

ENTEROTOXIGENIC *ESCHERICHIA COLI* INFECTIONS

ENTEROHEMORRHAGIC *Escherichia coli* (notably *E. coli* O157:H7) are only one of several pathogenic subgroups of this ubiquitous species (see companion article, *verso*). Enterotoxigenic *E. coli* (ETEC) are among the most common causes of diarrhea in residents and visitors of developing countries, but they are rarely recognized in the United States and other industrialized countries. Two 1993 U.S. outbreaks remind us that the hemorrhagic colitis so often in the news is only one of several syndromes associated with *E. coli* infections.

OUTBREAK 1

On March 25, the Rhode Island Department of Health was notified of gastrointestinal illness among passengers on an airline flight from Charlotte, North Carolina, to Providence, Rhode Island, on March 21. The flight carried 98 passengers; 47 (64%) of 74 passengers who were interviewed met the case definition of three or more loose stools in 24 hours beginning within 4 days after the flight. Additional symptoms included abdominal cramps (94%), nausea (70%), headache (57%), fever (13%), and vomiting (13%). The only common meal for all ill passengers was dinner served on board the flight. The median incubation period was 41 hours (range: 12-77 hours); two (5%) of 44 persons recovered within 48 hours of onset of illness.

Illness was most strongly associated with eating garden salad made from shredded carrots and iceberg, romaine, and endive lettuce (46 [98%] of 47 ill passengers compared with six [22%] of 27 well passengers; relative risk [RR]=4.4; 95% confidence interval [CI]=2.2-8.9). Fifty percent of the 18 passengers questioned who had been served the same meal on a different flight that day reported gastrointestinal illness. Approximately 4000 portions of salad had been prepared by one catering service for 40 flights operated by the same airline that day. All salad ingredients were of U.S. origin.

Stool cultures from 20 passengers were negative for *Salmonella*, *Shigella*, *Campylobacter*, *Yersinia*, and *Vibrio*; no viral particles were seen in the 12 stool specimens examined by electron microscopy. *E. coli* isolates from 10 ill passengers were tested for toxin production at CDC, and ETEC strains (O6:non-motile [NM]) producing heat stable (ST) and heat labile (LT) toxins were identified in isolates from three passengers.

No sanitary deficiencies were identified on inspection of the caterer's facilities. All food handlers denied gastrointestinal illness or recent travel outside the United States. Food samples collected March 27 did not yield ETEC.

OUTBREAK 2

On April 5, the New Hampshire Division of Public Health Services was notified of gastrointestinal illness in eight persons who ate a buffet dinner served at a mountain lodge on March 31. A total of 202 persons ate the dinner, including 132 guests and 70 lodge employees. A case was defined as diarrhea (three or more loose or watery stools in a 24-hour period) and one other symptom (cramps, fever, headache, nausea, or vomiting) with onset from April 1 through April 7 in a guest or employee who had eaten the dinner. Of the 123 guests and 56 employees who were interviewed, 96 (78%) and 25 (45%), respectively, had illness that met the case definition. Additional symptoms included cramps (92%), nausea (59%), myalgias (50%), headache (49%), fever (22%), and vomiting (11%). Illness began a median of 38 hours after foods from the buffet were eaten (range: 3-159 hours); 60 (65%) of 93 persons for whom information was available reported continuing illness 4-6 days after symptom onset.

Illness among guests was most strongly associated with consumption of tabouleh salad (cases occurred in 78 [94%] of 83 guests who ate the tabouleh and 18 [53%] of 34 guests who did not [RR=1.8; 95% CI=1.3-2.5]). Tabouleh

was the only food associated with illness among lodge employees (RR=6.4; 95% CI=2.2-18.8). The tabouleh was prepared from onions, carrots, zucchini, peppers, broccoli, mushrooms, green onions, tomatoes, parsley, bulgur wheat, olive oil, lemon juice, and bottled garlic—all of U.S. origin. All food preparers denied gastrointestinal illness or travel outside the United States the week before the banquet.

Stool specimens were negative for commonly recognized pathogens. LT- and ST-producing *E. coli* O6:NM were cultured from seven of nine ill guests and from one of five well employees. Additional ETEC serotypes were isolated from six specimens.

FOLLOW-UP INVESTIGATION

The plasmid profiles of the O6:NM isolates from both outbreaks were identical and distinct from those of 10 other toxigenic *E. coli* O6:NM isolates obtained from other sources. Carrots were the only item common to the tabouleh salad implicated in New Hampshire and the garden salad implicated in Rhode Island. Carrots used in both salads were grown in the same state; however, a traceback did not identify a single source.

