Managing Possible Cases

7. If the outbreak is linked to a public gathering or restaurant:
    a. Likely sources are undercooked meat, cross-contaminated food, or possibly food contaminated by an infected food handler. Environmental investigation should focus on specific food items and method of preparation.
    b. Environmental inspection of the dairy or water supply is also important.

2. If an outbreak is linked to raw milk or milk products:
    a. Conduct an environmental evaluation of the dairy or water facility.
    b. Impound any remaining products.

3. If food was served at a public gathering:
    a. Identify any individuals who prepared food to see if they had any diarrhea in the previous month.
    b. Identify any attendees who had diarrhea within two to eight days after the gathering.
    c. Impound any remaining food.

4. If an outbreak occurs at a day care or health care facility:
    a. Exclude all symptomatic individuals.
    b. In some situations, screening of asymptomatic attendees may also be helpful.
    c. Investigate the possibility of person-to-person spread, foodborne or waterborne spread, or direct contact with farm animals.

Case Definition for *E. coli* O157:H7 and Hemolytic Uremic Syndrome

Clinical Description of E. coli

An illness that causes diarrhea (often bloody) and abdominal cramps. The illness may be complicated by hemolytic uremic syndrome (HUS) or thrombotic thrombocytopenic purpura (TTP).

Laboratory Criteria for Diagnosis of E. coli

a. Isolation of *E. coli* O157:H7 from a clinical specimen.
b. Isolation of Shiga toxin producing *E. coli* O157 from a clinical specimen.

Case Classification of E. coli

Suspected: a case of post-diarrheal HUS or TTP

Probable:

a. A case with isolation of *E. coli* O157:H7 from a clinical specimen, pending confirmation of H7 or Shiga toxin.
b. A clinically compatible case that is epidemiologically linked to a confirmed or probable case.
c. Identification of Shiga toxin in a specimen from a clinically compatible case.
d. Definitive evidence of an elevated antibody titer to a known EHEC serotype from a clinically compatible case.

Confirmed: a case that meets the laboratory criteria for diagnosis.

Clinical Description of Hemolytic Uremic Syndrome (HUS)

HUS is characterized by the acute onset of microangiopathic hemolytic anemia, renal injury, and low platelet count. Thrombotic thrombocytopenic purpura (TTP) is characterized by these features but can also involve the central nervous system (CNS). Fever may be present in TTP and there may be a more gradual onset. Most cases of HUS (but a few cases of TTP) occur after an acute gastrointestinal illness (usually diarrheal).

Laboratory Criteria for Diagnosis of HUS

The following are both present at some time during the illness:

a. Anemia (acute onset) with microangiopathic changes (i.e., schistocytes, burr cells, or helmet cells) on peripheral blood smear, and
b. Renal injury with either hematuria, proteinuria, or elevated creatinine level (>1.0 mg/dl in a child less than 13 years of age and >1.5 mg/dl in anyone older than 13 years of age).

Case Classification of HUS

Probable:

a. 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 the preceding three weeks, or
b. An acute illness diagnosed as HUS or TTP that
    i. Has onset within three weeks after onset of acute or bloody diarrhea, and
    ii. Meets the laboratory criteria except that microangiopathic changes are not confirmed.

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

Laboratory Notes

The Office of Laboratory Services accepts stool specimens for EHEC. Laboratory surveillance for EHEC is critical. Local health departments should establish that laboratories in their jurisdiction screen all stools for Shiga toxin producing *E. coli* by one of two methods. The simplest method for most small labs is placing stool on SMAC followed by latex agglutination testing for O157 antigen. Larger labs may consider EIA screening of stools. If this method is chosen, please consult the Office of Laboratory Services to arrange testing of the broth/slant for Shiga toxin producing EHEC. Specimens should be submitted for confirmation/identification and PFGE. Local health departments are encouraged to routinely submit all EHEC isolates for testing to West Virginia Office of Laboratory Services, 167 11th Avenue, South Charleston, WV 25303.

Confirmation is based on laboratory findings, and clinical illness is not required.

Preventive Interventions

Share these prevention messages:

- Always wash hands with soap and water:
    a. after using the bathroom,
    b. after changing diapers,
    c. after cleaning the toilet,
    d. after handling soiled towels or linens,

e. before eating, and
f. after petting or handling animals.

- Drink only pasteurized milk products, fruit juices, and cider.
- Eat only fruits and vegetables that have been washed well.
- Follow these simple food preparation tips:
  a. Use a separate cutting board to prepare raw meats.
  b. Cook all ground beef and hamburger thoroughly. Ground beef should be cooked to at least 160°F. If the temperature cannot be checked, cook ground beef until the juices run clear, and the inside is gray or brown throughout (not pink).
  c. Avoid spreading harmful bacteria in your kitchen. Use a clean plate for cooked meat. Never return cooked meat back to the same plate used for raw meat. 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.
  d. If you are served an undercooked hamburger in a restaurant, send it back for further cooking.
  e. Marinade or BBQ sauce used on raw meat should not be used on cooked meat.
  f. Persons who have diarrhea from any cause should not prepare food that will be eaten by others, attend day care, or bathe or swim with others.

Treatment

No specific therapy will reduce the duration of illness. Most persons recover without antibiotics or other specific treatment in five to 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. Anti-diarrheal agents, such as loperamide (Imodium), should also be avoided. Sulfa drugs such as TMP-SMX are contraindicated because of the increased risk of developing HUS. When vomiting or diarrhea are severe, rehydration may be indicated.

Hemolytic uremic syndrome 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%.

Surveillance Indicators

- Proportion of investigations with complete demographic information.
- Proportion of investigations with complete information on high-risk occupations.
- Proportion of cases with laboratory confirmation and completed PFGE.
- Proportion of cases with complete risk factor investigation including a two- to eight-day food history.