Shiga Toxin-Producing *Escherichia Coli* Infections: What Clinicians Need to Know

Clinician Outreach and Communication Activity (COCA) Conference Call

September 16, 2010

Office of Public Health Preparedness and Response
Division of Emergency Operations

Objectives

At the conclusion of this hour, each participant should be able to:

- Discuss the epidemiology of Shiga toxin-producing Escherichia coli infection in the United States
- Discuss the clinical description of diseases caused by Shiga toxin-producing Escherichia coli
- Discuss clinical management of patients with Shiga toxin-producing Escherichia coli infections with post-diarrheal hemolytic uremic syndrome
- Identify laboratory tests used to diagnose Shiga toxin-producing Escherichia coli infections

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TODAY'S PRESENTERS

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Shiga Toxin-Producing *Escherichia coli* (STEC): What they are, why they matter, and how to look for them

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Medical Epidemiologist

Clinician Outreach and Communication Activity (COCA) Conference Call
September 16, 2010

National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne, Waterborne, and Environmental Diseases

Clinical scenario

- **An otherwise healthy person presents with acute community-acquired bloody diarrhea.**
  - You decide to order routine stool culture
  - The result is negative for *Salmonella, Campylobacter* and *Shigella*
  - What additional testing ideally should have been done?

Proposed best practice for detecting STEC

All stools submitted for testing from patients with acute community-acquired diarrhea should be:

- Cultured on receipt for *E. coli* O157 on selective and differential media
- Tested simultaneously for non-O157 STEC with an assay that detects Shiga toxin or the genes encoding these toxins

All suspected *E. coli* O157 isolates and Shiga toxin positive stools reported to physician and public health department promptly

Outline of presentation

- **STEC:**
  - What are they and what do they cause?
  - How are they monitored?
  - How common are they?
  - How are they transmitted?
  - How are they diagnosed?
- **Benefits of proposed best practice**

WHAT ARE STEC AND WHAT DO THEY CAUSE?

Shiga toxin-producing *E. coli* (STEC)

- ***E. coli* that acquired genes that encode Shiga toxins**
  - Shiga toxins = verocytotoxins
  - STEC is equivalent to VTEC (Verocytotoxin-producing *E. coli*)
- **Cause illness ranging from non-bloody diarrhea, to bloody diarrhea, to post-diarrheal hemolytic uremic syndrome (HUS)**
- **Not all STEC have been associated with human disease**
- **EHEC (Enterohemorrhagic *E. coli*)**
  - A definition intended to define a subset of pathogenic STEC

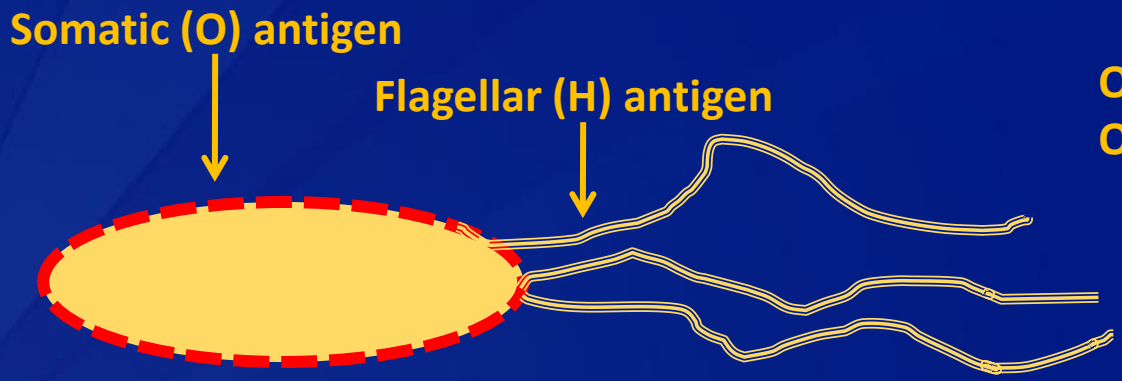
Terminology

STEC O157

- *E. coli* O157:H7

Non-O157 STEC

- *E. coli* O111:H8
- *E. coli* O103:H2
- *E. coli* O121:H19
- Many more



O Ag = serogroup
O Ag & H Ag = serotype

Shiga toxins

- **Act locally and systemically**
  - Receptors on intestinal epithelium and kidney endothelium
  - Inhibit protein synthesis
  - binding of toxin to vascular tissue thought to trigger coagulation cascade
- **Two subgroups (Shiga toxin 1 and Shiga toxin 2)**
  - Strains that produce Shiga toxin 2 are more virulent
- **Necessary but not sufficient to cause disease**
  - Other virulence factors involved

❖ ***Virtually all E. coli O157:H7 contain a full complement of factors necessary for severe disease***

Sequence of events in STEC infection

STEC O157 ingested

↓ *3 - 4 days* (range 1 to 8 days)

non-bloody diarrhea, abdominal cramps
(short-lived fever)

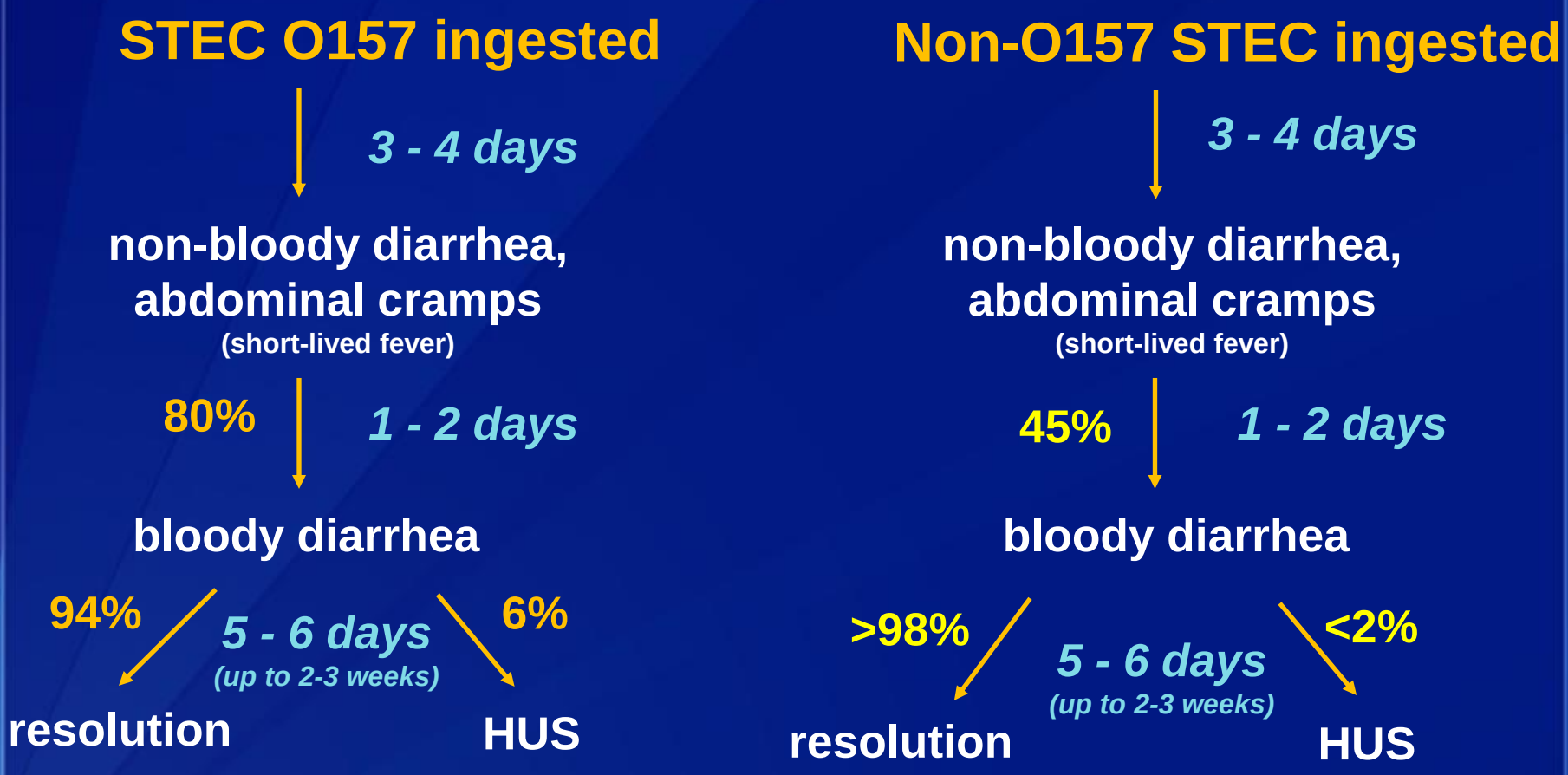
80% ↓ *1 - 2 days*

bloody diarrhea

- **94%** ↓ *5 - 6 days* (up to 2-3 weeks) → **resolution**
- **6%** (>15 to <2 % depending on age) → **HUS**
  - Acute renal failure
  - Thrombocytopenia
  - Non-immune hemolytic anemia with microangiopathy

❖ *Prompt diagnosis facilitates management that may decrease risk of progression and spread to others*

Sequence of events in STEC infection



- *Non-O157 STEC are a diverse group that vary in virulence*
- *STEC are isolated from persons with both bloody and non-bloody diarrhea*

Shiga toxin profiles of O157 and non-O157 STEC, FoodNet , 2007*

Shiga toxin	O157 (n=260) n (%)	Non-O157 (n=146) n (%)
1 only	13 (5%)	88 (60%)
1 and 2	144 (55%)	9 (6%)
2 only	103 (40%)	49 (34%)

Strains that produce only Shiga toxin 1 rarely isolated from persons with HUS

*An additional 285 O157 and 114 non-O157 isolates had missing or unknown Stx data

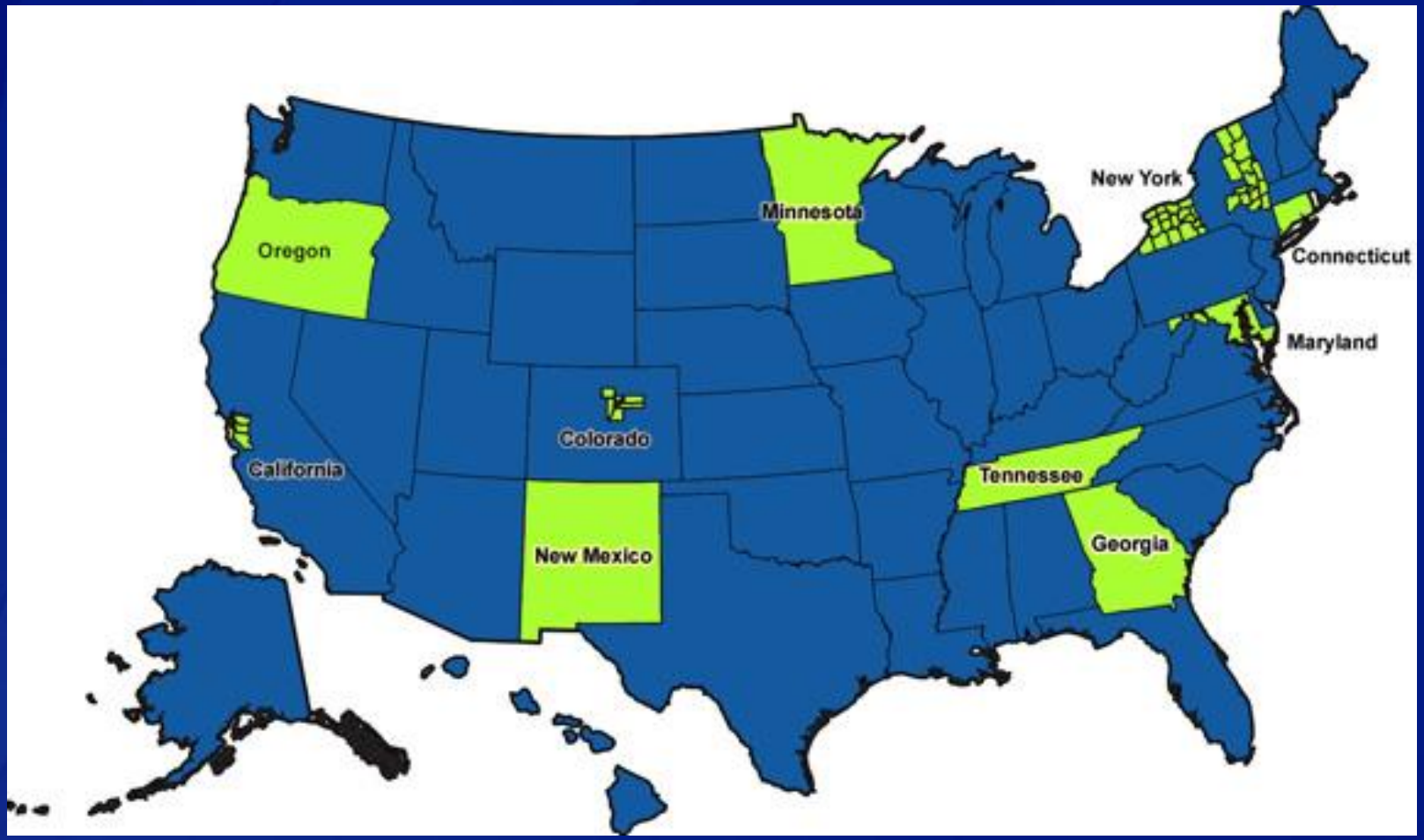
HOW ARE STEC AND HUS MONITORED?