DISCUSSION

Since 1975, 13 ETEC outbreaks have been reported in the U.S.; four occurred in 1993. Although nine of the thirteen U.S. outbreaks have been foodborne, waterborne and person-to-person outbreaks have also been described, including a 1975 outbreak at Crater Lake National Park.¹ More recent outbreaks have been attributed to spread from an infected food handler² and imported, contaminated food.³

Because ETEC are not detected by standard stool culture methods, and because symptoms of ETEC infection are relatively nonspecific, illness caused by ETEC may be incorrectly attributed to a viral etiology. Watery diarrhea is the predominant symptom of ETEC infection, usually reported by more than 90% of patients. The diarrhea is often accompanied by abdominal cramps and is generally

mild, although severe dehydrating diarrhea has been reported.⁴ Vomiting is reported by less than 15% of patients.

In contrast to illness caused by ETEC, gastroenteritis from infection with Norwalk virus is often characterized by vomiting but not always diarrhea. Because nausea, headache, and myalgias occur with varying frequency in association with ETEC and Norwalk virus infections, these symptoms are less useful for differentiating the two illnesses. Although the incubation periods—typically 24-48 hours—are similar for ETEC and Norwalk gastroenteritis, the latter illness tends to be shorter (usually 1-2 days).

Laboratory identification of ETEC isolates depends on methods that are not widely available. All suspected common-source or foodborne outbreaks should be reported *immediately* to your local health department. Do not wait for identification of an etiologic agent—something that often never happens and is not necessary for many purposes. Prompt reporting greatly facilitates investigation and makes possible timely public health interventions.

REFERENCES

- This article was adapted from *MMWR* 1994;43(5):79-82
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All About *Escherichia coli*

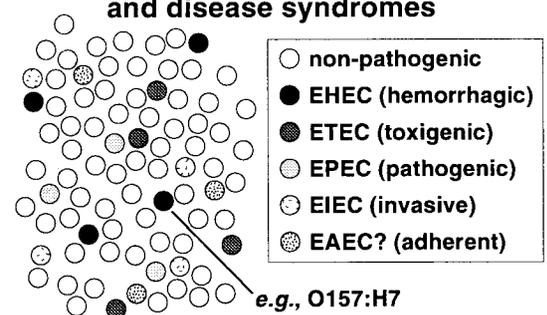
WHILE A POPULAR topic around many water coolers, the subtleties of bacterial taxonomy continue to elude many. This ignorance may contribute to confusion and unnecessary alarm. *Escherichia coli* is a ubiquitous species of bacteria—part of the intestinal flora of most warm-blooded creatures. These organisms are very easy to find in water or soil that is contaminated with animal waste. Essentially all humans are colonized with one or more types of *E. coli*,* which (along with other Enterobacteriaceae) are subclassified by cell wall antigens. These antigens, numbered in their order of discovery, include cell wall or “somatic” lipopolysaccharides (the “O” antigens, from the German *ohne Hauch*), flagellar proteins (the “H” antigens, from *Hauch*), and usually polysaccharide capsular antigens (“K,” from *Kapsel*).† K antigens are rarely specified for *E. coli*.

Most of the hundreds of *E. coli* serotypes are non-pathogenic for man. Several dozen have been recognized as human pathogens, however, and they are associated with at least five different pathogenic mechanisms.¹ Thus, we have enterohemorrhagic *E. coli* (e.g., O157:H7), enterotoxigenic *E. coli* (e.g., O6:NM in the above examples), enteropathogenic *E. coli*, Shigella-like enteroinvasive *E. coli*, and the poorly characterized enteroadherent *E. coli*. (This concept is illustrated schematically in the figure.) These dissimilar illnesses have

* not to be confused with the harmless protozoan *Entamoeba coli*, also correctly referred to (in other contexts) as *E. coli*.

† Regrettably, space does not allow a fuller discussion of the fascinating etymologies of these labels, first coined by 19th century microbiologists.

Schematic of *E. coli* serogroups and disease syndromes



quite distinct epidemiologies as well. With the exception of O157:H7, which only slowly ferments sorbitol, most disease-causing *E. coli* are not readily distinguishable in the lab from their non-pathogenic cousins. Hence, enteric *E. coli* infections *other* than O157:H7 are not routinely diagnosed. Even O157 identification requires the use of special culture media.

E. coli (sensu lato)—not necessarily of human origin—are widely used as indicators of fecal contamination—in water, for example. Such assays rarely differentiate serotypes, however, and do not *per se* indicate the presence of pathogens. Thus, finding *E. coli* in well water in and of itself rarely means that hemorrhagic colitis or cholera-like ETEC illness is imminent. It does suggest a lack or failure of treatment and/or the possibility of plumbing cross-connections, and suggests a *potential* for transmission of enteric pathogens that should be addressed.

In short, not all *E. coli* are created equal. Most serotypes are “normal flora.” Others cause illness in some species but not in others. And of those that cause human illness, there are several different kinds of infections, each with their own epidemiology.

REFERENCE

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