

Food Borne Illnesses Be Gone!!

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Why talk about this topic?

- ▶ The future of food safety depends on:
 - Supporting Centers of Excellence that are faster at responding to food borne outbreaks
 - Developing and sharing next generation DNA sequencing technology with all states
 - Improving integration of foodborne illness surveillance systems and **expanded data sharing** as required by the Food Safety Modernization Act

Objectives

Upon completion of this presentation, the participant will be able to:

- ▶ Discuss the infectious agents involved in food borne illnesses.
- ▶ Describe three main aspects of hand hygiene.
- ▶ Discuss the CDC recommended hand washing protocol.

Food Borne Illnesses (FBI)– CDC Statistics

- 1 in 6 Americans gets ill (~48 million); ~130,000 will be hospitalized; ~3000 will die
- Preventing 1 fatal case of *Escherichia coli* (*E. coli* O157:H7) would save ~\$7 million
- We are **not** impacting the incidence of *Salmonella*:
 - ~1 million cases/year
 - ~19,000 hospitalizations
 - almost 400 deaths
 - Data has remained constant for over 10 years
 - ***Salmonella* infections alone cost ≈\$3.6 billion each year in direct medical costs, productivity, & years of potential life lost**

How does food become contaminated?

- ▶ Meats – during slaughter
- ▶ Fresh fruits & vegetables – animal manure or human sewage in water (irrigating or washing)
- ▶ Eggs – deposited in egg before shell formed
- ▶ Oysters & other shell fish – filter feed; human sewage in water
- ▶ Cross contamination during processing commercially or preparation to eat

Outbreaks

- ▶ 2018 (2017)
 - Shell eggs, Rose Acre Farms' Hyde County, North Carolina *Salmonella* Braenderup (45 cases, 10 states, 11 hospitalized, no deaths; **206,749,248 eggs recalled**)
- ▶ 2017
 - Papayas, 2 farms in Mexico – *Salmonella* Urbana (7 cases, 3 states, 4 hospitalizations, no deaths) + *Salmonella* Newport & infantis (4 cases, 4 states, 2 hospitalizations, no deaths)
- ▶ 2016
 - Alfalfa Sprouts – *Salmonella* [*Salmonella* Reading (30 cases) & *Salmonella* Abony (5 cases) + 1 case with both strains = 36 cases, 9 states, 7 hospitalizations, no deaths]
 - Costco Rotisserie Chicken Salad (again) – *Salmonella* (4 cases, 3 confirmed, one store, one state)
- ▶ 2015
 - Costco Rotisserie Chicken Salad – *E. coli* O157:H7 (from the celery, onion? used)
 - Chipotle Mexican Grill – *E. coli* O26 (1st outbreak: 55 cases, 11 states – 21 hospitalized, no HUS, no deaths; 2nd outbreak: 5 cases, 3 states – 1 hospitalized, no HUS, no deaths)
- ▶ 2014
 - Raw Clover Sprouts – *E. coli* O121
 - Ground Beef – *E. coli* O157:H7
- ▶ 2013
 - Ready-to-Eat Salads – *E. coli* O157:H7
 - Farm Rich Brand Frozen Food Products – *E. coli* O121

*To get more information about infections that might be diagnosed but not reported, CDC developed a special surveillance system called FoodNet***

- FoodNet is a collaborative program among CDC, 10 state health departments, the U.S. Department of Agriculture's Food Safety and Inspection Service (USDA-FSIS), and the Food and Drug Administration (FDA).
- It provides the best available information about specific foodborne infections in the United States, and summarizes them in an annual report.
- FoodNet has conducted active, population-based surveillance for laboratory-confirmed infections caused by *Campylobacter*, *Listeria*, *Salmonella*, STEC O157, *Shigella*, *Vibrio*, and *Yersinia* since 1996; *Cryptosporidium* and *Cyclospora* since 1997; and STEC non-O157 since 2000.
- The surveillance area includes 15% of the United States population (46 million persons).
- Cost of funding for the surveillance sites & CDC - <\$7 million/year**
**<https://www.cdc.gov/foodnet/index.html>



2015 FOOD SAFETY REPORT
Measuring progress toward Healthy People 2020 goals

Pathogen	Healthy People 2020 Target Rate*	2015 Rate†	Change Compared with 2006-2008†	Progress
<i>Campylobacter</i>	15	12.97	↑ 9%	⊖
<i>E. coli</i> O157*	10	0.95	↓ 30%	⊕
<i>Listeria</i>	25	0.24	No change	⊖
<i>Salmonella</i>	10	15.89	No change	⊖
<i>Vibrio</i>	25	0.39	↑ 34%	⊖
<i>Yersinia</i>	25	0.29	No change	⊖

*U.S. Department of Health and Human Services, Healthy People 2020. †U.S. Department of Health and Human Services, National Center for Zoonotic Control and Prevention. For more information, visit www.cdc.gov/foodsaf.

