Shiga Toxin-Producing *Escherichia coli*: A Review of Reported Washington Cases and 2011 Laboratory Survey Results

Shiga toxin-producing *Escherichia coli* (STEC) are a leading cause of bacterial enteric infections in the United States and can result in serious complications including renal failure and death. Prompt laboratory diagnosis and rapid identification of disease clusters are critical to identify and remove sources of infection. Recently, STEC infections have dominated the news as O104 STEC, a newly emerged serotype, has caused nearly 800 cases of hemolytic uremic syndrome (HUS) and 25 deaths in Europe (http://www.cdc.gov/ecoli/2011/ecoliO104).

Public Health Discussion Points

The answers are contained in the text, or you may refer to the text to at the end of this section.

1. What are the CDC recommendations for laboratory identification of STEC?
2. Why is simultaneous culture on selective media and testing with an assay to detect Shiga toxin necessary for detection of all STEC?
3. What is one hypothesis about the increased incidence of non-O157 STEC in Washington?
Epidemiology of STEC in Washington State

*E. coli* are classified by their O and H antigens (e.g., *E. coli* O157:H7, *E. coli* O26:H11) and broadly categorized as STEC O157 or non-O157 STEC. For many years, most recognized STEC outbreaks were associated with STEC O157. Despite the dominance of STEC O157, at least 150 non-O157 strains are known to cause human illness and have been associated with outbreaks.

There are about 150-200 STEC cases reported each year in Washington. Children under five years of age are diagnosed most frequently and are at greatest risk for complications such as hemorrhagic colitis, hemolytic uremic syndrome (HUS) and death.

The Washington Department of Health (DOH) retrospectively reviewed all confirmed STEC cases reported during 2005 through 2010 to determine overall numbers of O157 and non-O157 infections. STEC O157 accounted for 83% (781 cases) of reported STEC during 2005 through 2010. Although non-O157 STEC accounted for only 17% of cases, the proportion of non-O157 STEC increased five-fold during this time period, associated with 40% of all reported STEC infections during 2010, up from just 6% during 2005 (Figure 1).

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Image 2. Components of *E. coli* bacterium
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During this time period, testing for non-O157 STEC changed greatly. To determine if the increase in reported non-O157 STEC incidence is real or the result of changes in STEC diagnostic testing, DOH surveyed all microbiology laboratories in the state with regards to their STEC testing practices.

**Laboratory Testing Recommendations**

Because STEC O157 cannot ferment sorbitol, it can be identified using sorbitol-containing media. However, this method will not detect non-O157 STEC. To identify non-O157 STEC, Shiga toxin assay methods such as enzyme immunoassay (EIA), lateral flow card testing or polymerase chain reaction (PCR) are employed.

The Centers for Disease Control and Prevention (CDC) published guidelines for laboratory identification of STEC (http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5812a1.htm) that recommend that all stool specimens submitted to test for enteric pathogens should be simultaneously cultured for *E. coli* O157:H7 AND assayed for Shiga toxin. Culture allows timely recognition of STEC O157 bacteria while Shiga toxin testing allows recognition of non-O157 STEC.

**STEC Laboratory Survey**

Of 74 clinical microbiology laboratories in Washington, 57 perform routine enteric pathogen testing, while 14 forward specimens to reference laboratories. All reference laboratories are included within the 57 surveyed laboratories. During a three-week period (January 18 – February 8, 2011), supervisors at the 57 laboratories were directed to an online survey. The survey requested data on annual stool culture capacity, current culture and non-culture STEC testing methods, and future Shiga toxin testing plans. Response to the survey was 100%.

The 57 surveyed laboratories collectively process an estimated 71,000 stool cultures annually. Fifteen laboratories (26%) representing 40% of stool specimens both test with a Shiga toxin assay and simultaneously culture for STEC O157, as recommended by CDC (Figure 2). An additional four laboratories (13%) representing 13% of specimens are tested with a Shiga toxin assay, but do not culture for STEC O157. This method is concerning, since STEC O157 can be detected (and serogrouped) within 24 hours of culture initiation, therefore the absence of culture until broth is submitted to PHL can delay the detection of STEC O157. This, in turn, delays diagnoses and medical and public health intervention.

On the other hand, 37 laboratories (65%) representing about half of annual specimens exclusively culture for STEC O157, without testing with an assay to detect Shiga toxins. This metric is particularly concerning, as it will not detect any non-O157 STEC.

Surveyed laboratories were asked about motivations and barriers towards the implementation of Shiga toxin testing. CDC recommendations were the most commonly reported motivation. Others included recognition of non-O157 STEC infections in community outbreaks, the desire to minimize wait time by processing in-house, pressure from physician requests, and the desire...
to keep up with other laboratories that offer Shiga toxin testing. The most commonly reported barriers were cost (e.g., new hires, kits), time, computer and billing updates, laboratory space, and provider education. Several supervisors stated that they did not think non-O157 STEC was common enough to warrant testing.

Among laboratories testing with a Shiga toxin assay, the majority (63%) implemented testing during 2009 or 2010, which parallels the timing of the most dramatic spike in reported non-O157 STEC incidence. Enhanced laboratory testing for Shiga toxin likely plays a large role in the increased incidence of reported non-O157 STEC in Washington.

**Answers to Public Health Discussion Points**

1. All stool specimens submitted for routine bacterial pathogen testing should be simultaneously cultured for *E. coli* O157:H7 and/or test with a Shiga toxin assay.
2. By not immediately initiating culture, the identification of O157:H7 can be delayed. The use of culture without Shiga toxin assay testing, however, will not detect non-O157 STEC.
3. The most dramatic increase in reported non-O157 STEC parallels the time during which the majority of laboratories implemented testing with a Shiga toxin assay (to detect non-O157 STEC). Enhanced laboratory testing procedures likely play a role in the increased incidence of reported non-O157 STEC in Washington.
References


2. CDC Guidelines (published 2009): http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5812a1.htm

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