<table>
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<th>1. Name of the Organism:</th>
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<td><em>Escherichia coli</em> O157:H7 (enterohemorrhagic <em>E. coli</em> or EHEC)</td>
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Currently, there are four recognized classes of enterovirulent *E. coli* (collectively referred to as the EEC group) that cause gastroenteritis in humans. Among these is the enterohemorrhagic (EHEC) strain designated *E. coli* O157:H7. *E. coli* is a normal inhabitant of the intestines of all animals, including humans. When aerobic culture methods are used, *E. coli* is the dominant species found in feces. Normally *E. coli* serves a useful function in the body by suppressing the growth of harmful bacterial species and by synthesizing appreciable amounts of vitamins. A minority of *E. coli* strains are capable of causing human illness by several different mechanisms. *E. coli* serotype O157:H7 is a rare variety of *E. coli* that produces large quantities of one or more related, potent toxins that cause severe damage to the lining of the intestine. These toxins [verotoxin (VT), shiga-like toxin] are closely related or identical to the toxin produced by *Shigella dysenteriae*.

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<th>2. Nature of Acute Disease:</th>
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Hemorrhagic colitis is the name of the acute disease caused by *E. coli* O157:H7.

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<th>3. Nature of Disease:</th>
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The illness is characterized by severe cramping (abdominal pain) and diarrhea which is initially watery but becomes grossly bloody. Occasionally vomiting occurs. Fever is either low-grade or absent. The illness is usually self-limited and lasts for an average of 8 days. Some individuals exhibit watery diarrhea only.

Infecive dose -- Unknown, but from a compilation of outbreak data, including the organism's ability to be passed person-to-person in the day-care setting and nursing homes, the dose may be similar to that of *Shigella spp.*, (as few as 10 organisms).
4. Diagnosis of Human Illness:

**CDC Case Definition**

Hemorrhagic colitis is diagnosed by isolation of *E. coli* of serotype O157:H7 or other verotoxin-producing *E. coli* from diarrheal stools. Alternatively, the stools can be tested directly for the presence of verotoxin. Confirmation can be obtained by isolation of *E. coli* of the same serotype from the incriminated food.

5. Associated Foods:

Undercooked or raw hamburger (ground beef) has been implicated in many of the documented outbreaks, however *E. coli* O157:H7 outbreaks have implicated alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. Raw milk was the vehicle in a school outbreak in Canada.

6. Relative Frequency of Disease:

Hemorrhagic colitis infections are not too common, but this is probably not reflective of the true frequency. In the Pacific Northwest, *E. coli* O157:H7 is thought to be second only to *Salmonella* as a cause of bacterial diarrhea. Because of the unmistakable symptoms of profuse, visible blood in severe cases, those victims probably seek medical attention, but less severe cases are probably more numerous.

**Reported cases of Ecoli O157, United States 1997**

**Reported isolates of Ecoli O157, United States 1997**
7. Course of Disease and Complications:

Some victims, particularly the very young, have developed the hemolytic uremic syndrome (HUS), characterized by renal failure and hemolytic anemia. From 0 to 15% of hemorrhagic colitis victims may develop HUS. The disease can lead to permanent loss of kidney function.

In the elderly, HUS, plus two other symptoms, fever and neurologic symptoms, constitutes thrombotic thrombocytopenic purpura (TTP). This illness can have a mortality rate in the elderly as high as 50%.

8. Target Populations:

All people are believed to be susceptible to hemorrhagic colitis, but young children and the elderly appear to progress to more serious symptoms more frequently.

9. Food Analysis:

Several microbiological methods can be used to isolate *E. coli* O157:H7 from foods. Unlike typical *E. coli*, isolates of O157:H7 do not ferment sorbitol and are negative with the MUG assay; therefore, these criteria are commonly used for selective isolation. Sorbitol-MacConkey agar has been used extensively to isolate this organism from clinical specimens. Hemorrhagic colitis agar, a selective and differential medium, is used in a direct plating method to isolate O157:H7 from foods. A third procedure uses Sorbitol-MacConkey medium containing potassium tellurite and Cefixime. It includes an enrichment step and is a new method developed as result of the recent foodborne outbreaks. Rapid methods using a variety of technologies, including recombinant DNA methods, are being developed.
10. Selected Outbreaks:

**MMWR 49(40):2000**

On June 15, 1998, the Division of Public Health, Wisconsin Department of Health and Family Services, was notified of eight laboratory-confirmed and four suspected *Escherichia coli* O157:H7 infections among west-central Wisconsin residents who became ill during June 8--12. This report summarizes the outbreak investigation, which implicated fresh (held <60 days) cheese curds from a dairy plant as the source of infection.