National Outbreak Reporting System (NORS)
[formerly - Foodborne Outbreak Online Database (FOOD Tool)]

- NORS Dashboard**
 - a web-based platform for searching CDC's Foodborne Disease Outbreak Surveillance System database; designed to allow the public direct access to information on foodborne outbreaks reported to CDC since 1998.
- Illinois Stats (1998-2016)**
 - Quick Stats - Current Search**
 - 2,170 Outbreaks
 - 66,180 Illnesses
 - 4,460 Hospitalizations (6.7%)
 - 115 Deaths (0.17%)
- Overall National Stats**
 - 41,269
 - 1,054,151
 - 27,909
 - 1,290 (0.12%)

****as of November 27, 2017**
<https://www.cdc.gov/norsdashboard/>

"Germs" and some foods responsible for most FBI:

- Campylobacter* (poultry)
- E. coli* O157:H7 [STEC] (ground beef, leafy greens, raw milk)
- Listeria monocytogenes* (deli meats, unpasteurized soft cheeses, produce)
- Salmonella* (eggs, poultry, meat, produce)
- Vibrio* (raw oysters)
- Norovirus* in many foods (e.g., sandwiches, salads)

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***Campylobacter*

- ▶ Cause zoonotic infections in humans
 - Many animals act as reservoirs
 - Poultry, cattle, sheep, pigs, pet animals
 - Improperly handled or cooked food products (poultry, unpasteurized milk)
- ▶ Most common cause of bacterial gastroenteritis
 - Mild to severe **bloody or non-bloody diarrhea, abdominal cramping, fever**
 - Most cases are self-limiting, but relapses in 5-10% of untreated patients
 - *C. jejuni* infections have been documented as preceding Guillain-Barré, reactive arthritis, & Reiter's syndrome

***Shiga Toxin Producing Escherichia coli (STEC)-E. coli O157:H7*

- ▶ **STEC produce one or both of Shiga toxins 1 & 2**
 - There are several variants of toxin 2
 - Shiga toxin is not the only important virulence mechanism of STEC: attachment and effacement
- ▶ **STEC colonize the guts of both dairy & beef cattle**
 - **Ground beef** implicated in more outbreaks than any other vehicle
 - Raw milk, sausages, roast beef, vegetable products, and **unchlorinated municipal water** have also been implicated
 - Infectious dose is low (<200 CFU), so it also spreads easily from **person-to-person**

***STEC (continued)*

- ▶ STEC can cause **bloody or non-bloody diarrhea** ranging from mild to severe
 - Abdominal cramping is common
 - STEC **do not cause fevers**
- ▶ STEC have been associated as a precursor to Hemolytic Uremic Syndrome (HUS)
 - Estimated that 4% or more of STEC infections result in HUS
 - *E. coli* O157 is estimated to cause 80% of HUS cases in the U.S.
 - O157 is the most common STEC in the U.S., but there are more than 150 non-O157 STECs

Listeria monocytogenes

- ▶ Affects older adults, pregnant women, newborns, and adults with weakened immune systems
- ▶ **Fever and muscle aches, sometimes preceded by diarrhea or other gastrointestinal symptoms**
- ▶ Almost everyone who is diagnosed with listeriosis has "invasive" infection:
 - **Pregnant women:** Pregnant women typically experience fever and other **non-specific symptoms**, such as fatigue and aches. However, infections during pregnancy can lead to miscarriage, stillbirth, premature delivery, or life-threatening infection of the newborn.
 - **People other than pregnant women:** Symptoms can include **headache, stiff neck, confusion, loss of balance, and convulsions in addition to fever and muscle aches.**

***Salmonella*

- ▶ Two species with multiple subspecies
- ▶ Two types of disease:
 - Typhoidal
 - Non-typhoidal
- ▶ Non-typhoidal salmonellosis:
 - **Diarrhea, fever, abdominal cramping**
 - Most common in infants and young children
 - Can last a week or more
 - Foods of animal origin, contact with animals, other food products, water, and person-to-person

***Vibrio*

- ▶ ***Vibrio* species belong to the family *Vibrionaceae***
 - Marine bacteria
 - Some species, like *V. cholerae*, require less sodium & are found in fresh water
- ▶ ***V. cholerae*, the etiologic agent of cholera, is associated with poor sanitation**
- ▶ ***V. parahaemolyticus* is a major cause of foodborne gastroenteritis worldwide**
 - This vibrio most commonly isolated in the U.S.
 - **Watery diarrhea, nausea, abdominal cramping, vomiting, low-grade fever, chills**
 - Associated with consumption of shellfish, especially in warm months
 - Less common in inland areas of the U.S. than the coasts

