Wisconsin State Laboratory of Hygiene

Shiga Toxin-Producing *E. coli* in Wisconsin: Past, Present and Future

WCLN Teleconference
November 3, 2010

Tim Monson, M.S.
Food and Waterborne Disease Program
Wisconsin State Laboratory of Hygiene
mony@mail.slh.wisc.edu

Objectives

- Explain why it is important for laboratories to routinely test stool specimens for the presence of Shiga toxin or STEC
- Describe current STEC diagnostic and surveillance activities going on in Wisconsin and their impact at both state and national levels
- Discuss expanded efforts to detect STEC in Wisconsin and what role your laboratory may play in these efforts in the future.

History of STEC Testing in WI

2005-	6 WI clinical laboratories testing stool for Shiga toxin
2006-	8 laboratories testing
2007*-	10 laboratories testing
2008-	13 laboratories testing
2009ǂ-	13 laboratories testing
2010-	Currently 28 WI labs testing

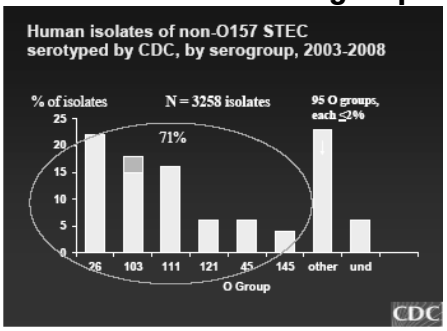
* Immunocard STAT!® EHEC available on the market

ǂ CDC Clinical Laboratory Guidelines for STEC testing published

Top Non-O157 STEC Serogroups: U.S. (CDC data) and WI

Serogroup	U.S. (%)	WI (%)
O26	22	24
O111	16	19
O103	12	25
O121	9	6
O45	7	9
O145	5	4

The Six Most Common Human Non-O157 STEC Serogroups



Wisconsin STEC Prevalence*:

Year	STEC	O157	non-O157
2006#	60	42 (70%)	18 (30%)
2007	106	55 (52%)	51 (48%)
2008	151	85 (56%)	66 (44%)
2009	125	68 (54%)	57 (46%)
Total	442	250 (57%)	192 (43%)

* Data only from those WI clinical laboratories performing Shiga toxin screening
# Numbers low due to smaller number of clinical labs screening for Shiga toxins in 2006; data skewed towards *E. coli* O157:H7 due to the national spinach outbreak

Outbreaks of Non-O157 STEC Infections, U.S. (CDC Unpublished Data)

Year	Serogroup	Exposure/Vehicle
1990	O111	Unknown
1994	O104	Milk
1999	O121	Lake water
1999	O111	Salad bar
2000	O103	Punch
2001	O111	Day care
2001	O26	Lake water
2004	O111	Apple cider
2005	O45	Food handler
2005	O26	Day care
2006	O45	Day care
2006	O121	Day care
2006	O121	Salad

Recent High Profile STEC Outbreaks

***E. coli* O111 infections linked to OK restaurant**

***E. coli* O145 infections linked to romaine lettuce**

Current National Clusters: WI STEC Isolate Link

- PulseNet cluster 1009MLEXD-1
  - *E. coli* O111
  - Isolates from NJ, MN and WI
  - No attribution determined at this time
- PulseNet cluster 1009MLEXD-2
  - *E. coli* O111
  - Isolates from PA, TX and WI
  - No attribution determined at this time

Is Routine Shiga Toxin Testing Justified in the Clinical Laboratory???

Guidelines for the Clinical Laboratory:

Recommendations for Diagnosis of Shiga Toxin–Producing *Escherichia coli* Infections by Clinical Laboratories

Guidelines for the Clinical Laboratory:

- All stools submitted for testing from patients with acute, community-acquired diarrhea should be cultured for O157 STEC on selective and differential media
- Stools from patients with acute, community-acquired diarrhea should be simultaneously tested for non-O157 STEC with a test that detects either Shiga toxins or the genes that encode for these toxins

Guidelines for the Clinical Laboratory:

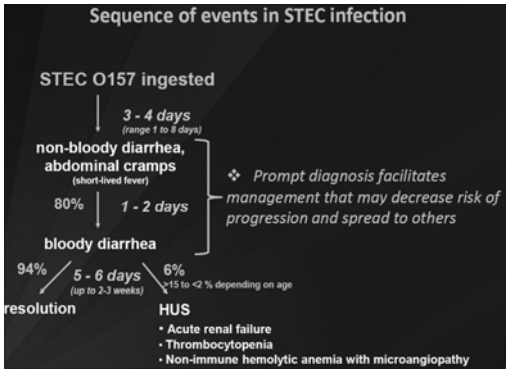
- All O157 STEC isolates should be forwarded as soon as possible to a state or local public health laboratory (PHL) for confirmation and molecular characterization (PFGE, MLVA, virulence genes)
- Detection of STEC or Shiga toxin should be promptly reported to the physician, PHL and proper public health authorities