Surveillance systems

- **National surveillance: passive**
  - National Notifiable Disease Surveillance System
  - Public Health Laboratory Information System
  - CDC National *E. coli* Reference Laboratory
- **Sentinel surveillance: active**
  - Foodborne Diseases Active Surveillance Network (FoodNet)

FoodNet

10 sites , 46 million persons (15% of US population)



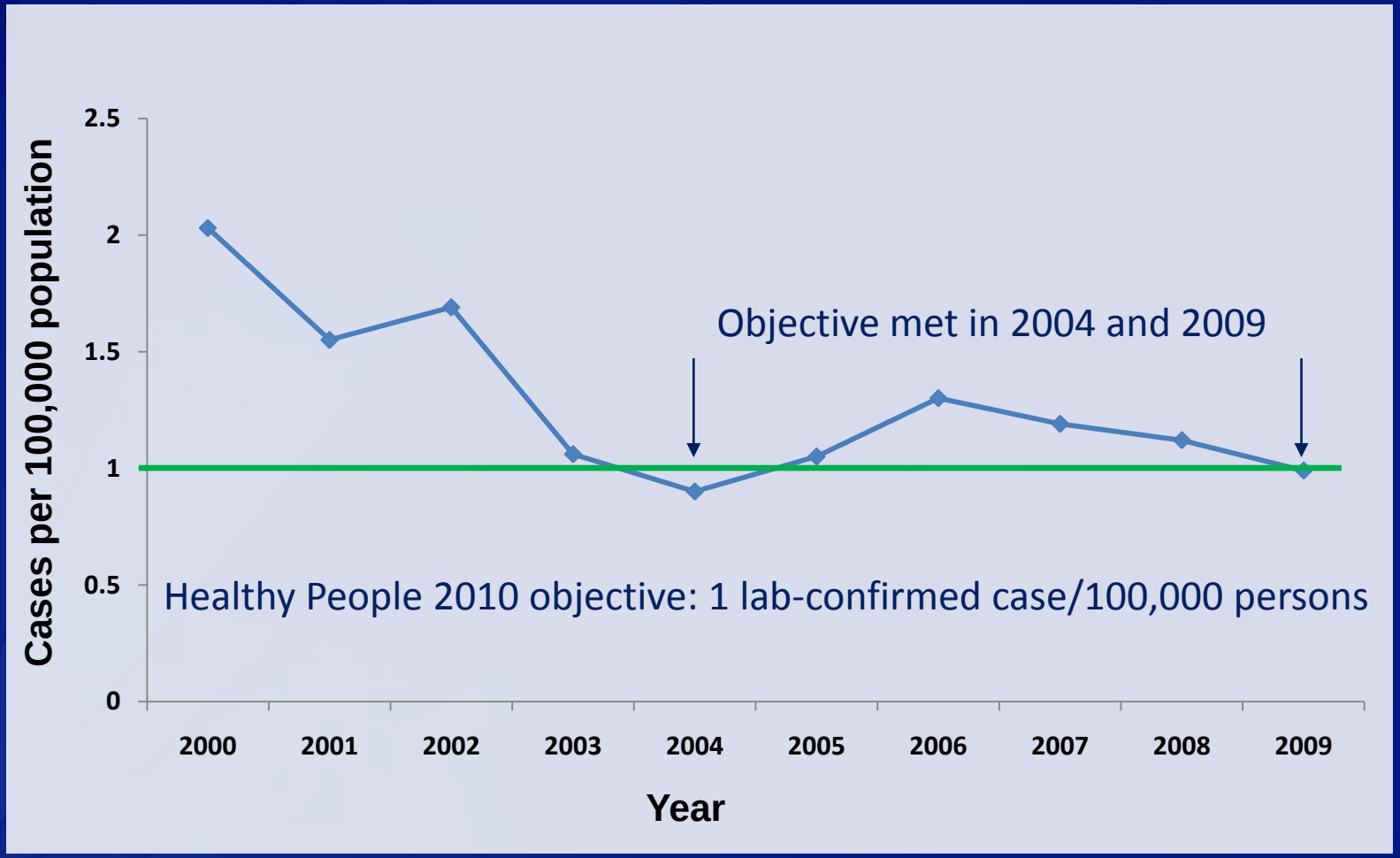
HOW COMMON ARE STEC INFECTIONS AND POST-DIARRHEAL HUS?

Frequency of STEC relative to other enteric pathogens

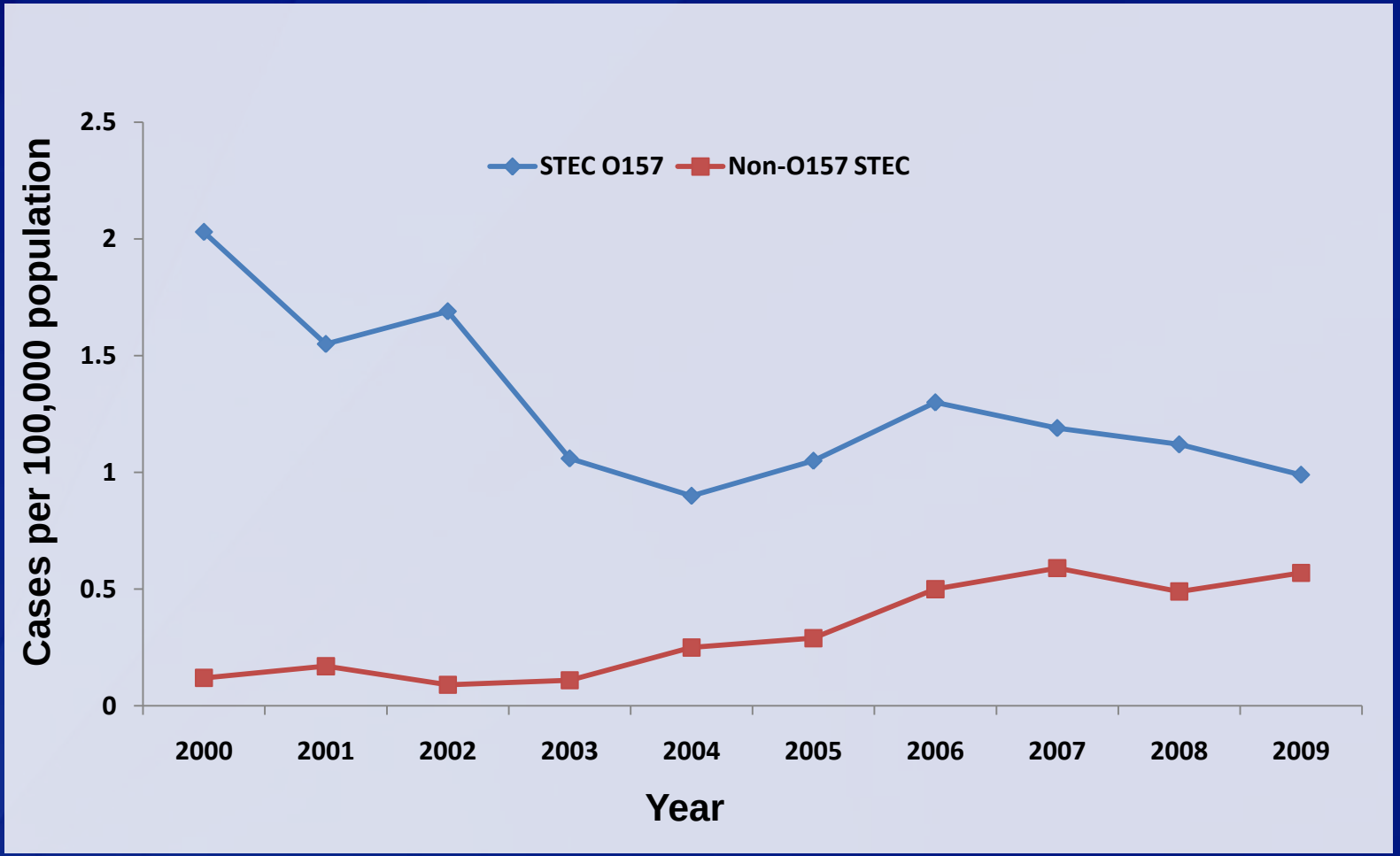
- **STEC might be detected as often as other pathogens**
  - STEC detected in 0-4% of clinical samples
  - *Salmonella*, 1.9-4.8%
  - *Shigella*, 0.2-3.1%
  - *Campylobacter*, 0.9-9.3%

Primary references can be found in, MMWR. 2009;58(No. RR-12)

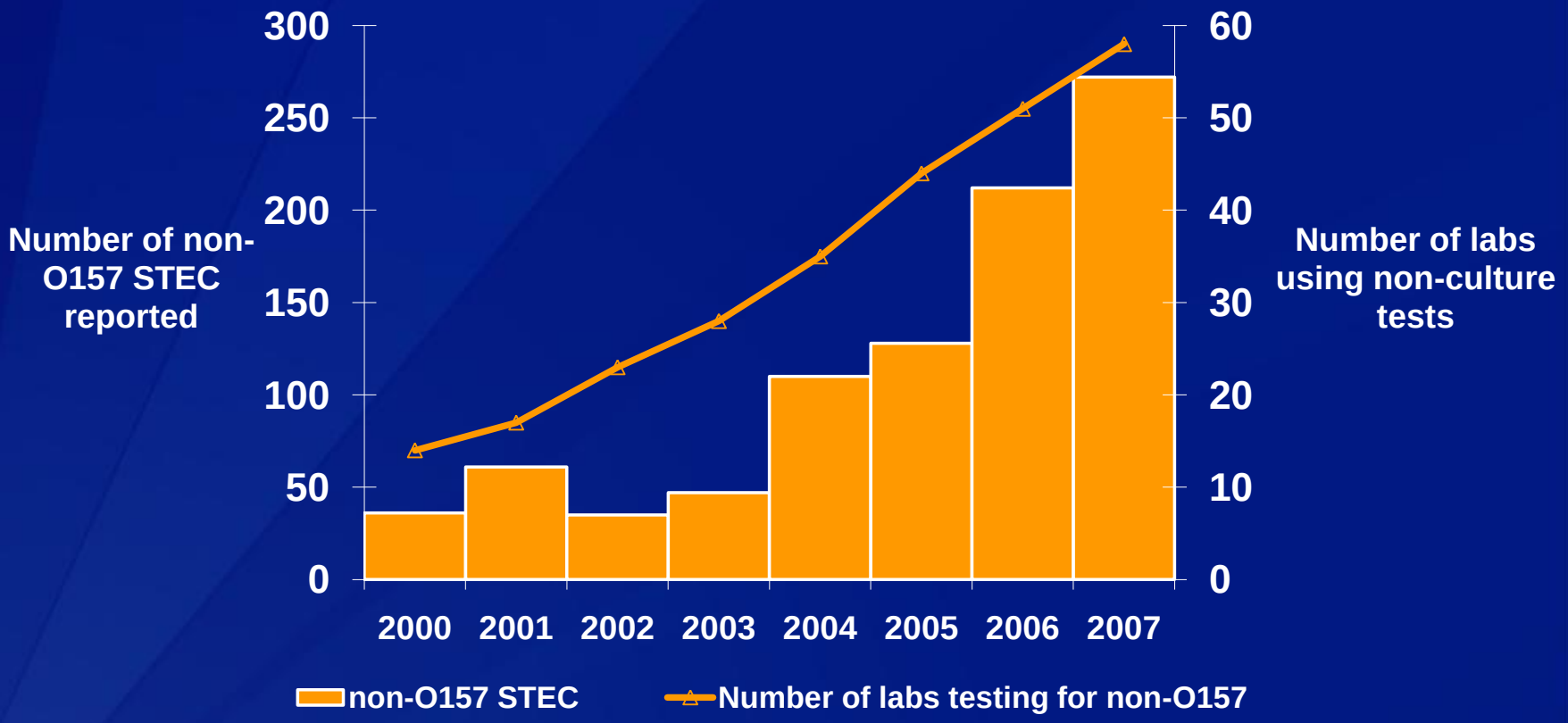
Incidence of reported STEC O157 infections, by year, FoodNet, 2000-2009



Incidence of reported STEC O157 and non-O157 STEC infections, by year, FoodNet, 2000-2009



Number of non-O157 STEC infections reported has increased as the number of labs testing for them has increased

