National Enteric Disease Surveillance: Shiga toxin-producing *Escherichia coli* (STEC) Annual Summary, 2008

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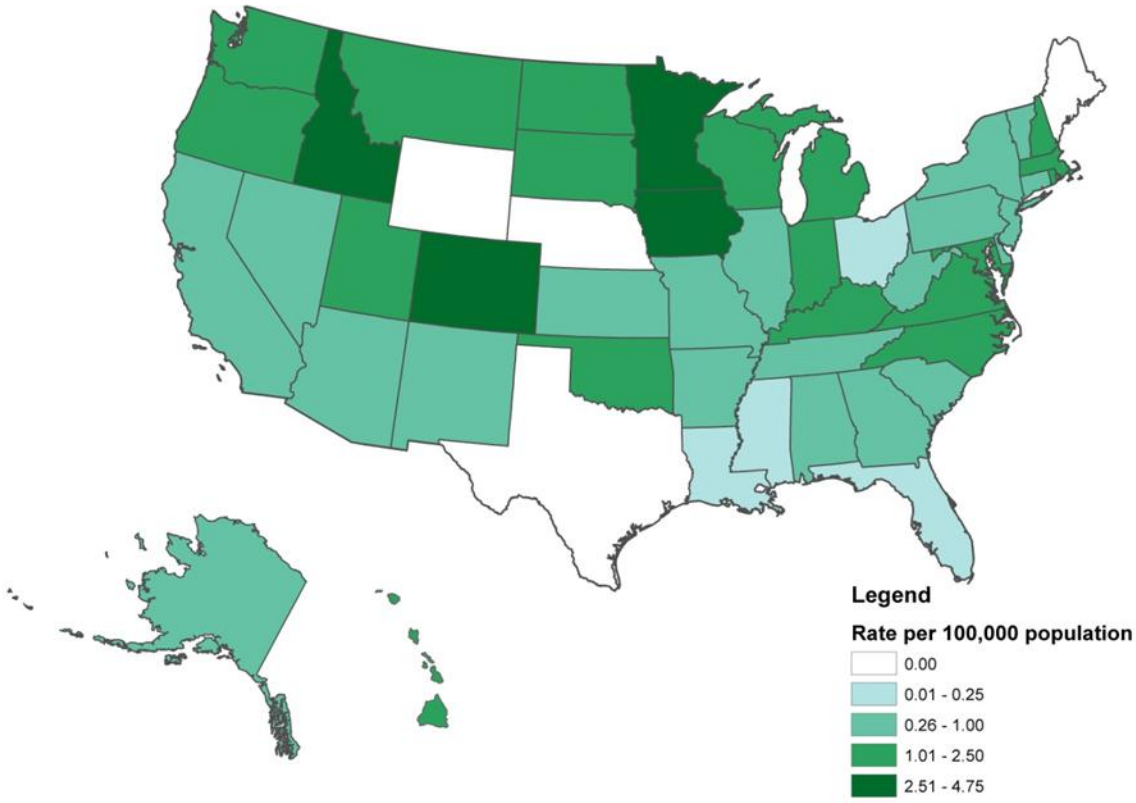
In this summary, we summarize the number of isolates reported, as well as isolation rates and specimen submission rates. The isolation rate is the number of STEC isolates from humans reported for a given year, divided by the population for that year. The non-O157 STEC specimen submission rate is the number of presumptive non-O157 STEC isolates and Shiga toxin-positive enrichment culture broths submitted to the enteric diseases laboratory branch (EDLB) at CDC for further characterization for a given year, divided by the population for that year. Reporting to LEDS and submission to the National *Escherichia coli* Reference Laboratory is voluntary, and the number of states submitting isolates varies from year to year. An overview of surveillance methods and systems for Shiga toxin-producing *Escherichia coli* (STEC) infections is available at http://www.cdc.gov/ncezid/dfwed/PDFs/national-stec-surveillance-overiew-508c.pdf.