Guidelines for the Clinical Laboratory:

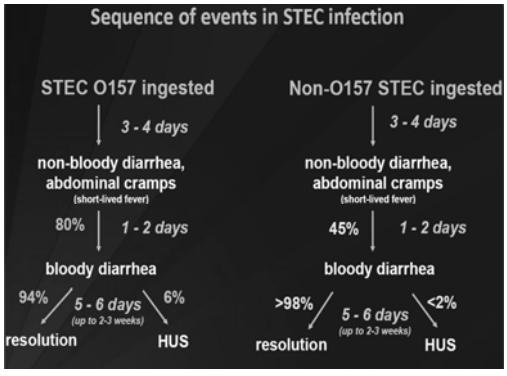
- Any specimens or enrichment broths in which Shiga toxin or STEC has been detected but from which no O157 STEC isolates are recovered, should be forwarded as soon as possible to a state or local public health laboratory for isolation of the STEC

STEC- Background Information

- CDC estimates 19% of O157 STEC and 9% of non-O157 STEC are outbreak related (majority of cases sporadic)
- STEC are low-infectious dose organisms (10-100 cells)
- STEC virulence dependent upon which virulence factors are present in a given strain (Stx1/Stx2, eae, Ehly); evidence suggests Stx and eae are most significant predictors of serious illness

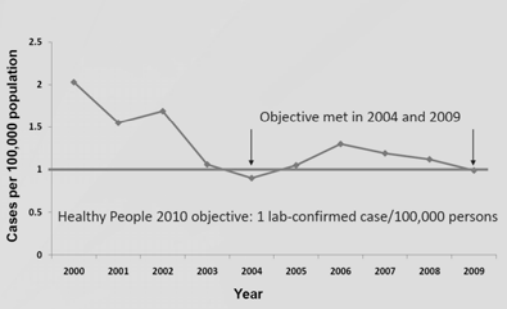


CDC

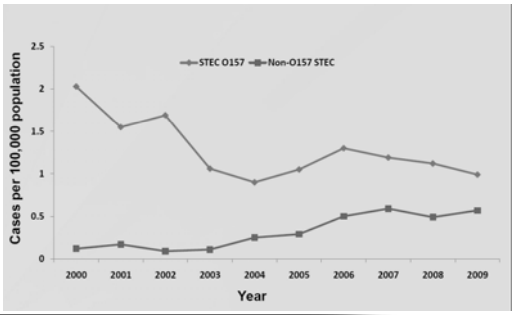


CDC

Incidence of Reported O157:H7 Infections, FoodNet Sites, 2000-09



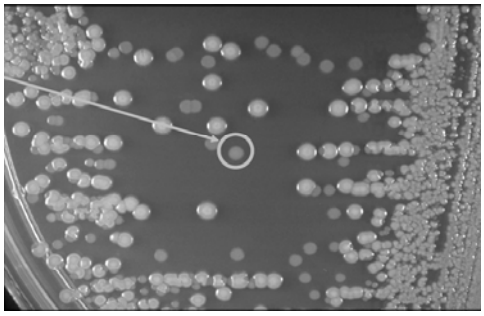
Incidence of All Reported STEC Infections, FoodNet Sites, 2000-09



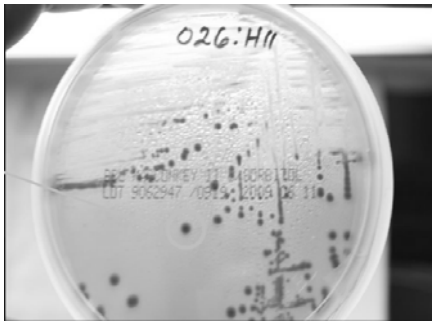
Justification for STEC Testing

- *E. coli* O157:H7 culture only is not sufficient for detection of all STEC
- Bloody diarrhea is not a reliable indicator of STEC infection
- No adequate medium for isolation of non-O157 STEC organisms
- Culture for *E. coli* O157:H7 still recommended concurrently with Shiga toxin testing; fastest way to ID O157 STEC