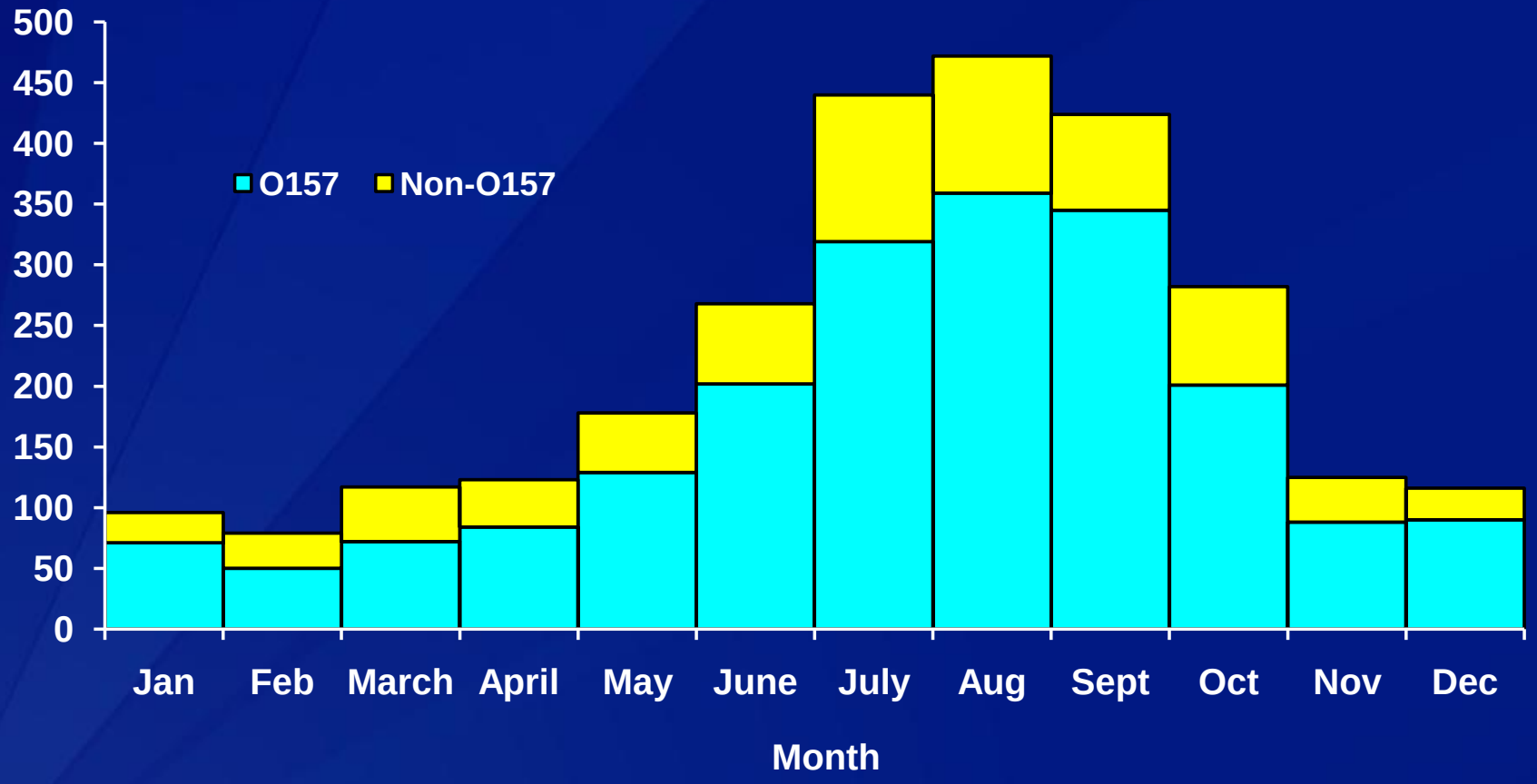


CDC, unpublished preliminary FoodNet data, 2009

Most common non-O157 STEC serogroups – FoodNet, 2009

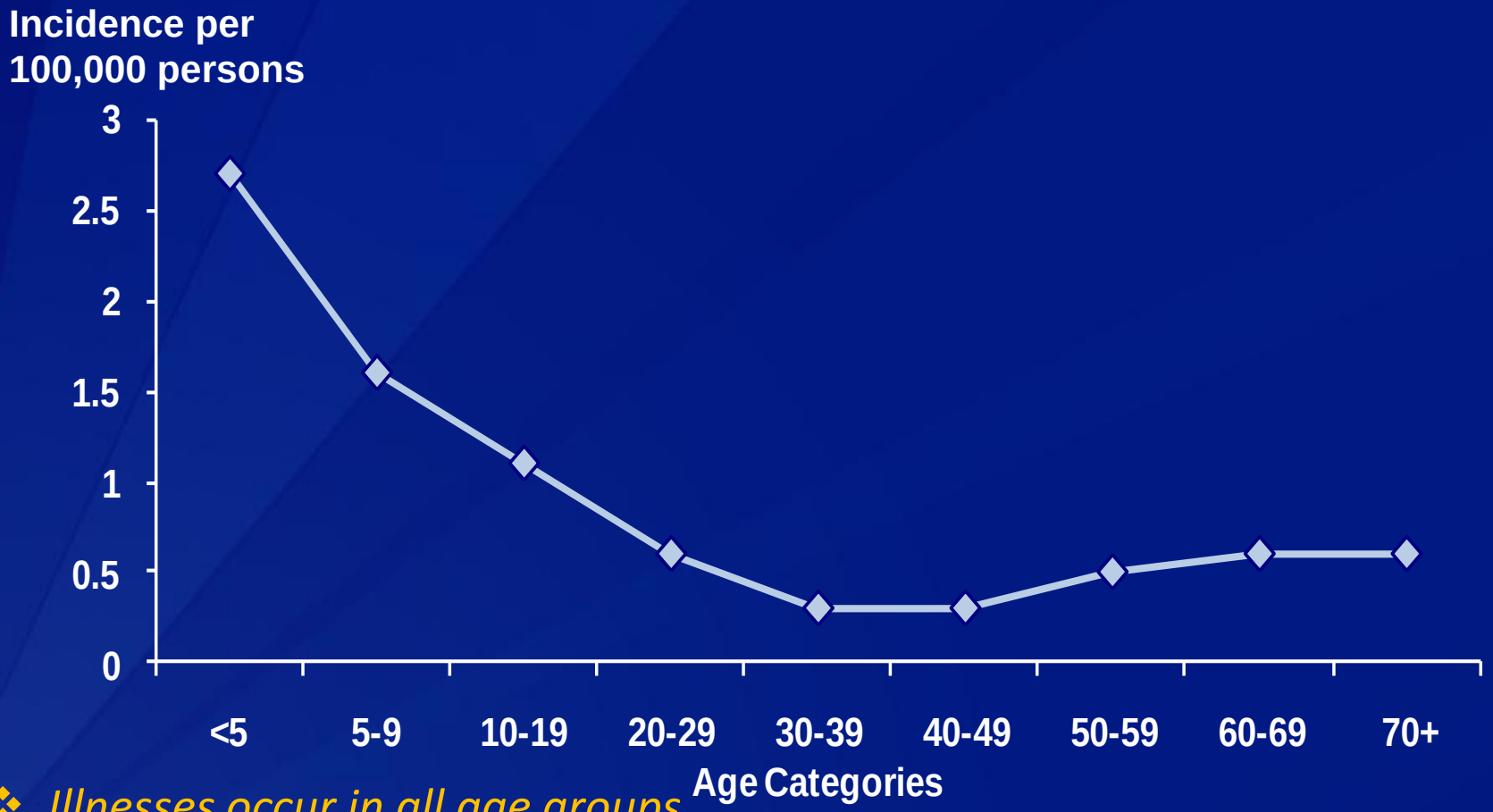
Rank	O antigen	% of all non-O157 STEC
1	26	26
2	103	18
3	111	13
4	121	4
5	45	3
6	145	2
Top 6		66

Number of STEC infections by month of isolation, FoodNet, 2004-2007



- *Approximately half of cases occur in summer months*

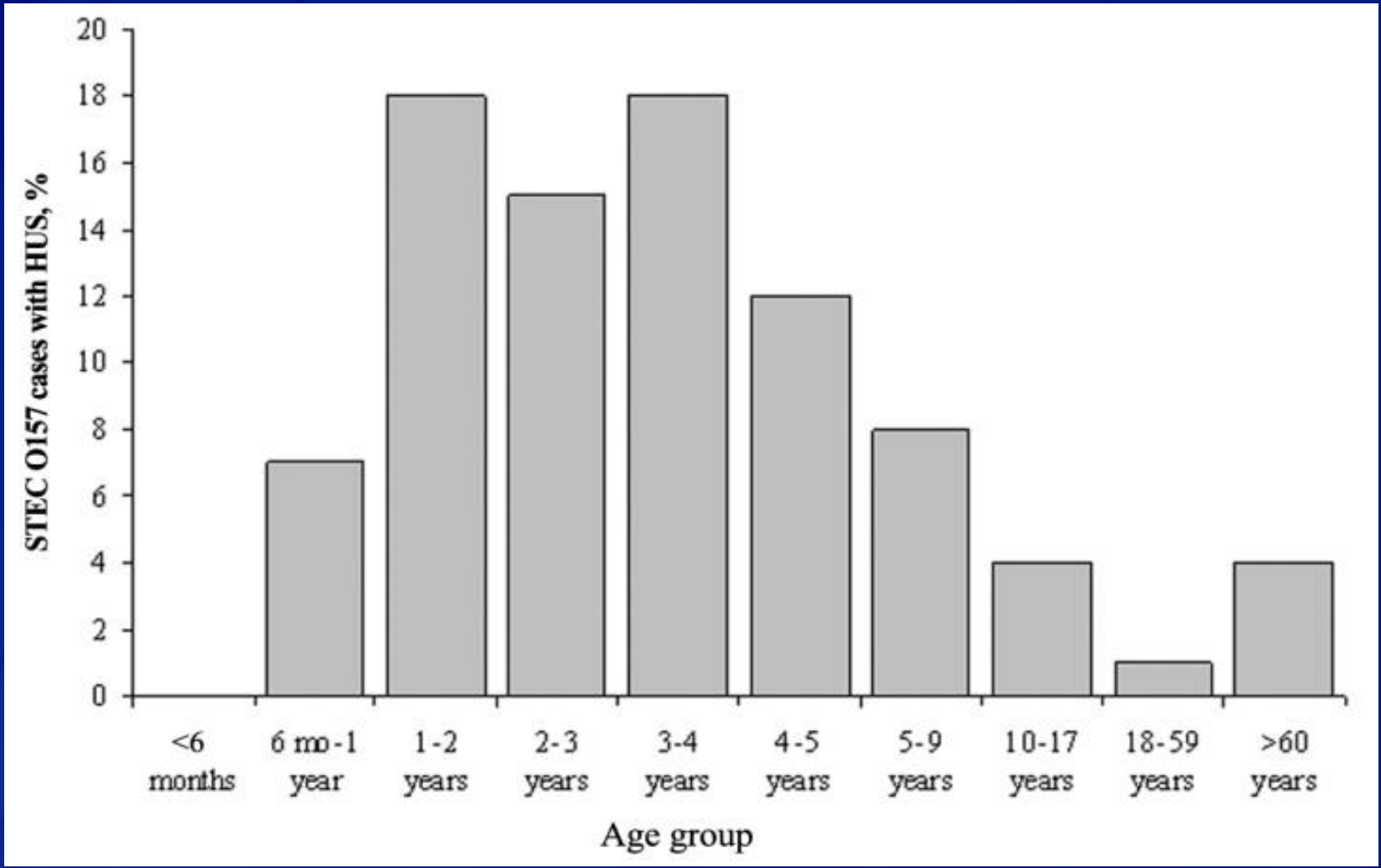
Average annual incidence of STEC O157 isolations, by age group, United States,1996-2006 (n=23,432 ill persons)



- *Illnesses occur in all age groups*

Public Health Laboratory Information System

Age groups most likely to develop HUS from STEC O157 infections



Gould LH, et al. CID. 2009

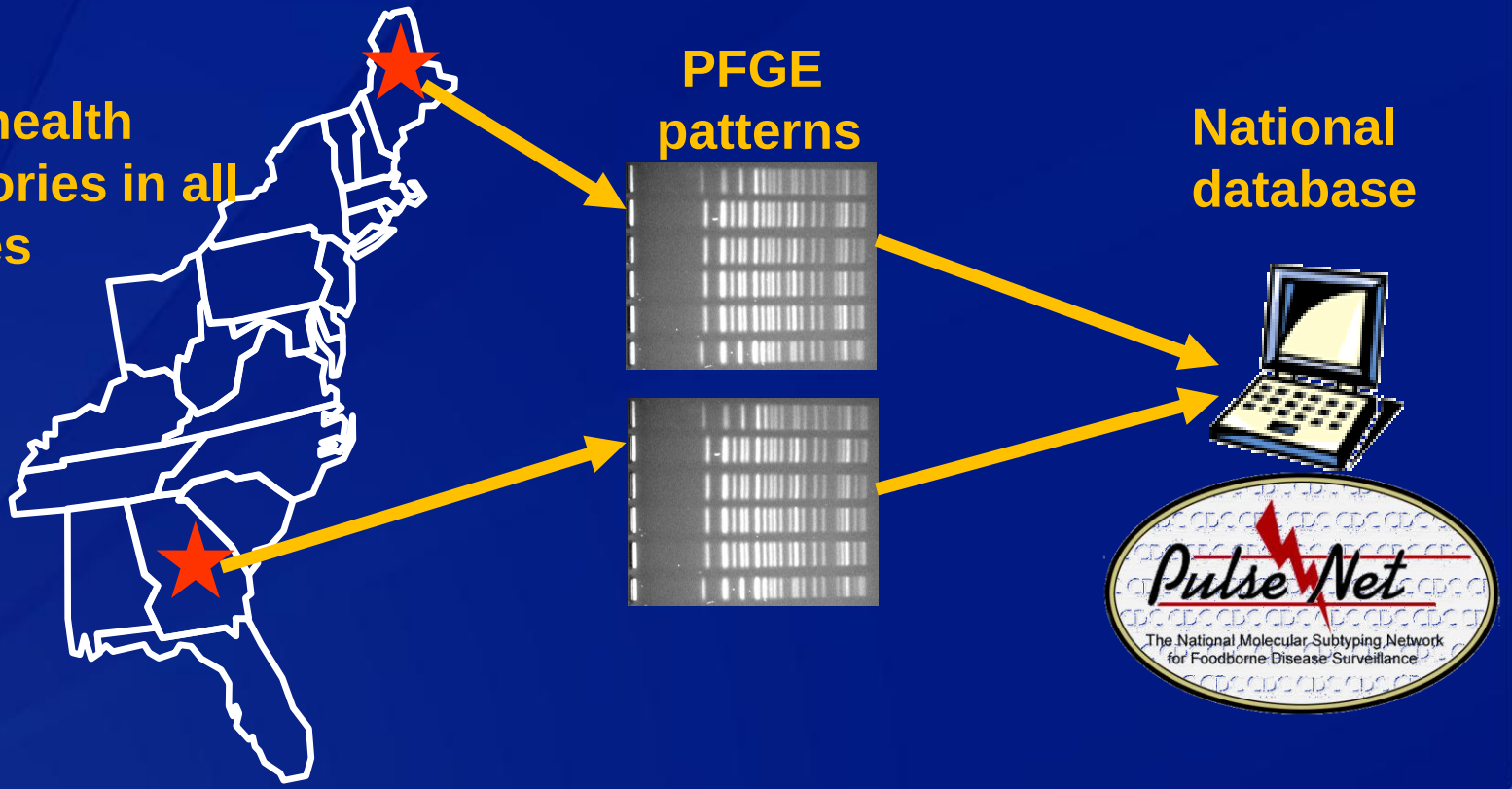
HOW ARE STEC TRANSMITTED?