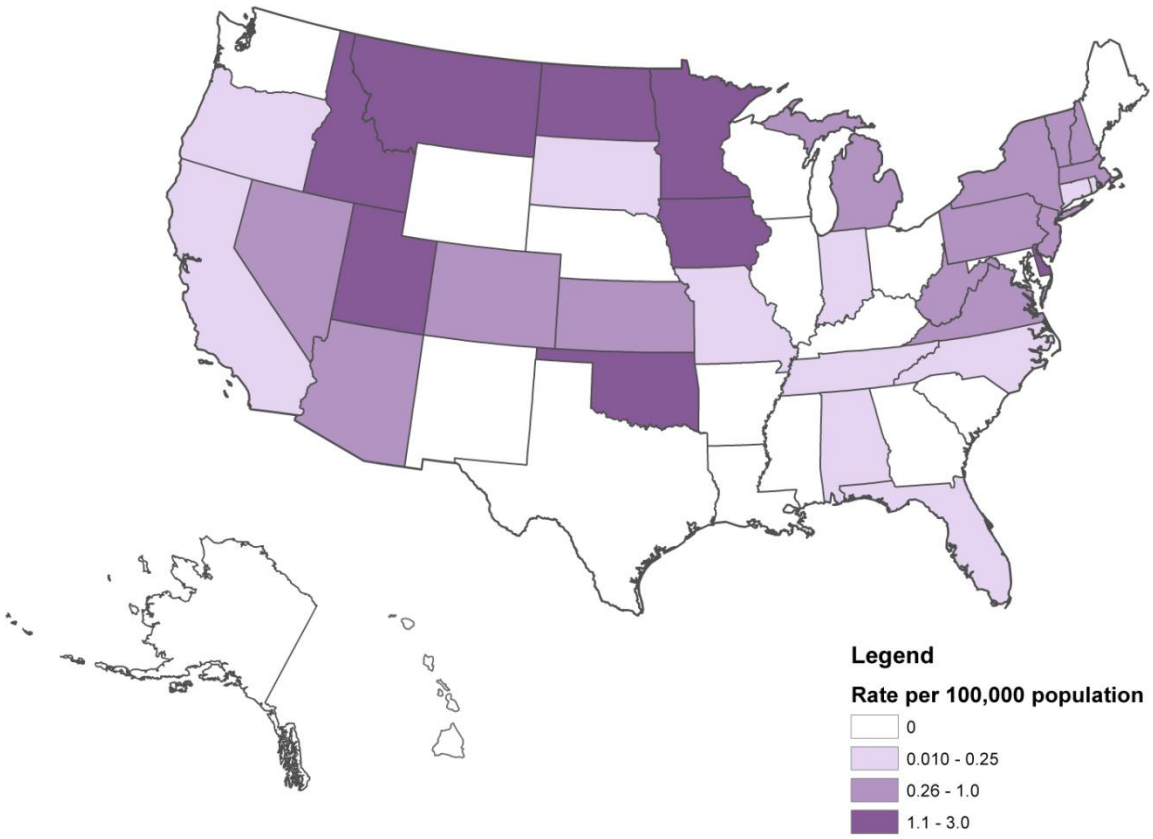
Laboratory-based Enteric Disease Surveillance (LEDS) data

Figure 1. Isolation rate of STEC O157 by state, United States, LEDS, 2008 (n=2,669).



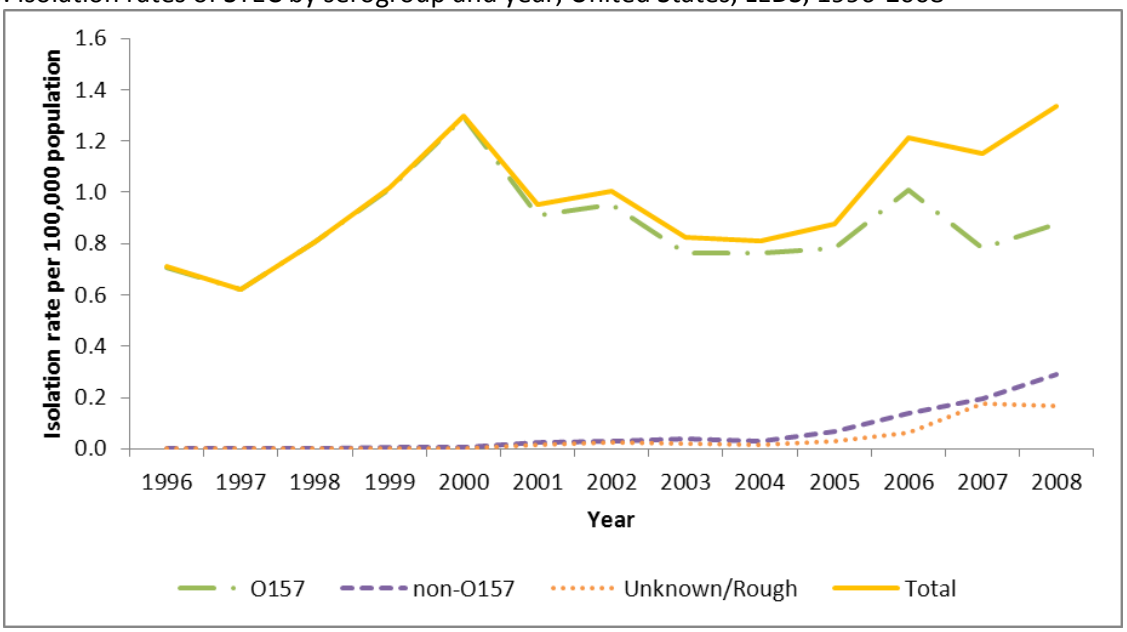
- During 2008, 46 states reported a total of 2,669 STEC O157 isolates, corresponding to an overall isolation rate of 0.88 per 100,000 population.
- States in the upper Midwest generally had the highest STEC O157 isolation rates, whereas states in the south generally had the lowest isolation rates.

