

## Bad Bug Book

U.S. Food & Drug Administration  
Center for Food Safety & Applied Nutrition  
Foodborne Pathogenic Microorganisms  
and Natural Toxins Handbook



# *Escherichia coli* O157:H7

Education

CDC/MMWR

NIH/PubMed

### 1. Name of the Organism:

*Escherichia coli*  
O157:H7  
(enterohemorrhagic  
*E. coli* or EHEC)

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](#).

### 2. Name of Acute Disease:

Hemorrhagic colitis is the name of the acute disease caused by *E. coli* O157:H7.

### 3. Nature of Disease:

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.

Infective 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.](#) (10 organisms).

### 4. Diagnosis of Human Illness:

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:

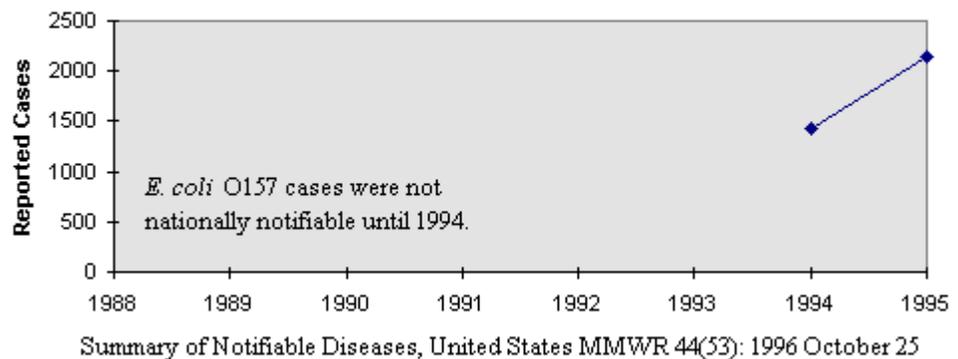
Undercooked or raw hamburger (ground beef) has been implicated in nearly

all documented outbreaks and in other sporadic cases. Raw milk was the vehicle in a school outbreak in Canada. These are the only two demonstrated food causes of disease, but other meats may contain *E. coli* O157:H7.

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 *E. coli* O157, United States 1994-1995



7. Usual Course of Disease and Some 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 larger outbreaks have occurred in institutional settings.

9. Analysis of Foods:

*E. coli* O157:H7 will form colonies on agar media that are selective for *E. coli*. However, the high temperature growth procedure normally performed to eliminate background organisms before plating cannot be used because of the inability of these organisms to grow at temperatures of 44.0 - 45.5°C that support the growth of most *E. coli*. The use of DNA probes to detect genes encoding for the production of verotoxins (VT1 and VT2) is the most sensitive method devised.

10. Selected

Three outbreaks occurred in 1982. Two of them, one in Michigan and one

## Outbreaks:

in Oregon, involved hamburgers from a national fast-food chain. The third occurred in a home for the aged in Ottawa, Ontario; club sandwiches were implicated, and 19 people died. More recently, several outbreaks in nursing homes and a day-care center have been investigated. Two large outbreaks occurred in 1984, one in 1985, three in 1986. Larger outbreaks have occurred in the Northwest U.S. and Canada.

In October-November, 1986, an outbreak of hemorrhagic colitis caused by *E. coli* O157:H7 occurred in Walla Walla, WA. Thirty-seven people, aged 11 months to 78 years developed diarrhea caused by the organism. All isolates from patients (14) had a unique plasmid profile and produced Shiga-like toxin II. In addition to diarrhea, 36 persons reported grossly bloody stools and 36 of the 37 reported abdominal cramps. Seventeen patients were hospitalized. One patient developed HUS (4 years old) and three developed TTP (70, 78, and 78 years old). Two patients with TTP died. Ground beef was the implicated food vehicle.

An excellent summary of nine *E. coli* O157:H7 outbreaks appeared in the *Annals of Internal Medicine*, 1 November, 1988, pp. 705-712.

There was a recall of frozen hamburger underway (12 Aug 1997). For more information, see the [USDA announcement](#) and [follow-up announcement](#) (15 Aug 1997) on the U.S. Department of Agriculture web site concerning the recall of Hudson frozen ground beef.

The Centers for Disease Control and Prevention have reported on the above outbreak in [preliminary \(MMWR 45\(44\):975, 1996 November 8\)](#) and in [updated \(MMWR 46\(1\):4-8, 1997 January 10\)](#) form.

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](#).

A non-food related outbreak of *E. coli* O157:H7 is reported in [MMWR 45\(21\):1996 May 31](#). 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*.

[MMWR 45\(12\):1996 Mar 29](#) reports on an outbreak of O157:H7 that occurred in Georgia and Tennessee in June of 1995.

A community outbreak of hemolytic uremic syndrome attributable to *Escherichia coli* O111:NM in southern Australia in 1995 is reported in [MMWR 44\(29\):1995 Jul 28](#).

A report on [enhanced detection of sporadic \*E. coli\* O157:H7 infections](#) in New Jersey and on [an \*E. coli\* O157:H7 outbreak at a summer camp](#) are in MMWR 44(22): 1995 Jun 9.

An outbreak of *E. coli* O157:H7 in Washington and California associated with dry-cured salami is reported in [MMWR 44\(9\):1995 Mar 10](#).

Information concerning an outbreak that occurred because of home-cooked hamburger can be found in this [MMWR 43\(12\):1994 Apr 01](#).

[MMWR 43\(10\):1994 Mar 18](#) reports on laboratory screening for *E. coli* O157 in Connecticut.

The outbreak of EHEC in the western states of the US is reported in preliminary form in this [MMWR 42\(4\):1993 Feb 5](#), and in updated form in this [MMWR 42\(14\):1993 Apr 16](#).

An outbreak of *E. coli* O157 in 1990 in North Dakota is reported in the [MMWR 40\(16\):1991 Apr 26](#).

The Centers for Disease Control and Prevention has reissued the [5 November 1982 MMWR report](#) that was the first to describe the diarrheal illness of *E. coli* O157:H7. This reissue is a part of the commemoration of CDC's 50th anniversary.

**For more information on recent outbreaks see the [Morbidity and Mortality Weekly Reports](#) from CDC.**

#### 11. Education:

[USDA Urges Consumers To Use Food Thermometer When Cooking Ground Beef Patties \(Aug 11 1998\)](#)

The CDC has an information brochure on preventing [Escherichia coli O157:H7 infections](#).

#### 12. Other Resources:

Dr. Feng of FDA/CFSAN has written a monograph on *E. coli* O157:H7 which appeared in the CDC journal [Emerging Infectious Diseases Vol. 1 No. 2, April-June 1995](#).

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#### 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.

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