Key factors in STEC transmission

- **Reservoir is the intestinal tract of animals**
  - Especially cattle
- **Very low infectious dose**
  - <100 organisms
- **Multiple modes of transmission**
  - Foodborne
  - Animal contact
  - Waterborne
  - Person-to-person contact
- **Most infections are not outbreak-related**
  - ~19% of E. coli O157 infections and ~9% of non-O157 STEC infections are part of a recognized outbreak

Outbreaks

- Unique opportunity to identify sources of infections
- Detection greatly improved by subtyping infections



Food Commodities causing illness in outbreaks of STEC O157 infections due to simple foods*, 1998-2008

Commodity	1998-2003 (n=2,289 ill)	2004-2008 (n=1,529 ill)
	% of illness	% of illness
Beef	**35**	**57**
Leafy vegetables	**13**	**36**
Dairy	**12**	**4**
Fruits-nuts	**37**	**2**
Sprouts	**2**	**0.1**
Game	**-**	2
Poultry	**2**	-

*Simple foods are foods that contain ingredients from a single commodity; account for 61% of foodborne *E. coli* O157 outbreaks. Data are preliminary

What causes sporadic STEC O157 infections?

	FoodNet case-control studies	
Exposure	1996–97 PAF* (%)	1999–2000 PAF* (%)
Eating at a table service restaurant	20	-
Pink hamburger at home	8	6
Pink hamburger in a restaurant	7	2
Drinking untreated surface water	-	5
Living on, working on, or visiting a cattle farm	6–8	8

*Population Attributable Fraction (PAF) = the percentage by which the infection incidence would be expected to decrease if the (causal) exposure was removed

Kassenborg HD, et al. CID. 2004.; Voetsch AC, et al. Epidemiol Infect. 2007.

Non-O157 STEC outbreaks: modes of transmission—United States, 1990-2008

Mode of transmission	Number of outbreaks	%
Foodborne	9	33
Person-to-person	7	26
Water	4	15
Animal contact	4	15
Mixed modes	1	4
Unknown	2	7
Total	**27**	**100**

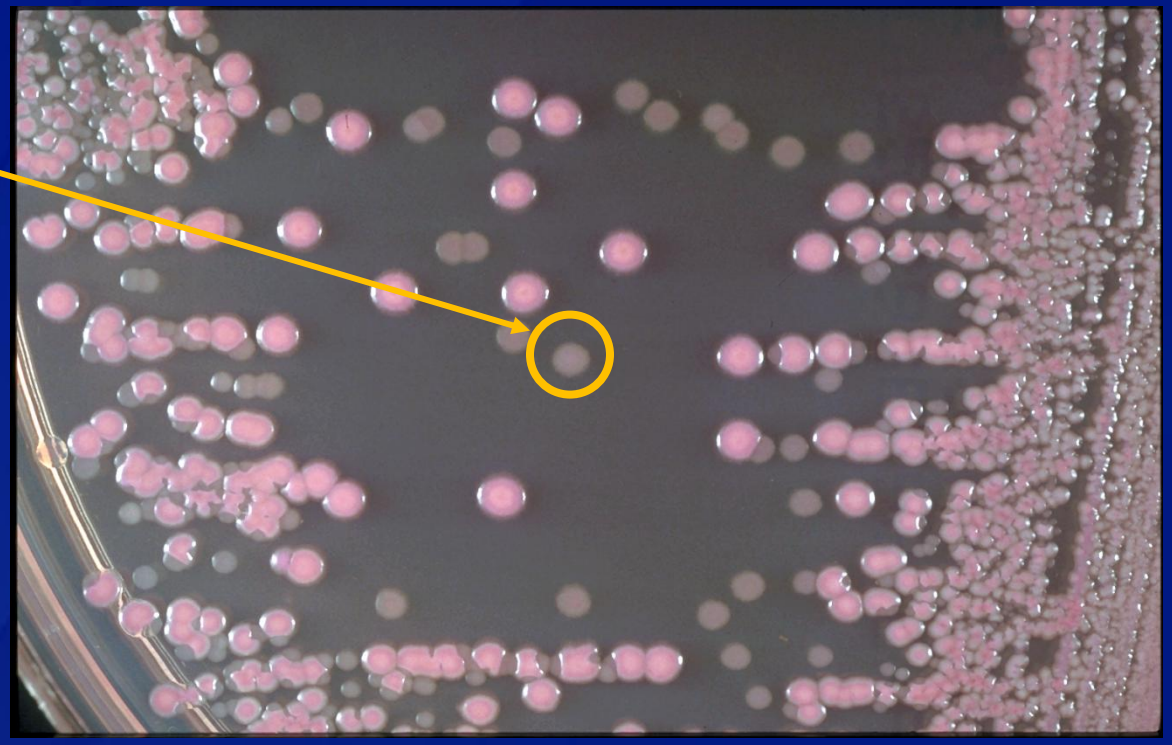
CDC, Unpublished data

Outbreak of STEC O145 Infections – April 2010

- **33 cases in 5 states**
  - Michigan, New York, Ohio, Pennsylvania, and Tennessee
  - First recognized multistate outbreak of non-O157 STEC
- **40% hospitalized, 10% developed HUS**
  - As severe as illness caused by *E. coli* O157:H7
- **Caused by contaminated romaine lettuce**

HOW ARE STEC INFECTIONS DIAGNOSED?

Detection of *E. coli* O157:H7



- Do not rapidly ferment sorbitol
- Readily identified if selective and differential agar used
  - Usually Sorbitol MacConkey +/- cefixime and tellurite

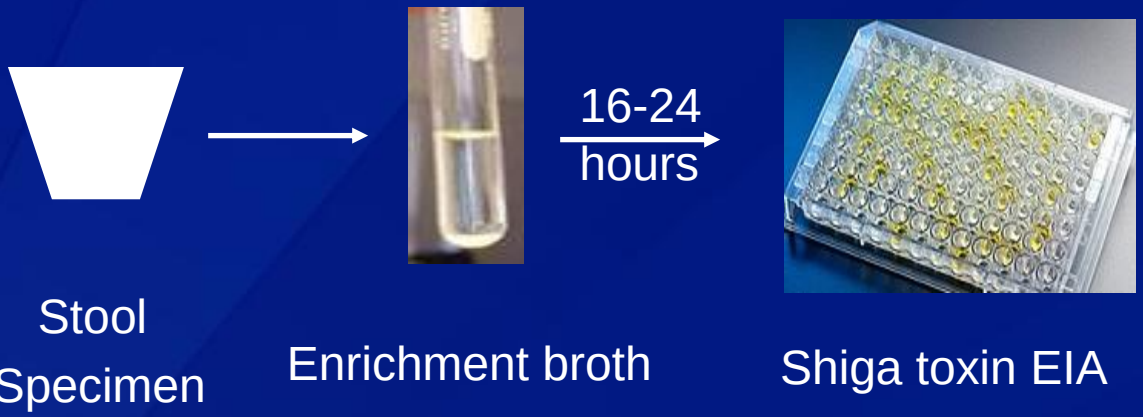
Detection of non-O157 STEC

Typical colony of non-O157 STEC

- Most ferment sorbitol and are indistinguishable from commensal *E. coli* strains

❖ *Looking for Shiga toxin can help detect STEC*

Detection of STEC



What happens if this is all that is done?

If only a Shiga toxin EIA is performed…

- **Serogroup not determined**
  - Simply report "Shiga toxin positive" to doctor
  - But it's important to know quickly if it's O157
- **Subtype not determined**
  - But subtype is important for outbreak detection
- **It could be a false positive**
  - Norovirus outbreaks have been incorrectly attributed to STEC
- **Could miss ~5% of *E. coli* O157:H7 infections**

MMWR. 2006;55(No. 38); Klein, et al. J Peds. 2002

PROPOSED BEST PRACTICE FOR THE DIAGNOSIS OF STEC INFECTIONS

Clinical laboratory recommendations, 2009

- Simultaneously culture all stools submitted from patients with acute community-acquired diarrhea or suspected HUS for O157 and assay for non-O157 STEC with a test that detects Shiga toxin
- Report and send *E. coli* O157 isolates and Shiga toxin positive broths to a public health laboratory as soon as possible

MMWR. 2009;58(No. RR-12)

Culture for *E. coli* O157

Clinical labs:

Stool Specimen

16-24 hours

Select colony

Agglutination in O157 antiserum

Physician notified

Biochemically ID as *E. coli*

Send isolate to Public health lab

Public heath labs:

Confirm and characterize isolate

- Shiga toxin profiles and other virulence factors
- H7 antigen
- PFGE for outbreak detection

Non-O157 STEC

Clinical labs:

Stool Specimen

Enrichment broth

Shiga toxin EIA

Send positive broths to public health lab If no *E. coli* O157 detected by culture

Public health labs:

- Confirm presence of Shiga toxin in broth
- Plate broth on culture media
  - Test representative sorbitol + and - colonies for Shiga toxin
  - Characterize Shiga toxin positive colonies
    - Serogroup
    - Shiga toxin profile and other virulence factors
    - PFGE for outbreak detection

Why simultaneously culture for *E. coli* O157 and assay for Shiga toxin?

- Most sensitive approach to detect all STEC infections
- Rapidly distinguishes O157 from non-O157 STEC infections
- Isolates are obtained in a timely manner

Cohen MB. J Pediatrics. 2002

Proposed best practice benefits patient care and public health

- **Patient care**
  - Facilitates early clinical management decisions to reduce risk of HUS
    - Avoidance of antibiotics and anti-diarrheals
  - Early identification of *E. coli* O157 can further influence management decisions
    - Intravenous fluids
  - Avoidance of unnecessary procedures
- **Public health**
  - Allows for prompt confirmation and subtyping by public health labs to detect and control outbreaks
  - Allows for monitoring of epidemiological trends

HOW ARE WE DOING?

STEC diagnostic practices, clinical laboratories in FoodNet sites

	Percent of clinical laboratories		
	2000	2003	2007
Among labs testing on site:			
Used a method to detect Shiga toxin	3	2	11
Simultaneously cultured for all stool samples for *E. coli* O157 and assayed for Shiga toxin			2

Boyce, J Clin Micro 1995; Voetsch CID 2004; and unpublished preliminary data

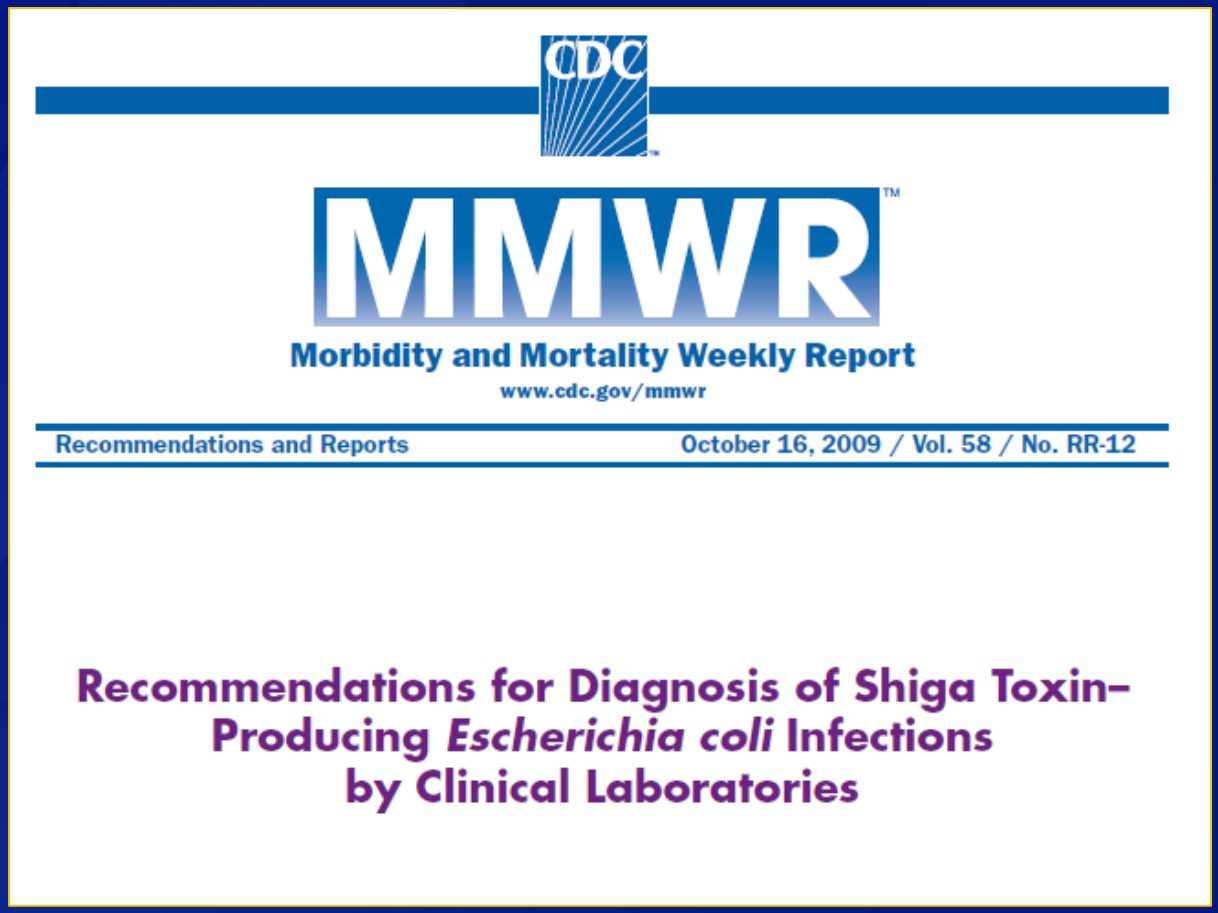
What can you do?