Figure 2. Isolation rate of non-O157 STEC, by state, United States, LEDS, 2008 (n=883).



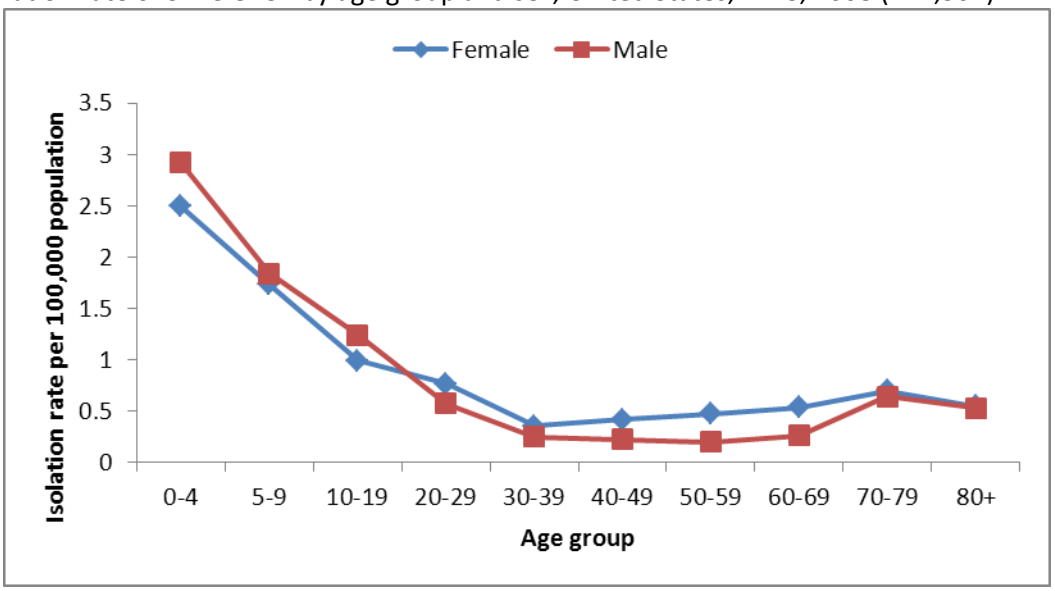
- During 2008, 32 states reported a total of 883 non-O157 STEC isolates, corresponding to an overall isolation rate of 0.29 per 100,000 population.
- Fewer states reported non-O157 STEC isolates to LEDS than reported STEC O157 isolates. This finding reflects, at least in part, substantial state-to-state variation in clinical testing practices and public health reporting practices, as well as possible true variation in infection rates. See Surveillance Overview (link) for further information

Figure 3. Isolation rates of STEC by serogroup and year, United States, LEDS, 1996-2008