**MMWR 49(15):2000**

In June 1999, the Tarrant County Health Department reported to the Texas Department of Health (TDH) that a group of teenagers attending a cheerleading camp during June 9--11 became ill with nausea, vomiting, severe abdominal cramps, and diarrhea, some of which was bloody. Two teenagers were hospitalized with hemolytic uremic syndrome (HUS), and two others underwent appendectomies. Routine stool cultures from eight ill persons failed to yield a pathogen. Stools subsequently were sent to laboratories at the Texas Department of Health and CDC, where *Escherichia coli* O111:H8 was isolated from two specimens.

**MMWR 48(36):1999**

On September 3, 1999, the New York State Department of Health (NYSDOH) received reports of at least 10 children hospitalized with bloody diarrhea or *Escherichia coli* O157:H7 infection in counties near Albany, New York. All of the children had attended the Washington County Fair, which was held August 23-29, 1999; approximately 108,000 persons attended the fair during that week. Subsequently, fair attendees infected with *Campylobacter jejuni* also were identified. An ongoing investigation includes heightened case-finding efforts, epidemiologic and laboratory studies, and an environmental investigation of the Washington County fairgrounds.

**USDA announcement (12 Aug 1997) and follow-up announcement (15 Aug 1997)**

These reports announce a recall of Hudson frozen ground beef.

**MMWR 46(33):1997**

The same recall investigation reported by the CDC.

**MMWR 46(32):1997**

In June and July 1997, simultaneous outbreaks of *Escherichia coli* O157:H7 infection in Michigan and Virginia were independently associated with eating alfalfa sprouts grown from the same seed lot. The outbreak strains in Michigan and Virginia were indistinguishable by molecular subtyping methods. This report summarizes the preliminary findings of
As part of its commemoration of CDC's 50th anniversary, MMWR is reprinting selected MMWR articles of historical importance to public health, accompanied by current editorial notes. Reprinted below is a report published November 5, 1982, which was the first in MMWR to describe diarrheal illness attributable to Escherichia coli serotype O157:H7 infections.

The FDA has issued on 31 October 1996 a press release concerning an outbreak of E. coli O157:H7 associated with Odwalla brand apple juice products.

In October 1996, unpasteurized apple cider or juice was associated with three outbreaks of gastrointestinal illness. These reports summarizes the clinical and epidemiologic features of the two apple cider-related outbreaks, one infection the Western US and the other in the Northeast.

On July 5, 1995, the Winnebago County Health Department (WCHD) in northern Illinois received a report from the local hospital of five cases of Escherichia coli O157:H7 infection among children who resided in Rockford. Interviews of the children's parents revealed no common food source; however, on June 24-25, they all had visited an Illinois state park with a lake swimming beach. On July 6, the Illinois Department of Public Health (IDPH) closed the swimming beach because of suspected transmission of infection through lake water. While, the source of the outbreak is thought to be waterborne, the article is linked to this chapter to provide updated reference information on enterohemorrhagic E. coli.