Talk with your clinical labs

- **Do they routinely culture all submitted stool specimens for *E. coli* O157:H7**
- **Do they routinely simultaneously test for non-O157 STEC with an assay that detects Shiga toxin or the genes encoding these toxins**
- **If not,**
  - Request that these be done when ordering cultures on patients with acute community-acquired diarrhea
  - Give them a copy of the recommendations published in the MMWR

MMWR Recommendations

http://www.cdc.gov/mmwr/PDF/rr/rr5812.pdf



CDC

MMWR™

Morbidity and Mortality Weekly Report

www.cdc.gov/mmwr

Recommendations and Reports | October 16, 2009 / Vol. 58 / No. RR-12

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

Thank you for your attention

For more information please contact Centers for Disease Control and Prevention

1600 Clifton Road NE, Atlanta, GA 30333
Telephone, 1-800-CDC-INFO (232-4636)/TTY: 1-888-232-6348
E-mail: cdcinfo@cdc.gov Web: www.cdc.gov

Escherichia coli O157:H7 and the Hemolytic Uremic Syndrome: How can we do better?

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Department of Pediatrics
Washington University School of Medicine

COCA

September 16, 2010

Perspective

E. coli O157:H7: ~ 4,000 diagnosed infections (2006) (MMWR, April 13, 2007)

HUS: 500-750 cases per annum, ca. half < age 10

Rare infections need good systems, protocols, and vigilance

- How can we optimally diagnose this infection?
- Can we attenuate human illnesses?
- Can we better prevent outbreaks and sporadic infections?

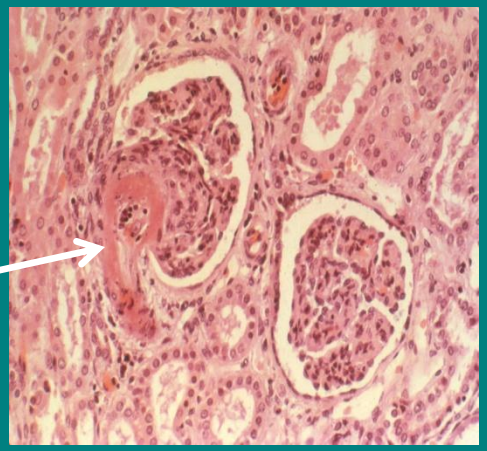
Karmali (Lancet 1983; 1:619)

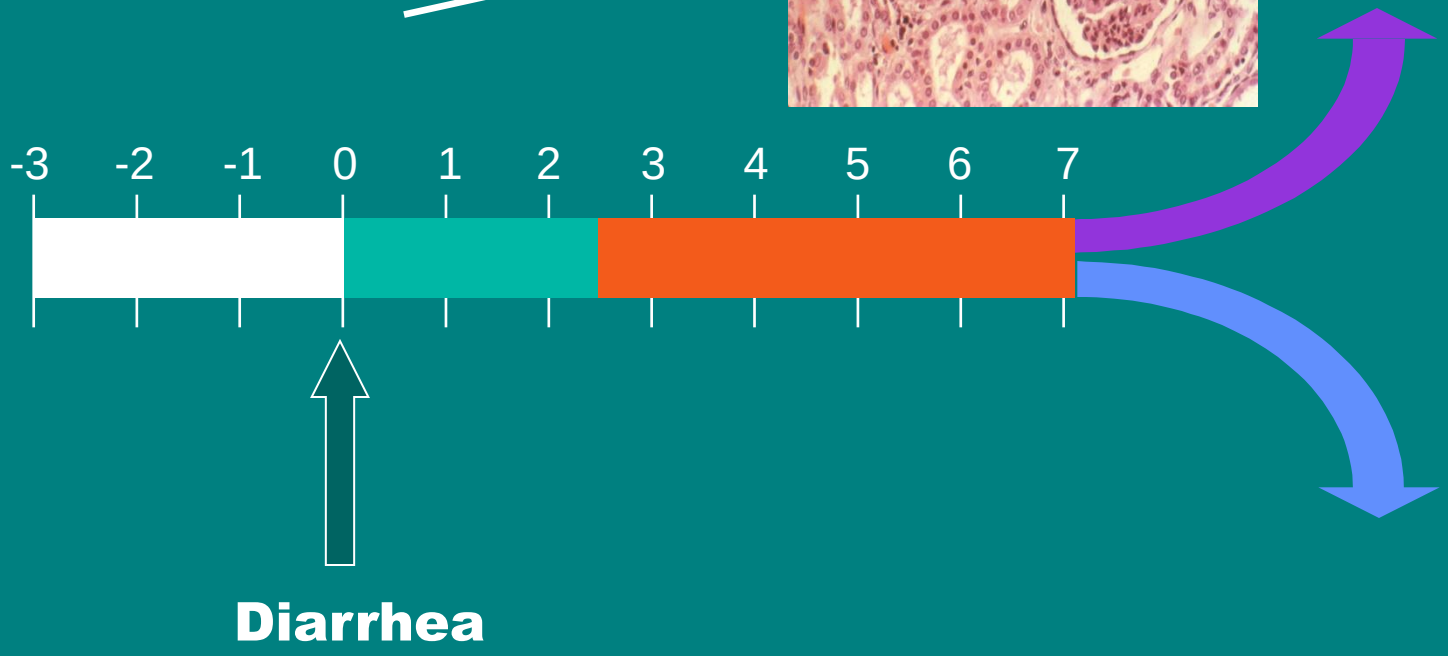
- HUS Fecal filtrates killed Vero Cells
- Toxicity attributed to *E. coli*
- *E. coli* O157:H7 among serotypes recovered

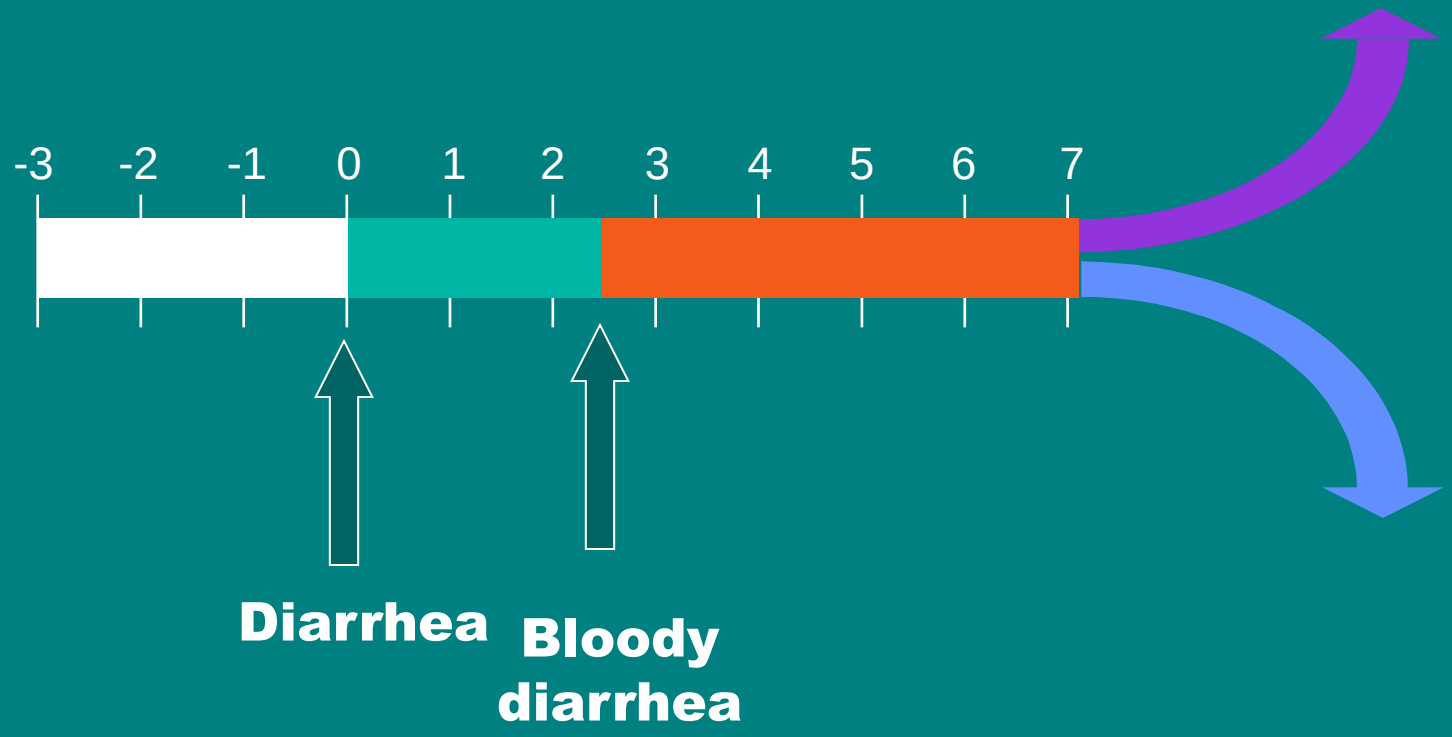
Riley (NEJM 1983; 308:681)

- Bloody diarrhea in Oregon and Michigan
- *E. coli* O157:H7 in patients stools, and in hamburger

Time is not on your side!






-3
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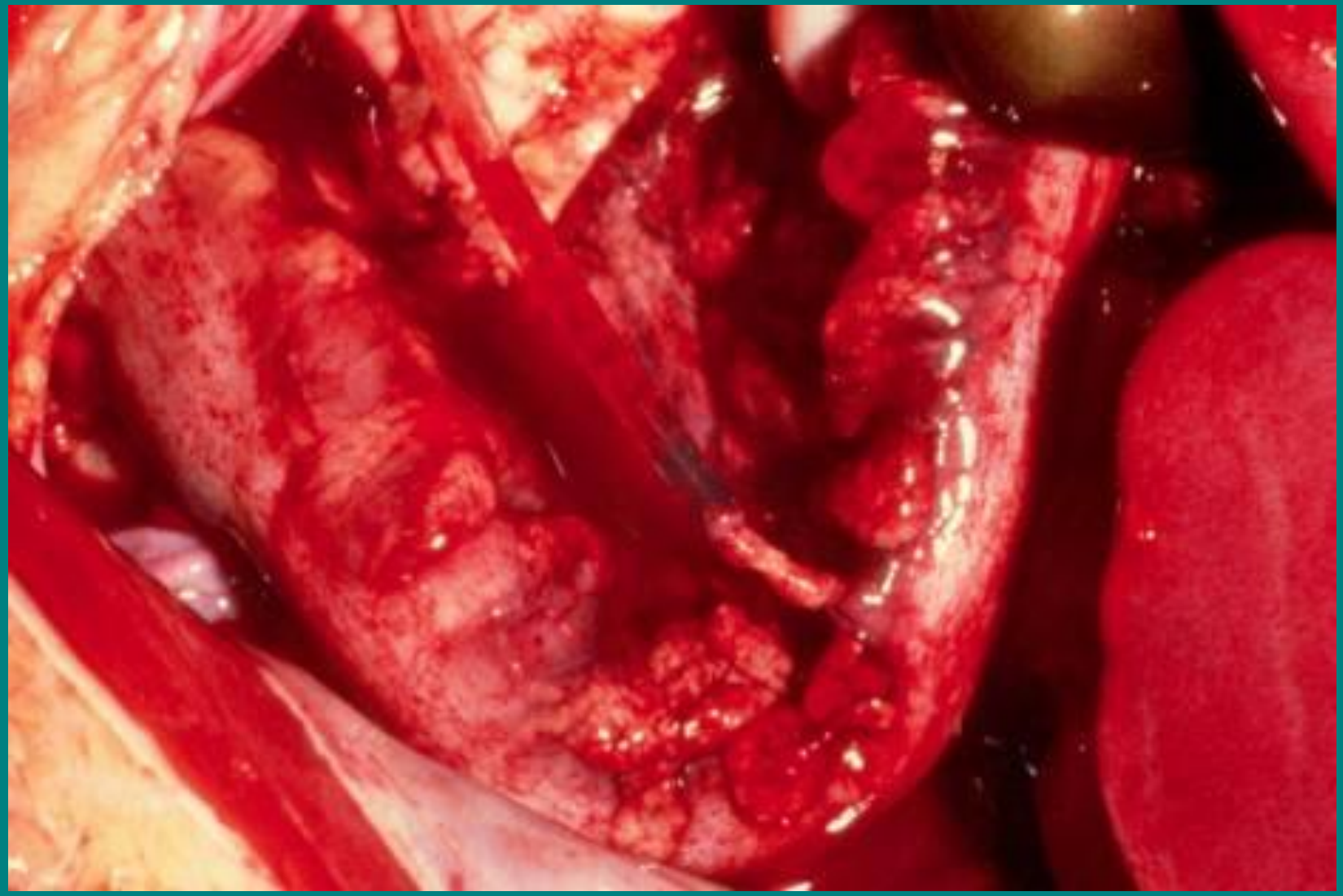
Diarrhea
Bloody diarrhea

Severe Colitis



First Contact (frequently ER)

- Profile:
  - Usually 1-3 days nonbloody diarrhea, suddenly turns bloody
  - Abdominal pain, esp. during defecation
  - Multiple (median 7) BMs previous 24 hours
  - Contact history: most cases non-epidemic, diverse vehicles
  - Usually afebrile at presentation
  - Abdomen frequently tender

Holtz, et al, Gastroenterology. 2009 ;136:1887

First Medical Contact

- Culture!