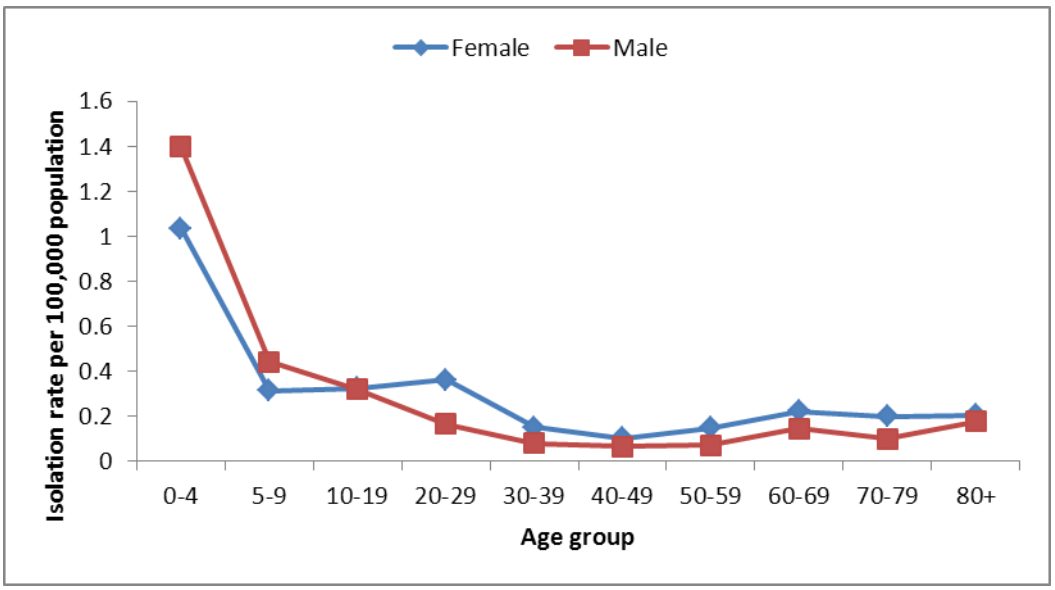
- The overall STEC isolation rate (including both O157 and non-O157) increased from 2007 and was the highest ever reported. Increased testing for and reporting of non-O157 STEC in recent years may have contributed to this overall upward pattern.
- The STEC O157 isolation rate was lower in 2008 than 2006 but was similar to 2001.
- Isolation rates of non-O157 STEC and STEC reported as "unknown serogroup" or "rough" steadily increased from 2000-2007, likely due to increased testing for non-O157 STEC in clinical laboratories. The isolation rate in 2008 was similar to 2007.

Figure 4. Isolation rate of STEC O157 by age group and sex, United States, LEDS, 2008 (n=2,367).



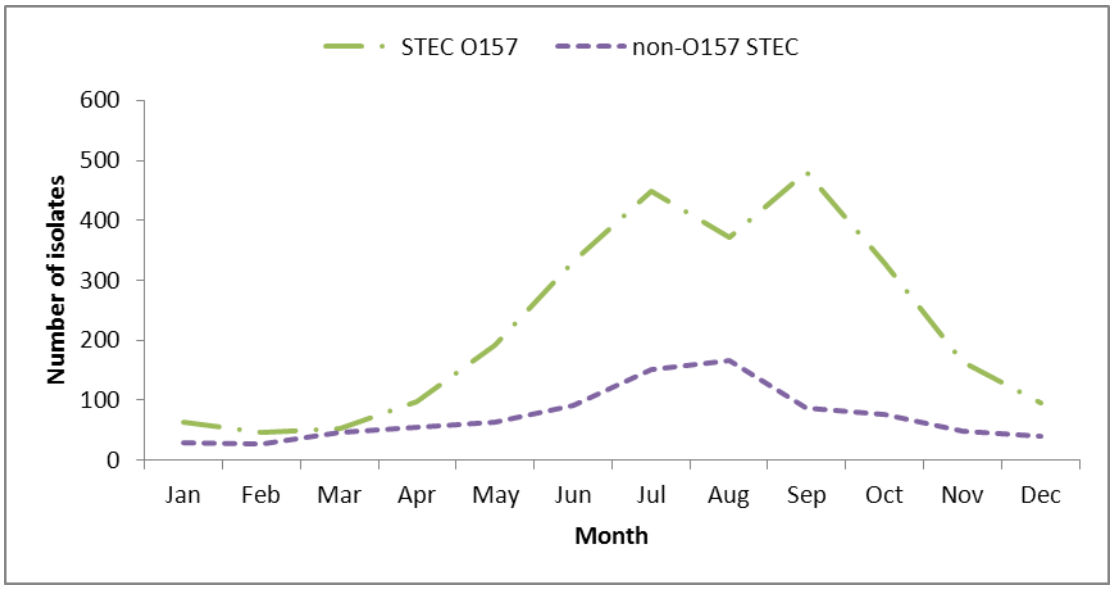
- The isolation rate of STEC O157 was slightly higher in males aged 0 to 19 years than females in the same age group but higher in females than males aged 20 to 79 years.
- The highest isolation rates for both O157 and non-O157 STEC were in children aged < 4 years old.