****Norovirus (and Sapovirus)**

- ▶ **Belong to the family *Caliciviridae***
- ▶ **Norovirus is the most important cause of non-bacterial gastroenteritis worldwide**
 - Developed and developing countries
 - Associated with contaminated food, water, and surfaces
- ▶ **Large outbreaks of Norovirus**
 - Large institutional settings
 - Environmentally stable
 - Low infectious dose
- ▶ **Sapovirus mainly affects children**

Others:

- ▶ **Bacteria**
 - *Shigella*
 - *Aeromonas, Plesiomonas*
 - *Yersinia enterocolitica*
- ▶ **Parasites**
 - *Cryptosporidium, Giardia*
 - *Entamoeba histolytica*
 - *Cyclospora cayatensis* (imported fruits & vegetables)

Reportable Cases of Gastroenteric Pathogens in Michigan, 2008-2012

	Total Number of Cases 2012	Mean 5 year prevalence (2008-2012)
<i>Campylobacter</i>	1209	1147
Cryptosporidiosis	352	320
Cyclosporiasis	0	3
Giardiasis	547	611
Salmonellosis	946	926
STEC (Shiga-toxin producing <i>E. coli</i>)	285	116 ^a
Shigellosis	260	238
Vibriosis (non-cholera)	7	6
<i>Yersinia enteritis</i>	23	22

^a STEC were reported under multiple categories until 2010 when all categories were consolidated

Bacterial Identification

- ▶ Sheep's blood agar (SBA)
- ▶ MacConkey agar (MAC)
- ▶ Hektoen Enteric agar (HE)
- ▶ Campylobacter (CAMPY)
- ▶ GN broth
 - Incubated 4-6 hours
 - Subcultured to HE
- ▶ *Campylobacter, Salmonella, and Shigella* as well as *Aeromonas, Plesiomonas, and Vibrio*
- ▶ All media used for Stool Culture as well as
 - Cefsulodin-irgasan-novobiocin (CIN) agar for *Yersinia enterocolitica*
 - Sorbitol MacConkey (SMAC) for *E. coli* O157
 - Shiga toxin detection by EIA performed on GN broth after 18-24 hours of incubation
- ▶ Indicated by physician order, diagnosis indicating blood in stool, or visible blood in stool

Stool Culture

Expanded Stool Culture

**Organism	Media	Appearance	Identification	Routine AST
<i>Salmonella</i>	MAC; HE	Lactose negative; H ₂ S on HE	Vitek 2 plus Latex Agglutination	Yes
<i>Shigella</i>	MAC; HE	Lactose negative	Vitek 2 plus Latex Agglutination	Yes
<i>Campylobacter</i>	CAMPY	Wet-looking	Oxidase pos; Catalase pos; Gram stain	No
<i>Aeromonas</i>	SBA	Beta hemolytic	Oxidase pos; Indole pos; Vitek 2	No
<i>P. shigelloides</i>	SBA; MAC; HE	Beta hemolytic; Lactose negative	Oxidase pos; Vitek 2	No
O157 STEC	SMAC	Sorbitol negative	Vitek 2	No
Non-O157 STEC	ImmunoCard STAT! EHEC	---	Isolated if possible	No
<i>Y. enterocolitica</i>	CIN	"bullseye"	Vitek 2	No
<i>Vibrio</i>	MAC; HE	Lactose negative	Oxidase pos; Vitek 2	No

****Turn-around-times**

- ▶ **Stool Culture/Expanded Stool Culture:**
 - Negative: at least 52 hours
 - Positive: may take 72 hours or more
 - Reportable: follow up can take weeks
- ▶ **EIA:**
 - Usually take 30 minutes or less to run
 - Often run during only one or two shifts
 - Shiga toxin takes 18-24 hour incubation
- ▶ **Send-out Testing:**
 - O&P often takes over 1 week
 - Limited to when tests are offered at reference lab

****Multiplex Molecular Assays**

Assay	Specimen	Hands-on Time	Run Time	Throughput	Targets
BioFire FilmArray	Cary-Blair 4 day stability at RT or 2-8C	1-2 min	1 hr 10 min	1 assay per instrument; each unit: 7 tests in 8 hr	22 Total: 13 Bacterial 5 viral 4 parasitic
BD Max	Unpreserved or Cary-Blair Stability: 24hr at RT or 5 days at 2-8C	1-2 min	3 hr	Runs of 12, 24 sample capacity; 48 tests in 8 hr	Panels: Bacterial: 4 Ext Bact: 3 Viral: 3 Parasitic: 3
Luminex xTAG	Unpreserved or Cary-Blair *specimen stability not publicly available	*Hands on time not reported publicly	Multi-step	96 well plate; 5 hour total time; 1 run in 8 hr	14 Total: 8 bacterial 3 viral 3 parasitic
Nanosphere Verigene	Cary-Blair Stability: 48 hr	5 min	2 hr	1 assay per instrument; each unit: 4 tests in 8 hr	9 Total: 7 bacterial 2 viral