(*C. difficile* optional,

parasite and viral

studies not helpful,
could be confusing)

Consider a rectal swab

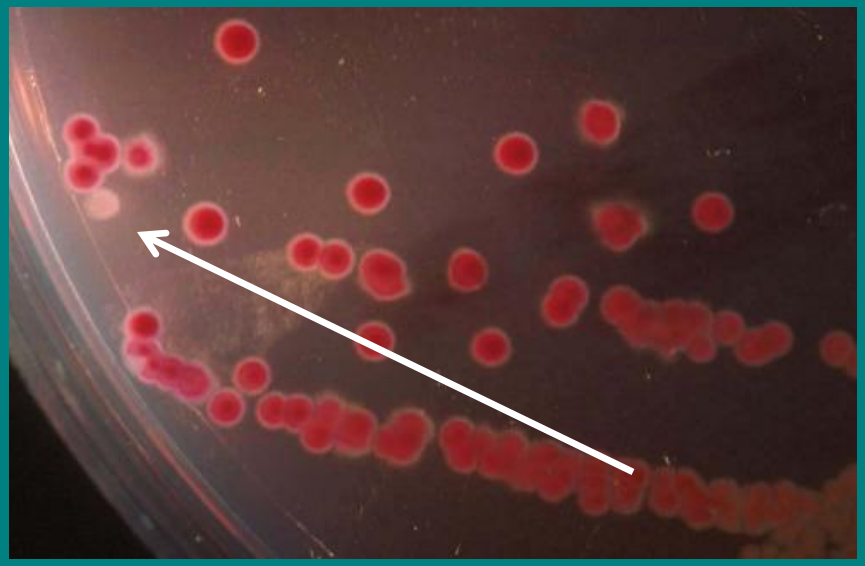
First Medical Contact

- Laboratory tests
  - CBC, BUN, creatinine, electrolytes
  - No urinalysis!
- Imaging studies optional – prefer to limit
  - Colon and TI edema

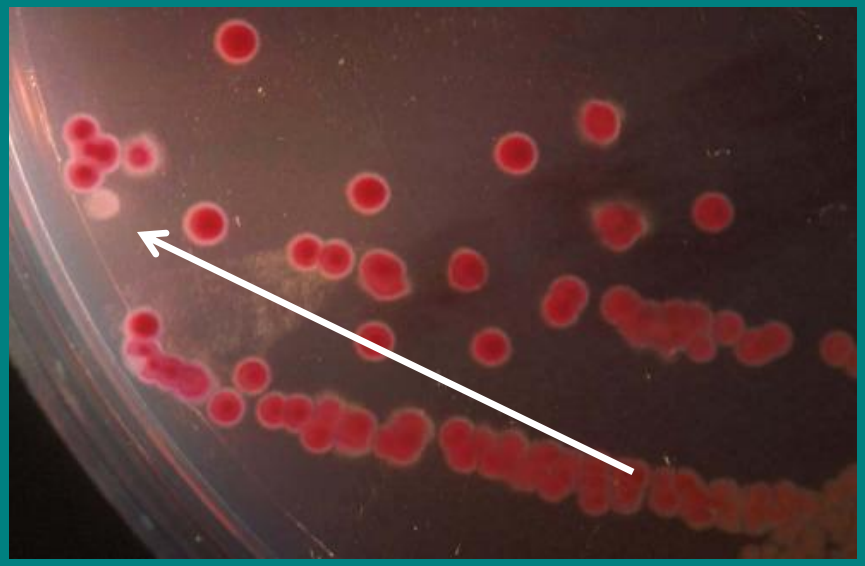
First Medical Contact

Microbiologic Evaluation is critical

Sorbitol MacConkey agar



Sorbitol MacConkey agar



EIA for toxin

Stool

↓

Broth

↓

Incubate O/N

↓

Shiga Toxin EIA

SMAC Agar Screening

- Quickest route to *E. coli* O157:H7

USA, Canada, Japan, UK, South America: *E. coli* O157:H7 is the nearly exclusive (> 95%), cause of post-diarrheal HUS.

Pediatrics. 1987;80:37
J Infect Dis. 1990;162:553
J Pediatr. 1998;132:777
J Infect Dis. 2001;183:1063
J Pediatr. 2002;141:172
Foodborne Pathog Dis. 2006;3:88
Epidemiol Infect. 2007 Mar 5 (epub)1-7

Three pediatrics series (Seattle, St. Louis): SMAC plus EIA testing on all stools

	O157 (68)	non-O157* (26)
HUS	18%	0%
Bloody	92%	50%
Laboratory blood	70%	22%

EIA screening missed 5 (7.3%) *E. coli* O157:H7

Klein, E, et al, J Peds 2002; 172
Unpublished data

* O26, O103, O111, O118 (O121, O165, O174, O177, O165, O174, Orough).

Why rapidly diagnose O157?

- *E. coli* O157:H7 → thrombotic complications, epidemics; other serotypes rarely do
- Syndromic profiling helpful, but clinician needs + or - culture result ASAP
- HD needs isolate
- Intervention appears possible

Accelerate Microbiology

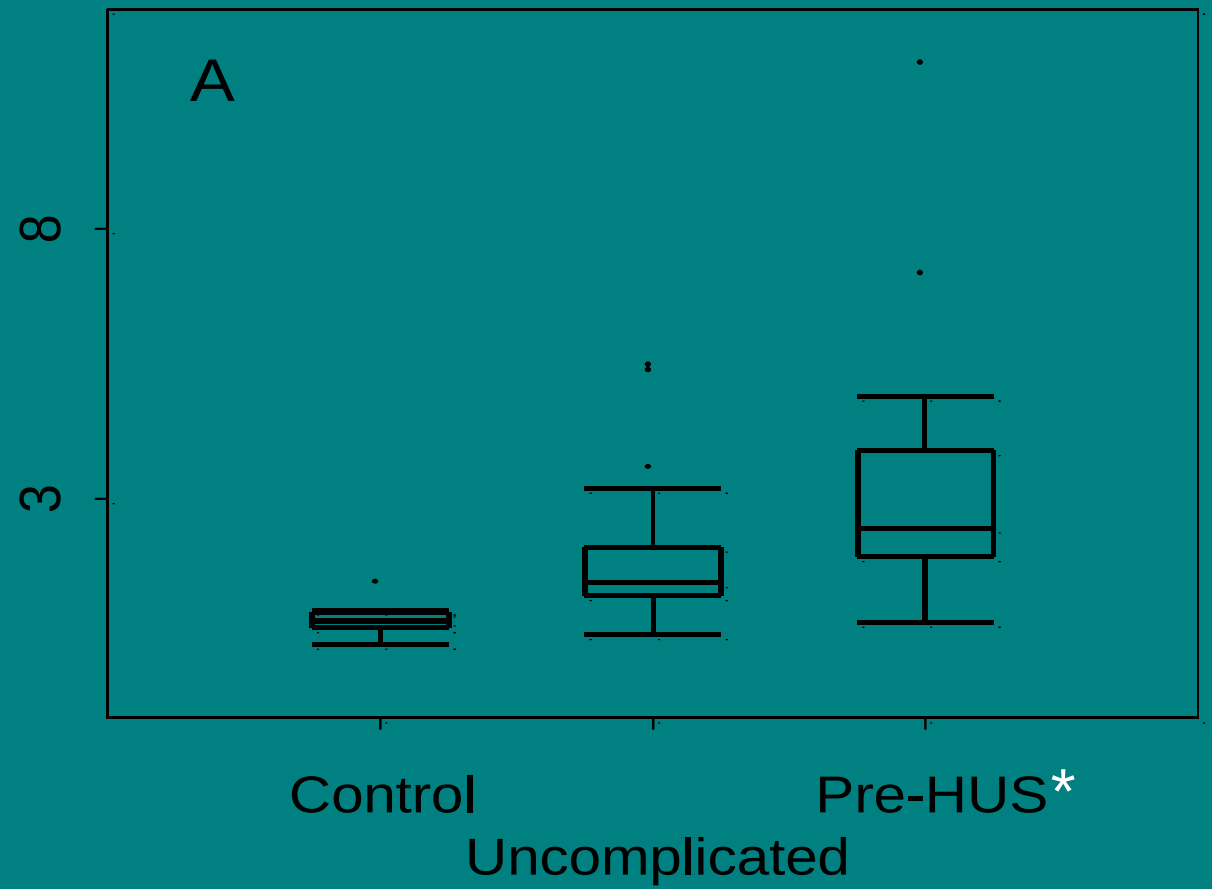
Plate 24/7, don’t wait for morning shift

Report presumptive positives - don’t wait for H7 testing or *E. coli* ID

Receipt to telephone call:

23 hr, 53 min (14 – 56 h)

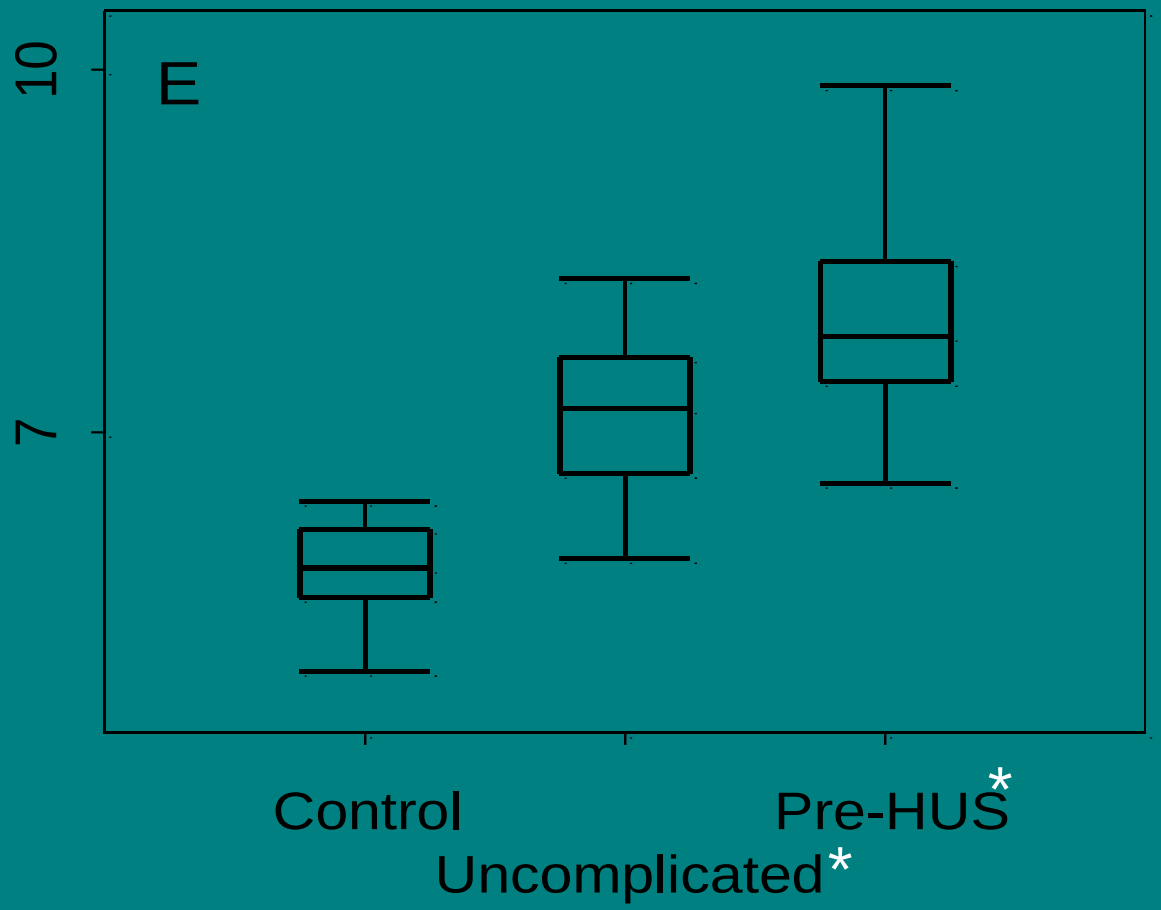
F 1+2: Thrombin generation before HUS



NEJM 2002; 346:23

P<0.01
p<0.001

↑D-dimer Before HUS, as Lesion Evolves



Laboratory values, all groups

	Normal	Uncomp	Pre-HUS
HCT (%)	36 ± 3	37 ± 3	38 ± 5
Plts (k/mm^3)	321 ± 70	317 ± 74	322 ± 97
Cr (mg/dL)	0.4 ± .1	0.4 ± .1	0.4 ± .2

Scant toxin in Stool

	Stx Frequency	Titer
Pre-HUS:	40%	320 (160-1280)
Uncomplicated:	48%	1689 (160-40 K)
At HUS:	16%	

Cornick, N., J Infect Dis. 2002;186:57

Child at Presentation

- Little or no toxin in stool
- Coagulation system activated, but CBC normal
- Pathogen still present in stool
- Kidneys not yet injured

What’s a provider to do?