On June 26, 1995, the Division of Public Health, Georgia Department of Human Resources (GDPH), was notified of three cases of Escherichia coli O157:H7 infection among residents of a community in north Georgia who had onsets of illness within a 24-hour period. Because of the proximity of this community to the Tennessee border, on June 28 GDPH notified the Tennessee Department of Health (TDH) about these cases. TDH subsequently identified two confirmed cases with onsets of illness during June 23-24. Both of these cases were among persons residing in eastern Tennessee approximately 100 miles from the community in Georgia, and one occurred in an 11-year-old boy who was hospitalized with hemolytic uremic syndrome (HUS). This report summarizes the investigation of this outbreak, which implicated eating hamburgers purchased at a fast-food restaurant chain as the source of infection.
<table>
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<th>MMWR 44(29):1995</th>
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<td>Post diarrheal hemolytic uremic syndrome (HUS) is characterized by microangiopathic hemolytic anemia, renal injury, and thrombocytopenia and is associated with infection with Shiga-like toxin-producing Escherichia coli (SLTEC). From January 4 through February 20, 1995, the South Australian Communicable Disease Control Unit of the Health Commission (SACDCU) received reports of 23 cases of HUS among children aged less than 16 years who resided in South Australia. In comparison, during 1994, a total of three cases of HUS was reported in South Australia (1991 population: 1.4 million).</td>
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<td>During February-March, 1994, four persons in Helena, Montana (1995 population: 24,569), developed bloody diarrhea and severe abdominal cramps. Stool cultures for Salmonella, Shigella, Campylobacter, and Escherichia coli O157:H7 were negative; however, sorbitol-negative E. coli colonies were identified in stools from all four patients. Isolates from three patients were identified at CDC as a rare serotype, E. coli O104:H21, that produced Shiga-like toxin II. Although other SLTECs also have been identified in sporadic cases of diarrhea and HUS, the findings in this report document the first reported outbreak of a non-O157 SLTEC in the United States, and the first documentation of illness attributable to Shiga-like toxin-producing E. coli O104:H21. The clinical manifestations of infection in this outbreak were similar to those reported for patients infected with E. coli O157:H7.</td>
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<td>In 1993, the Council of State and Territorial Epidemiologists recommended that clinical laboratories begin culturing all bloody stools -- and optimally all diarrheal stools -- for E. coli O157:H7. This report describes the investigation of a pseudo-outbreak of E. coli O157:H7 infection that occurred in New Jersey during July 1994 after a year-long increase in the number of laboratories culturing all diarrheal specimens for this pathogen.</td>
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<td>On August 8, 1994, the Virginia Department of Health was notified that several campers and counselors at a summer camp had developed bloody diarrhea. The outbreak began during the July 17-30 session at a rural camp where activities included frequent overnight trips at which meals were cooked over a campfire. This report summarizes the findings from the investigation, which confirmed E. coli O157:H7 as the causative agent.</td>
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<th>MMWR 44(09):1995</th>
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<td>From November 16 through December 21, 1994, a total of 20 laboratory confirmed cases of diarrhea caused by Escherichia</td>
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coli O157:H7 were reported to the Seattle-King County Department of Public Health (SKCDPH). In comparison, three cases were reported during October 1994. Epidemiologic investigation linked E. coli O157:H7 infection with consumption of a commercial dry-cured salami product distributed in several western states. Three additional cases subsequently were identified in northern California.

Most epidemiologic investigations of illness associated with E. coli O157:H7 infections have been directed at restaurant-associated outbreaks, and the sources of infection for sporadic cases rarely have been identified. In July 1993, three cases of culture-confirmed E. coli O157:H7 infection among persons residing in a small community in California were traced to consumption of hamburger purchased from a local grocery store; E. coli O157:H7 was isolated from that meat. This report summarizes the investigation of these cases by local and state public health officials.

Reports on laboratory screening for E. coli O157 in Connecticut.

From November 15, 1992, through February 28, 1993, more than 500 laboratory-confirmed infections with E. coli O157:H7 and four associated deaths occurred in four states -- Washington, Idaho, California, and Nevada. This report summarizes the findings from an ongoing investigation (see next paragraph) that identified a multistate outbreak resulting from consumption of hamburgers from one restaurant chain.

During January 1-29, 1993, 230 persons with culture-confirmed infection with Escherichia coli O157:H7 resulting in bloody diarrhea and, in some cases, hemolytic uremic syndrome (HUS) were reported in the state of Washington. Culture results are pending for 80 others with similar illnesses. Preliminary investigations by public health agencies linked cases to consumption of hamburgers from one fast-food restaurant chain. E. coli O157:H7 has been isolated from epidemiologically implicated lots of ground beef; an interstate recall was initiated by the restaurant on January 18.