E. Coli O157:H7 on SMAC Plate



Non-O157 STEC on SMAC Plate



Justification for STEC Testing

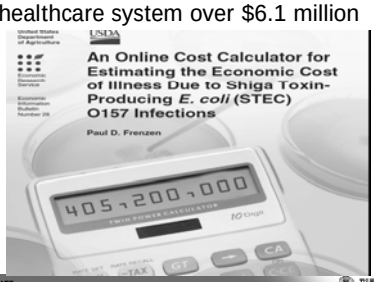
- Early identification and treatment of patients that might develop HUS
  - 15% of culture + *E. coli* O157:H7 patients < 10 yrs of age will develop HUS
  - Strong evidence suggesting that STEC isolates that produce Stx2, and in particular Stx2 only, have a higher likelihood to lead to HUS development
  - Evidence supporting improved outcomes in individuals that receive prompt intervention (parenteral fluid admin. may prevent renal damage)

Justification for STEC Testing

- Cost Effectiveness
  - Varies with product manufacturer and whether the product differentiates Stx1 from Stx2
  - Possible to generate positive revenue for the laboratory
  - Reimbursement for STEC testing may be much greater than for conventional culture
- Prevention

Prevention of Illness is Hard to Measure; Hard to Sell

- Even though STEC are low prevalence, single case of HUS may cost the healthcare system over $6.1 million



Justification for STEC Testing

- STEC may be as or more prevalent than other enteric bacterial pathogens routinely tested for:
  - STEC may be found in 0-4% of stools
  - *Salmonella* may be found in 1.9-4.8%
  - *Shigella* may be found in 0.2-3.1%
  - *Campylobacter* may be found in 0.9-9.3%

FoodNet Data, CDC

What Does the Future Hold for STEC Testing?

Future of STEC Testing

- In 2011, USDA Food Safety Inspection Service (FSIS) may begin testing for non-O157 STEC in food
  - Presumptive positive → PCR positive screen for Stx1, Stx2 or both
  - Confirmed positive → PCR positive, eae positive and serogroup identified for isolated colony (adulterant)
  - How will these isolates compare to human isolates?

Future of STEC Testing

- New Public Health Laboratory STEC Testing Recommendations
  - More screening performed at the public health laboratory
  - Fewer isolate submissions to CDC for virulence marker determination
  - Fewer CDC lab reports back to clinical laboratories

"Shiga toxin-producing *Escherichia coli* (STEC): Isolation and Characterization Guidance for Public Health Laboratories"

Prepared by the APHL STEC Working Group:

Robyn Atkinson – TN
John Besser – MN*
Cheryl Bopp – CDC
Chris Carlson - SD
Claudia Crandall – CA
Cindy Fisher – UT
Karim George - KY
Peter Gerner-Smidt – CDC
Stephen Gladbach – MO
L. Hannah Gould – CDC
Cami Hartley - NC
Hugh Maguire – CO
Tim Monson – WI
Debbie Rutledge – DE
Sharon Shea - APHL
Patricia Somsel - MI
Nancy Strockbine – CDC

*Currently at CDC

"Shiga toxin-producing *Escherichia coli* (STEC): Isolation and Characterization Guidance for Public Health Laboratories"

Table of Contents

Future of STEC Testing

- Enhanced HUS case surveillance
  - Asking clinical laboratories and local health officials to help identify cases of HUS
  - Majority of HUS cases are due to STEC; many cases go undiagnosed
  - May solicit submission of sera and stool specimens for STEC testing at WSLH (IMS) or CDC (serology)

Future of STEC Testing

- Expanded routine Shiga toxin testing by WI clinical laboratories
  - Increased awareness of non-O157 STEC; more clinical and food data to support comprehensive testing
  - OutbreakNet Sentinel Site grant activities; one goal is to expand and enhance state-wide STEC testing in clinical laboratories

Future of STEC Testing

- Improved Shiga toxin and virulence factor detection methodologies are in development
  - Luminex platform shows promise (CDC)
  - Rapid and sensitive methods to detect the presence of Shiga toxin, eae, Ehly and other virulence factors
  - Ability to serogroup STEC isolates at the same time for surveillance purposes

Summary

- Many factors to justify routine Shiga toxin screening in stools were presented
- Clinical laboratories are an integral part of Shiga toxin detection and surveillance activities in WI and the U.S.
- Efforts are under way to enhance current state clinical laboratory Shiga toxin testing capabilities

Submission of STEC Specimens to WSLH

- As with other enteric pathogens, STEC specimens may be submitted to WSLH via overnight courier as part of the Wisconsin Enteric Pathogen Surveillance (WEPS) Program
- Contact Dunham Express for courier: 800-236-7127
- For technical questions, call WSLH: 800-862-1013

Questions or Comments?