Admit to hospital

Isolate

Inpatient (contact) precautions:

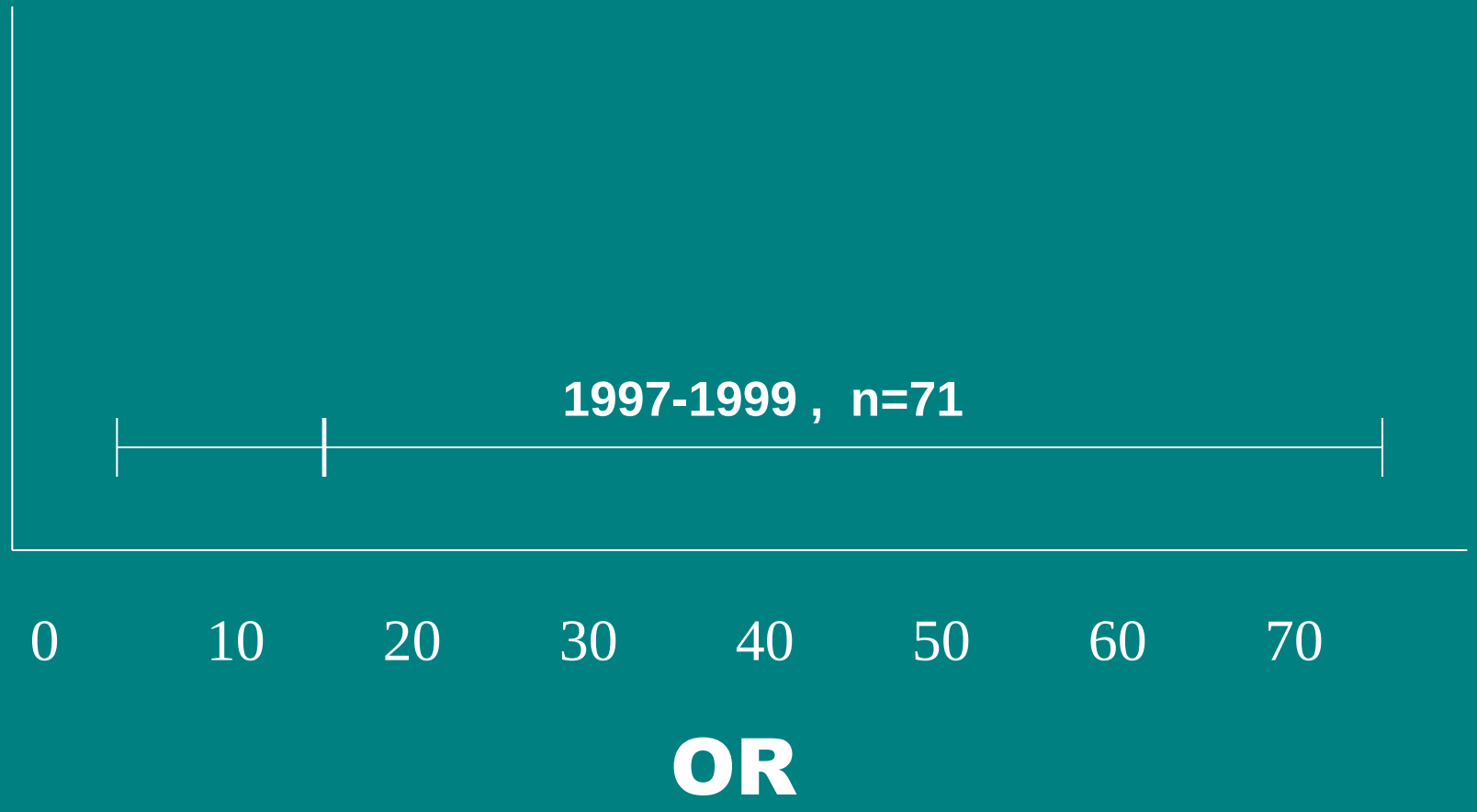
dedicated equipment, gowns, gloves

Outpatient advice:

“Wash your hands well!”

Werber, et al, Clin Infect Dis. 2008;46:1189-96.

Withhold antibiotics

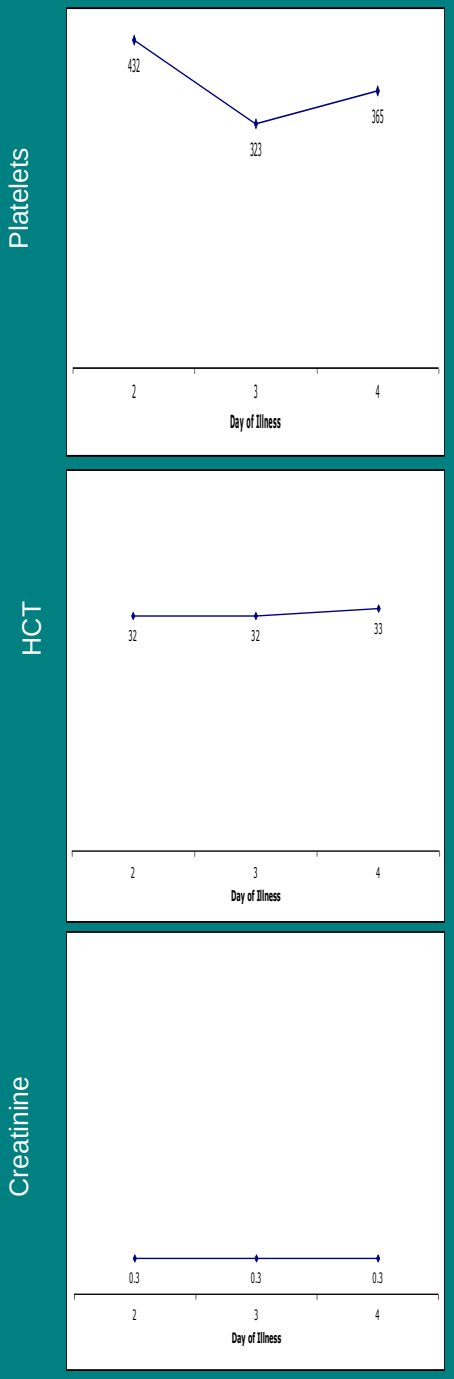


N Engl J Med. 2000;342:1930-6.

Volume Expand

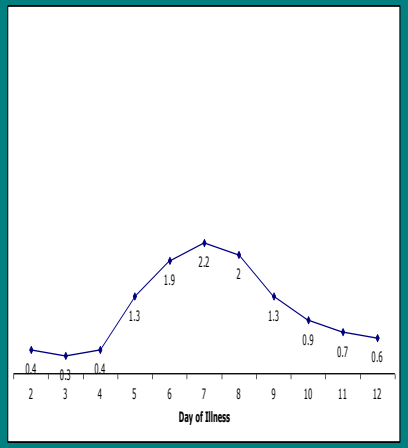
- Comfort
- Vascular protection in view of HUS risk
- Daily CBC, BUN, creatinine, electrolytes
- Wait for platelets to rise
  (single determination rarely sufficient)

Pattern 1



Daily CBC, BUN, creatinine, electrolytes.

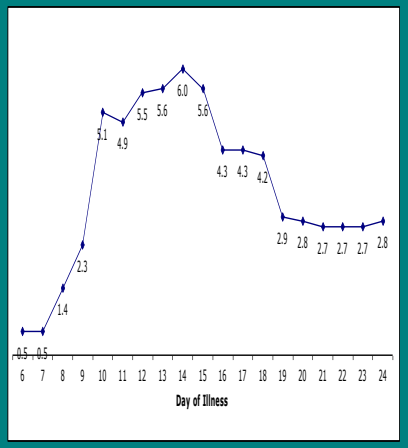
Await platelet dip and rise (75%), or development of HUS (25%).



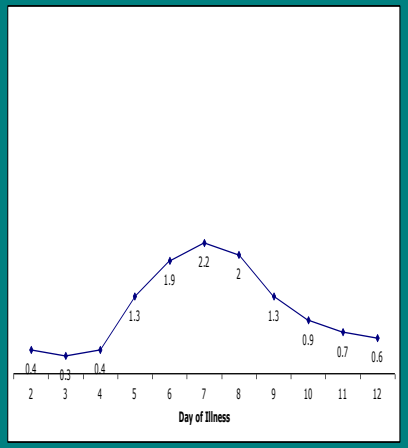
creatinine

Non-oligoanuric

Oligoanuric



creatinine

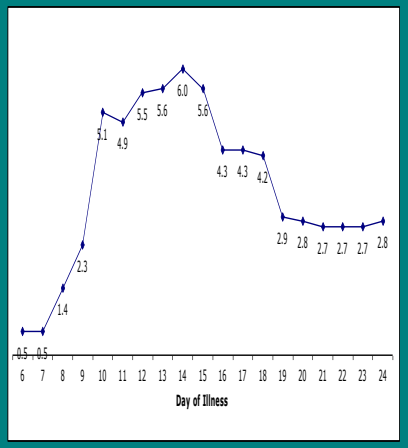


creatinine

Non-oligoanuric

Oligoanuric

Oligoanuric renal failure is worse



creatinine

Oakes RS, Kirkham JK, Nelson RD, Siegler RL. Duration of oliguria and anuria as predictors of chronic renal-related sequelae in post-diarrheal hemolytic uremic syndrome. *Pediatr Nephrol*. 2008;**23**:1303–8.

Loirat C. [Post-diarrhea hemolytic-uremic syndrome: clinical aspects]. *Arch Pediatr*. 2001;**8 Suppl 4**:776s–84s.

Siegler RL, Pavia AT, Christofferson RD, Milligan MK. A 20-year population-based study of postdiarrheal hemolytic uremic syndrome in Utah. *Pediatrics*. 1994;**94**:35–40.

Siegler RL, Milligan MK, Burningham TH, Christofferson RD, Chang SY, Jorde LB. Long-term outcome and prognostic indicators in the hemolytic-uremic syndrome. *J Pediatr*. 1991;**118**:195–200.

Garg AX, Suri RS, Barrowman N, Rehman F, Matsell D, Rosas-Arellano MP, et al. Long-term renal prognosis of diarrhea-associated hemolytic uremic syndrome: a systematic review, meta-analysis, and meta-regression. *JAMA*. 2003;**290**:1360–70.

Robson WL, Leung AK, Brant R. Relationship of the recovery in the glomerular filtration rate to the duration of anuria in diarrhea-associated hemolytic uremic syndrome. *Am J Nephrol*. 1993;**13**:194–7.

Tonshoff B, Sammet A, Sanden I, Mehls O, Waldherr R, Scharer K. Outcome and prognostic determinants in the hemolytic uremic syndrome of children. *Nephron*. 1994;**68**:63–70.

Huseman D, Gellermann J, Vollmer I, Ohde I, Devaux S, Ehrich JH, et al. Long-term prognosis of hemolytic uremic syndrome and effective renal plasma flow. *Pediatr Nephrol*. 1999;**13**:672–7.

Mizusawa Y, Pitcher LA, Burke JR, Falk MC, Mizushima W. Survey of haemolytic-uraemic syndrome in Queensland 1979-1995. *Med J Aust*. 1996;**165**:188–91.

Spizzirri FD, Rahman RC, Bibiloni N, Ruscasso JD, Amoreo OR. Childhood hemolytic uremic syndrome in Argentina: long-term follow-up and prognostic features. *Pediatr Nephrol*. 1997;**11**:156–60.

Gianantonio CA, Vitacco M, Mendilaharzu F, Gallo G. The hemolytic-uremic syndrome. Renal status of 76 patients at long-term follow-up. *J Pediatr*. 1968;**72**:757–65.

Gianantonio CA, Vitacco M, Mendilaharzu F, Gallo GE, Sojo ET. The hemolytic-uremic syndrome. *Nephron*. 1973;**11**:174–92.

Dolislager D, Tune B. The hemolytic-uremic syndrome: spectrum of severity and significance of prodrome. *Am J Dis Child*. 1978;**132**:55–8.

de Jong MC, Monnens LA. Recurrent haemolytic uraemic syndrome. *Padiatr Padol*. 1976;**11**:521–7.

Mencia B. S., Martinez de Azagra A, de Vicente A. A., Monleon L. M., J. CF. Uremic hemolytic syndrome. Analysis of 43 cases. *An Esp Pediatr* 1999;**50**:467–70.