In late July and early August 1990, an outbreak of gastroenteritis occurred among persons who had eaten a meal while attending an agricultural threshing show in North Dakota on July 28-29. At least 70 (3.5%) of the more than 2000 attendees were affected. Analysis of food histories obtained from 157 persons implicated a buffet-style dinner on July 28. Although food samples were not available at the time of the investigation, food history analysis indicated that roast
beef served at the dinner was the most likely source of infection.

**MMWR 35(34):1986**

A patient recently died in Seattle with a clinical and pathologic diagnosis of TTP had bloody diarrhea associated with E. coli O157:H7 infection for 1 week before the onset of her other symptoms. This patient's clinical course suggested that E. coli O157:H7 infection may have been related to the development of thrombotic thrombocytopenic purpura (TTP).

**MMWR 32(10):1983**

In November 1982, 31 (8.8%) of 353 residents at a home for the aged in Ottawa, Ontario, Canada, became ill with gastrointestinal symptoms. Cases occurred over an 18-day period. None of the usual enteric pathogens (Salmonella, Shigella, Campylobacter, Yersinia, or Amoeba) were found in stool specimens obtained from the 31 affected residents. Escherichia coli O157:H7 was isolated from the stools of 17 patients.

**MMWR 31(43):1982**

Since the beginning of August 1982, stool isolates of Escherichia coli serotype 0157:H7 have been identified at CDC from specimens obtained from four patients in two states. The four patients with sporadic cases in which E. coli was isolated from stools and 24 of the remaining 25 patients with sporadic cases had eaten hamburgers from a variety of sources (including homes and/or local or national-chain restaurants) within the week before they became ill. Additionally, as part of its commemoration of CDC's 50th anniversary, MMWR is reprinting selected MMWR articles of historical importance to public health, accompanied by current editorial notes.

For more information on recent outbreaks see the CDC.

11. Education and Background Resources:

**Loci index for genome Escherichia coli O157:H7**

Available from the GenBank Taxonomy database, which contains the names of all organisms that are represented in the genetic databases with at least one nucleotide or protein sequence.

**USDA (Aug 11 1998)**

USDA Urges Consumers To Use Food Thermometer When Cooking Ground Beef Patties
Preventing *Escherichia coli* O157:H7 infections

A CDC information brochure.

In the past decade, outbreaks of human illness associated with the consumption of raw vegetables and fruits (or unpasteurized products produced from them) have increased in the United States. Pathogens such as *Listeria monocytogenes*, *Clostridium botulinum*, and *Bacillus cereus* are naturally present in some soil, and their presence on fresh produce is not rare. *Salmonella*, *Escherichia coli* O157:H7, *Campylobacter jejuni*, *Vibrio cholerae*, parasites, and viruses are more likely to contaminate fresh produce through vehicles such as raw or improperly composted manure, irrigation water containing untreated sewage, or contaminated wash water. Treatment of produce with chlorinated water reduces populations of pathogenic and other microorganisms on fresh produce but cannot eliminate them. Reduction of risk for human illness associated with raw produce can be better achieved through controlling points of potential contamination in the field; during harvesting; during processing or distribution; or in retail markets, food-service facilities, or the home.

**Frequently Asked Questions about *Escherichia coli* O157:H7.**

A monograph on *E. coli* O157:H7, written Dr. Feng of FDA/CFSAN

The overall goal of this risk assessment is to assess the likelihood of human morbidity and mortality associated with *E. coli* O157:H7 in ground beef in the United States. The risk assessment identifies the occurrence and concentration of this pathogen at specific points from farm-to-table and will assist FSIS in reviewing and refining its risk reduction strategy for *E. coli* O157:H7 in ground beef. In addition, the risk assessment will identify future research needs.

None currently available.

**12. Molecular Structural Data:**

**CDC/MMWR**

The CDC/MMWR link will provide a list of Morbidity and Mortality Weekly Reports at CDC relating to this organism or toxin. The date shown is the date the item was posted on the Web, not the date of the MMWR. The summary
statement shown are the initial words of the overall document. The specific article of interest may be just one article or item within the overall report.

**NIH/PubMed**

The NIH/PubMed button at the top of the page will provide a list of research abstracts contained in the National Library of Medicine's MEDLINE database for this organism or toxin.

**AGRICOLA**

The AGRICOLA button will provide a list of research abstracts contained in the National Agricultural Library database for this organism or toxin.

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