

Shiga Toxin-producing *Escherichia coli* (STEC) Infections in New Mexico, 2004-2006

Shiga toxin-producing *Escherichia coli* (STEC) are diarrhea-causing strains of a group of bacteria called *Escherichia coli*. *E. coli* O157:H7 is the most well-known type of STEC; however, there are other types that cause illness in humans (Table). STEC strains produce illness by manufacturing toxins that destroy the intestinal lining. Symptoms of STEC infection usually appear 3 to 4 days after exposure to the organism. Initially, STEC produce non-bloody diarrhea and severe abdominal cramping. After several days, the diarrhea usually becomes bloody. Shiga toxins can also enter the bloodstream and act on small blood vessels, specifically in the kidneys. The ensuing kidney damage can trigger hemolytic uremic syndrome (HUS), which can cause kidney failure and death. Antibiotics and antimotility agents are associated with an increased risk of developing HUS and should not be used in the treatment of STEC. Children less than 5 years of age and the elderly are at greatest risk for developing HUS.

Epidemiology

STEC live in the intestines of healthy cattle, deer, sheep and goats. STEC infections usually result from inadequate hand-washing following contact with infected animals, drinking unpasteurized milk, or from handling or eating raw or undercooked meat. Many other foods can also become contaminated. Recent nationwide outbreaks of *E. coli* O157:H7, which included cases in New Mexico, have been associated with contaminated spinach and lettuce.

Nationwide, an estimated 73,000 infections, 2,168 hospitalizations and 61 deaths annually are attributed to *E. coli* O157, which in the United States is the most commonly reported STEC. The primary complication of STEC infection leading to hospitalization is HUS; and HUS complicates 5-10% of O157 infections and an unknown percentage of non-O157 infections. The incidence rate of STEC associated HUS in North America is three cases per 100,000 children less than 5,

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somewhat lower among older children and not known in adults. During the widely-reported 2006 spinach related outbreak of *E. coli* O157:H7 involving a total of 199 persons nationwide, 102 (51%) cases were hospitalized, 31 (16%) developed HUS and 3 STEC-related deaths occurred.

According to FoodNet, a Centers for Disease Control and Prevention (CDC) funded initiative that monitors foodborne infection in 10 U.S. states including New Mexico, the incidence of STEC has decreased nationwide since baseline data were collected from 1996-1998. However, FoodNet data also indicate increased incidence for 2005 and 2006 following substantial declines in 2003 and 2004. This national trend appears to correspond with the trend in New Mexico. Between 2004 and 2006, New Mexico experienced a 111% in-

Table. Serotypes of Shiga toxin-producing *E. coli*, New Mexico, 2004-2006

Serotype	Number (%)			
	2004 n = 18	2005 n = 20	2006 n = 42	Total n = 80
Non-O157	11 (61)	10 (50)	22 (52)	43 (54)
O157	7 (39)	10 (50)	20 (48)	37 (46)
O157:H7	6	8	16	30
O157:non-motile	1	2	3	6
O157:H not typed	0	0	1	1

crease in reported cases of STEC (Figure on the back page). It is not known if this increase in reports represents a true increase in STEC infections or is the result of increased testing by health care providers. In 2006, 4 cases of HUS were reported to the New Mexico Department of Health (NMDOH); three of the cases were less than 5 years of age at the time of diagnosis.

Laboratory Methods

There are a variety of laboratory methods available for the diagnosis of STEC infection, but the most commonly used tests are culture for *E. coli* O157 and testing for the presence of Shiga toxin using an enzyme-linked immunoassay (EIA). *E. coli* O157 has unique properties compared to other *E. coli* and can be detected with special culture techniques. The Shiga toxin EIA test allows stool specimens to be tested directly for the presence of Shiga toxin. The EIA test can detect all STEC, but cannot distinguish between O157 and other serotypes. Ideally, a positive EIA test is followed by culture and isolation of the *E. coli* organism so that a serotype can be determined. Unfortunately, since the introduction of the EIA test, many laboratories have abandoned culture and isolation, which presents a significant problem for public health surveillance and investigations. The availability of isolates for serotyping and DNA fingerprinting through pulsed-field gel electrophoresis (PFGE) is crucial to the rapid identification of STEC outbreaks.