Figure 5. Isolation rates of non-O157 STEC by age group and sex, United States, LEDS, 2008 (n=803).



- Isolation rates of non-O157 STEC in females aged 10 and older were higher than males in the same age groups. Isolation rates in males less than 9 years old were substantially higher than in females in this age group.

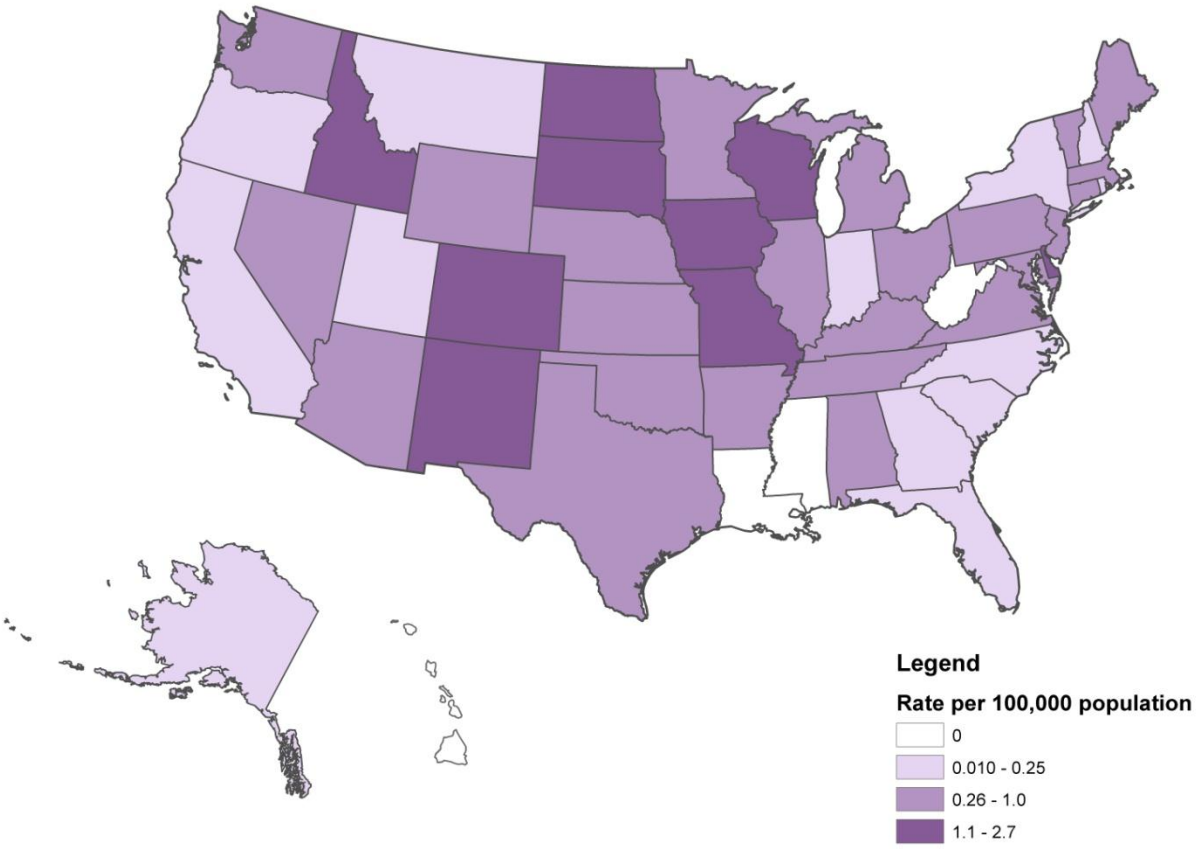
Figure 6. Number of STEC isolates by month of specimen collection, United States, LEDS, 2008 (n=3,522).



- As in previous years, both O157 and non-O157 STEC isolations showed a summer and fall peak, however, this year the largest number of STEC O157 isolations were in September, compared with July for previous years. The largest number of non-O157 STEC isolations occurred in July and August, similar to previous years.