13 good outcomes

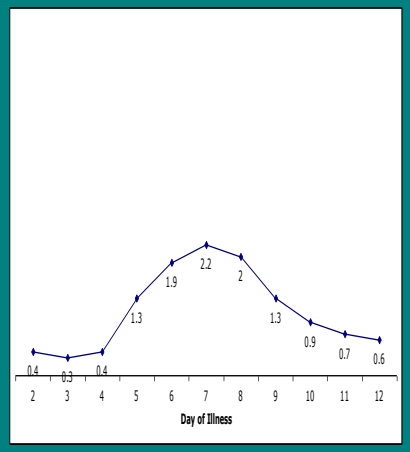
16 poor outcomes

29 Children, 1 center (Seattle), 1997-2003

All culture +

Admitted pre-HUS, or with HUS

Demographically similar



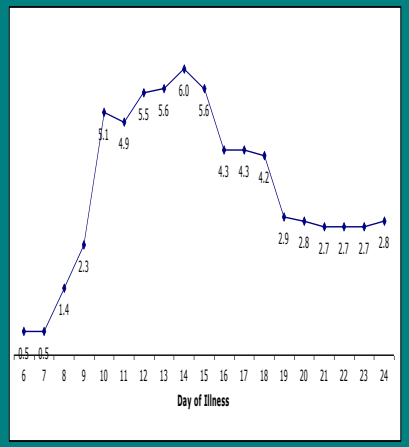
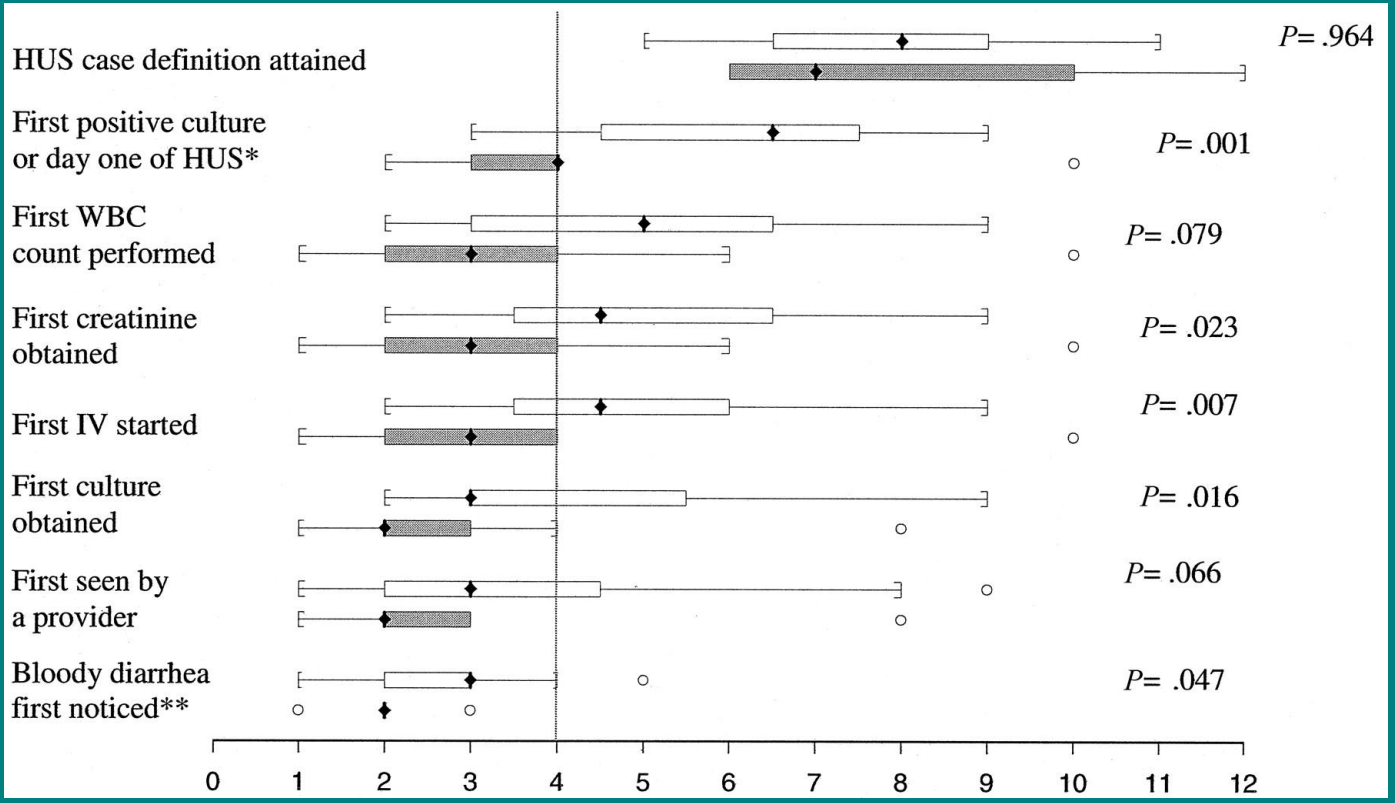


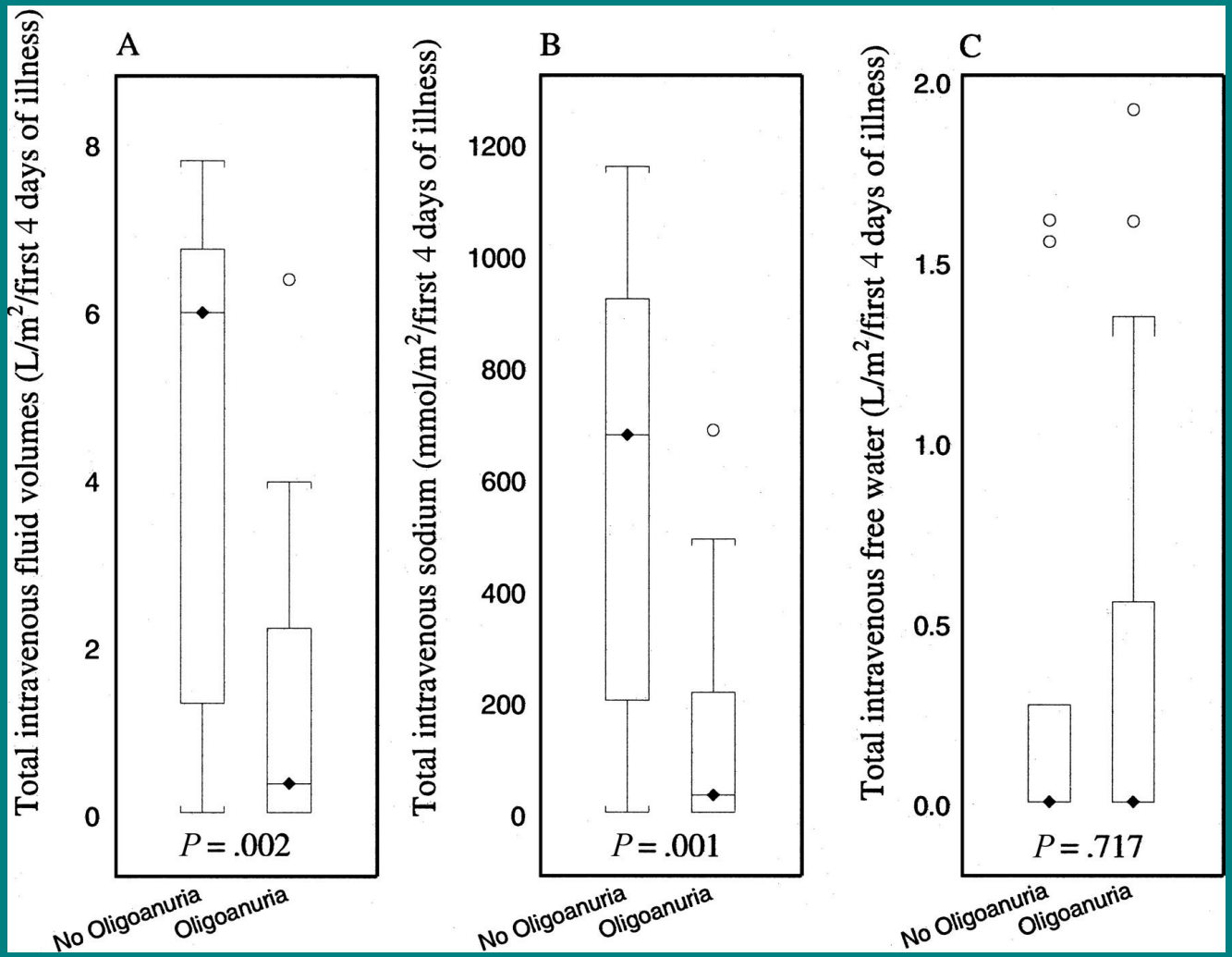
Fig 1. Timing of critical events during illness



Pediatrics. 2005 Jun;115(6):e673-80

PEDIATRICS®

Fig 2. Volume and characteristics of fluids that were administered during first 4 days of illness



Pediatrics. 2005
Jun;115(6):e673-80

PEDIATRICS®

Multivariate Analysis

VARIABLE	ADJUSTED RELATIVE RISK (95% C.I.)	P
Age (yr)	1.9 (.8-4.4)	0.15
Female	1.5 (.1-19.4)	0.77
Pre-HUS antibiotics	1.1 (0.1-17.0)	0.95
Free water in IVF (mL/m^2)	1.0 (.999-1.001)	0.49
Na in IVF ($mmol/m^2$)	**0.994 (.989-.999)**	**.017**

Pediatrics. 2005
Jun;115(6):e673-80

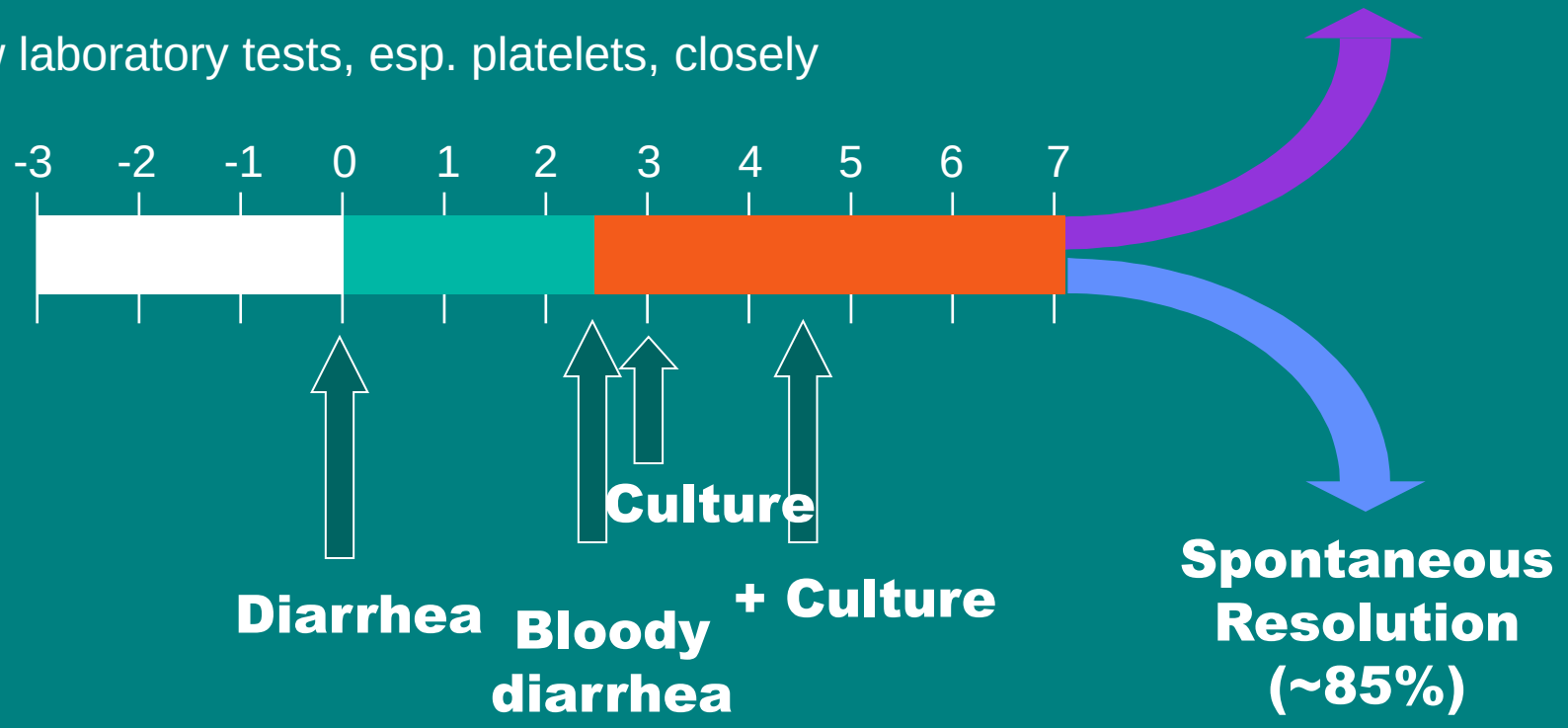
Profile, admit

Culture with SMAC 24/7, don't rely on toxin tests

Volume expand (isotonic crystalloid), monitor

No antibiotics

Follow laboratory tests, esp. platelets, closely



Cease Therapy

Need to know:

Day of illness (day 1 = first day of diarrhea)

Platelet count (need at least 2 day trend)

Clinical condition (improving, worsening)

Culture result (thorough testing assumed)

Guidelines in Holtz, et al, Gastroenterology. 2009;136:1887

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Thank you for joining the call - Please email us questions at coca@cdc.gov