In New Mexico, many laboratories can perform *E. coli* O157 specific cultures. These labs are required to forward all *E. coli* O157 isolates to the NMDOH Scientific Laboratory Division (SLD) for confirmation and PFGE. Although two laboratories in New Mexico can perform the Shiga toxin EIA test, the vast majority of the EIA tests done in the state are performed by a single lab. This lab does not perform culture and isolation of STEC following a positive EIA, but instead forwards EIA positive specimens to SLD for further testing. For all *E. coli* O157 isolates and Shiga toxin positive specimens submitted by clinical labs, SLD utilizes a standardized algorithm that includes EIA testing, selective culture media and specific antigen tests to confirm the presence of an STEC organism and determine if it is an O157 or non-O157 strain. SLD performs PFGE on all STEC isolates to determine if individual specimens of the same *E. coli* subtype have identical DNA fingerprints and presumably are from the same source.

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Prior to 2006, the NMDOH Infectious Disease Epidemiology Bureau did not investigate Shiga toxin positive results until an organism could be identified and serotyped either by SLD or, when SLD was unable to identify an organism, CDC. Consequently, in many cases there were significant delays (days to months) from the time Shiga toxin was identified until an organism was identified and an investigation was initiated.

Of the Shiga toxin positive specimens submitted to SLD during 2004-2006 from the large New Mexico clinical lab that does EIA testing in-house, 80% were eventually culture-confirmed by either SLD or CDC. This percentage increased over time from 68% in 2004 to 92% in 2006. These results indicate that initiating an investigation of a Shiga toxin EIA positive result prior to culture-confirmation will generally not result in a misuse of public health resources and could potentially improve outbreak detection.

In June 2006, the NMDOH identified a cluster of STEC-related HUS cases that prompted enhanced surveillance, including the implementation of a 17-page extended exposure questionnaire on all subsequent STEC cases. The purpose of the questionnaire is to identify common exposures among cases. In this instance, the questionnaire allowed the NMDOH to determine that the three HUS cases did not share a common food or environmental exposure. In addition, PFGE subtyping indicated that the cases had different DNA fingerprints, providing further evidence that the cases were not part of an outbreak.

In August 2006, six *E. coli* O157 cases from Bernalillo County were reported to NMDOH in a single week. This unusually high number of cases prompted the NMDOH to expedite interviews of the cases with the extended STEC questionnaire. Within a week of the report of the first case, spinach was identified as a common exposure among at least three of the cases. The extended questionnaire was crucial to identifying this unusual exposure. PFGE subtyping indicated that these three cases and two others had identical DNA fingerprints that also matched cases from Wisconsin, Utah and Oregon. The multi-state investigation that followed identified cases from 26 states that were all linked to consumption of contaminated prepackaged spinach from California. The sixth New Mexico case

reported that week had a different DNA fingerprint and had not eaten spinach prior to illness onset, indicating the case was not linked to the outbreak.

Results and Recommendations

Of the Shiga toxin EIA positive specimens submitted to SLD during 2004-2006 from the large New Mexico clinical lab that does EIA testing in-house, 80% were eventually culture-confirmed by either SLD or CDC. This percentage increased from 68% in 2004 to 92% in 2006. These results indicate that initiating an investigation of a Shiga toxin EIA positive result prior to culture-confirmation will generally not result in a misuse of public health resources and could potentially improve outbreak detection. Based on these results, and the experience surrounding the 2006 HUS cluster and spinach-related *E. coli* O157 outbreak, the following policy changes surrounding STEC infections have been instituted:

1. NMDOH adopted CDC's suspect STEC case definition (Box);
2. NMDOH initiates STEC investigations as soon as a Shiga toxin positive EIA result is received;
3. NMDOH routinely uses the extended exposure questionnaire to interview all suspected and confirmed STEC cases.

NMDOH maintains a commitment to continually monitor infectious disease trends and improve operational policies and procedures in order to protect the health and welfare of all New Mexicans.

Box. CDC suspect, probable and confirmed case definitions or STEC, 2005.

Case classification

Suspect: A case of postdiarrheal HUS or TTP (thrombotic thrombocytopenic purpura), or identification of Shiga toxin in a specimen from a clinically compatible case without the isolation of the Shiga toxin-producing *E. coli*.

Probable:

- A case with isolation of *E. coli* O157 from a clinical specimen, without confirmation of H antigen or Shiga toxin production,
- OR
- A clinically compatible case that is epidemiologically linked to a confirmed or probable case,
- OR
- Identification of an elevated antibody titer to a known Shiga toxin-producing *E. coli* serotype from a clinically compatible case.

Confirmed: A case that meets the laboratory criteria for diagnosis. When available, O and H antigen serotype characterization should be reported

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Figure. Culture-confirmed STEC Cases by Year