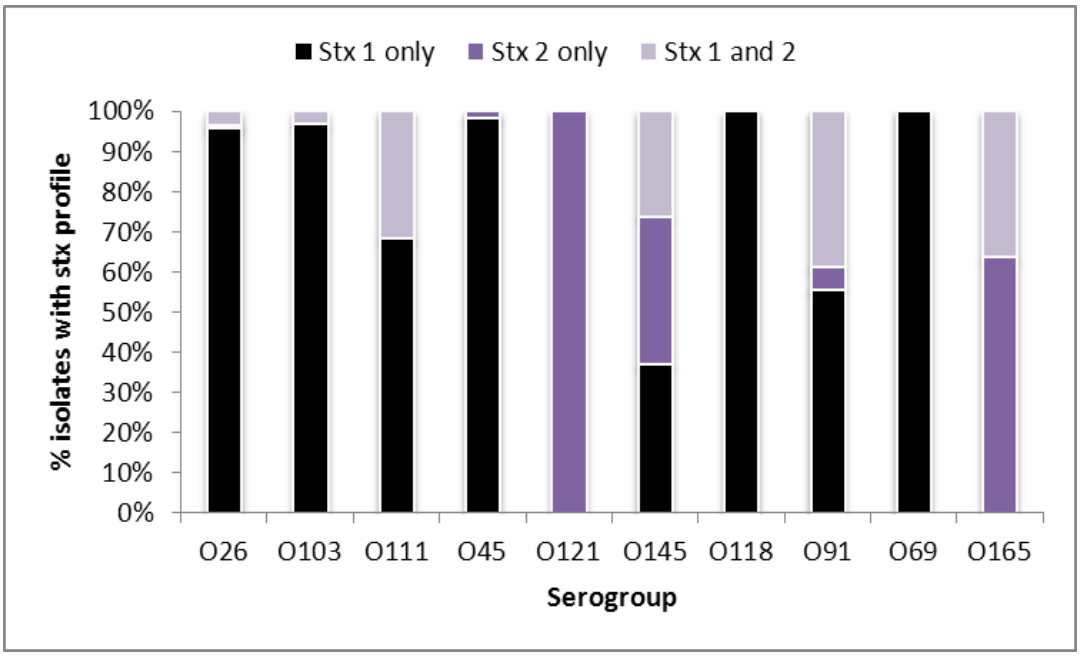
National Escherichia coli *Reference Laboratory data*

Figure 7. Rate of submission of specimens for further characterization by state, United States, National *Escherichia coli* Reference Laboratory, 2008 (n=1,180).



- 46 states submitted a total of 1,180 specimens for further characterization, which includes serogrouping and identification of genes encoding Shiga toxin types.
- The submission rate reflects the frequency of specimen submission. It is important to note that the National *Escherichia coli* Reference Laboratory is not intended to function as a nationwide surveillance system; many states have the capacity to determine the serogroups of STEC isolates in their state public health laboratories and so do not use the National *Escherichia coli* Reference Laboratory for serogrouping.
- Because many states have the ability to identify the most common STEC serogroups, the distribution of serogroups among STEC isolates that are sent to the National *Escherichia coli* Reference Laboratory for characterization is likely not representative of all STEC isolated from ill persons

Figure 8. Percentage of non-O157 STEC isolates by serogroup and Shiga toxin (stx) profile, National *Escherichia coli* Reference Laboratory, 2008.



Note: STEC O111 and O111ac were combined.

- Shiga toxin profiles (presence of genes encoding Shiga toxin 1 (*stx1*), Shiga toxin 2 (*stx2*), or both) vary by serogroup.
- Non-O157 serogroups for which greater than 90% of isolates were *stx1*-positive were O26, O103, O45, O118, and O69, similar to data from 2007.
- The only non-O157 serogroup for which greater than 90% of isolates were *stx2*-positive was O121.

Table 1. Non-O157 STEC isolates characterized at the National *Escherichia coli* Reference Laboratory, by serogoup, 2008 (n=1,1081).

Serogroup	Number of isolates	Percent of total
O26	228	21%
O103	221	20%
O111*	161	15%
O45	58	5.4%
O121	56	5.2%
O145	38	3.5%
O118	19	1.8%
O91	18	1.7%
O69	15	1.4%
O165	11	1.0%
O76	9	0.8%
O128	6	0.6%
O14	6	0.6%

O7	6	0.6%
O146	6	0.6%
O174	6	0.6%
O84	6	0.6%
O123	5	0.5%
O141	5	0.5%
O28*	5	0.5%
O55	5	0.5%
O175	4	0.4%
O153	3	0.3%
O113	3	0.3%
O119	3	0.3%
O126	3	0.3%
O172	3	0.3%
O178	3	0.3%
O50	3	0.3%
O156	2	0.2%
O100	2	0.2%
O11	2	0.2%
O110	2	0.2%
O117	2	0.2%
O162	2	0.2%
O166	2	0.2%
O22	2	0.2%
O42	2	0.2%
O43	2	0.2%
O71	2	0.2%
Rough[†]	42	3.9%
Undetermined[§]	62	5.7%
All other serogroups[¶]	27	2.5%
Unknown	13	1.2%
Total	1081	100.0%

* Note: STEC O111 and O111ac were combined; STEC O128 and O128ab were combined.
† Rough means that part of the O antigen was missing and therefore the isolate could not be assigned to a serogroup.
§ Undetermined means that the O antigen has not been assigned a number.
¶ Serogroups with only 1 reported isolate were: O105, O110, O112, O12, O126, O134, O135, O137, O143, O151, O152, O162, O163, O168, O175, O18, O181, O20, O21, O22, O28ab, O50, O61, O73, O77, O82, O86, O96, O98.

- During 2008, 1,081 (92%) of the 1,180 presumptive non-O157 STEC isolates received were determined to be non-O157 STEC.

NNDSS Data

The National Notifiable Disease Surveillance System (NNDSS) collects and compiles reports of nationally notifiable infectious diseases, including STEC infection The 2008 NNDSS report is available at http://www.cdc.gov/mmwr/pdf/wk/mm5754.pdf (2).

- A total of 5,309 cases of STEC infection were reported to NNDSS during 2008, which includes laboratory-confirmed, probable, and suspect cases.

Outbreak Data

The Foodborne Disease Outbreak Surveillance System (FDOSS) collects reports of foodborne disease outbreaks from local, state, tribal, and territorial public health agencies. The 2008 annual summary of foodborne disease outbreaks is available at http://www.cdc.gov/mmwr/pdf/wk/mm6035.pdf (3).

- In 2008, 479 foodborne outbreaks with an identified pathogenic etiology were reported; 36 were caused by STEC, with 920 illnesses were reported
    - The most common serogroup causing confirmed single-etiology STEC outbreaks was O157 (35 outbreaks).
    - One outbreak was caused by STEC serogroup O111.

The Waterborne Disease and Outbreak Surveillance System (WBDOSS) collects reports of disease outbreaks associated with drinking water and recreational water from local, state, tribal, and territorial public health agencies. The 2007 and 2008 annual summary is available at http://www.cdc.gov/mmwr/pdf/ss/ss6012.pdf (4,5).

- In 2007 and 2008, 36 waterborne disease outbreaks associated with drinking water were reported; 1 was caused by STEC O157, which was associated with ground water from an individual water system resulted in 6 cases (4). No STEC non-O157 outbreaks were reported.
- In 2007 and 2008, 134 waterborne disease outbreaks associated with recreational water were reported; 3 were caused by STEC (5)
    - 2 outbreaks of STEC O157 infection associated with treated water resulted in 42 cases
    - 1 outbreaks of STEC O157 infection associated with untreated water resulted in 3 cases

References

1. Ethelberg S, Olsen K, Flemming S, Jensen C, Schiellerup P, Engberg J, Munk Petersen A, Olesen B, Gerner-Smidt P, Molbak K. Virulence factors for hemolytic uremic syndrome, Denmark. Emerg Infect Dis [serial online]. 2004 May [10/13/2011]. Available from: http://wwwnc.cdc.gov/eid/article/10/5/03-0576.htm.
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4. Brunkard JM, Ailes E, Roberts VA, et al. Surveillance for waterborne disease outbreaks associated with drinking water---United States, 2007--2008. MMWR Surveillance Summary. 2011 Sep 23;60(12):38-68.
5. Hlavsa MC, Roberts VA, Anderson AR , et al. Surveillance for waterborne disease outbreaks and other health events associated with recreational water --- United States, 2007--2008. MMWR Surveillance Summary. 2011 Sep 23;60(12):1-32.

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