Target	BioFire	BD Max	Luminex	Nanosphere
Aeromonas spp.	✓	Extended Panels (under development)		
Campylobacter (jejuni, coli, upsaliensis)	✓	Bacterial Panel (jejuni and coli only)	✓	✓ (C. jejuni, C. coli, C. lari)
Clostridium difficile (Toxin A/B)	✓		✓	
Fleximonas shigelloides	✓			
Salmonella	✓	Bacterial Panel	✓	✓
Yersinia enterocolitica	✓	Extended Panels (under development)	✓	✓
Vibrio (parahaemolyticus, vulnificus, cholerae)	✓	Extended Panels (under development)		✓
Vibrio cholerae	✓		✓	
Enteropneumovirus E. coli	✓			
Enteropathogenic E. coli	✓			
Enterotoxigenic E. coli	✓		✓	
Shiga-like toxin-producing E. coli (stx-1, Stx-2, E. coli O157)	✓	Bacterial Panel (stx1 and stx2 only)	✓	✓ (stx 1 and 2 only)
Shigella/Enteroinvasive E. coli	✓	Bacterial Panel	✓	✓ (Shigella spp. only)
Cryptosporidium	✓	Parasite Panel (under development)	✓	
Cyclospora cayentensis	✓		✓	
Entamoeba histolytica	✓	Parasite Panel (under development)	✓	
Giardia lamblia	✓	Parasite Panel (under development)	✓	
Adenovirus F40/41	✓	Extended Panels (under development)	✓	
Astrovirus	✓			
Norovirus GI/GII	✓	Extended Panels (under development)	✓	✓
Rotavirus A	✓	Extended Panels (under development)	✓	✓
Sapovirus (J,II,IV, and V)	✓			

Cycle of Infection

- Robert Koch, 1876, germ theory of infection
- Factors (4) involved in the spread of disease:
 - 1) Infectious microorganism (pathogen)
 - 2) Source or reservoir of infection
 - 3) Susceptible host
 - 4) Mode of transmission
 - Contact
 - *Direct – touched with the hands*
 - *Indirect – touching fomites*
 - Droplet
 - Airborne
 - Vehicles
 - Vectors

Clean Kitchen #1 Reusable grocery bags

- ▶ Use **color coded, washable grocery bags** to separate items to prevent cross contamination
- ▶ Wash grocery bags frequently
 - **Immediately** if a "leak" (meats?)
 - Based on use – once a month?

Clean Kitchen #2 Look at the "flow"

- ▶ "Outside" to "Inside"
 - Deliveries (close to the back door) **to** preparation areas (close to the main kitchen/eating area)
- ▶ "Dirty" to "Clean"
 - Original "packaging" (raw meats and seafoods, fresh fruits & vegetables) **to** meal "presentation" (fast food, served meal, buffet, condiment/drink "stations")

Clean Kitchen #3 Use color coded cutting boards (SLU's Food Lab)



Clean Kitchen #4 Bleach vs Vinegar

- ▶ **10% solution**
 - 1 part bleach or vinegar to 9 parts water
 - Spray bottle on kitchen counter
- **Bleach**
 - Dilution must be made every 24 hours
 - Must be washed/rinsed off
 - Harmful to surfaces?
 - Harmful to children & pets
- **Vinegar**
 - Good forever?
 - Does not need to be rinsed off
 - Safe for surfaces (check manufacturer's info)
 - Not harmful to children & pets
 - ****Can be used as a "soak" for food (poultry, vegetables, etc.)**

Hand Awareness

- **Hand awareness**
 - Hands touch approximately 300 surfaces/30 minutes
 - Don't touch the "T-zone"
 - eyes, nose and mouth



Hand Hygiene - Clean Hands!!

- **Handwashing**
 - Soap
 - Antibacterial agents - triclosan (now banned!!!)
- **Hand sanitizers**
 - Alcohol
 - Non-alcohol
 - benzalkonium chloride
- **"Wipes"**
 - Most (?) are benzalkonium chloride

Handwashing

The Centers for Disease Control (CDC) states:

The most effective means of stopping the spread of infectious agents is ...



HANDWASHING

Handwashing - When to Wash

- **When they are visibly dirty**
- **Before and after eating**
- **After going to the bathroom**
- **After blowing your nose, coughing or sneezing**
- **Before and after treating a cut or wound**
- **After handling animals or animal waste**
- **After handling money**

Handwashing-Proper Technique

- **Procedure:**
 - Adequate amount of soap (1) and warm water (2)
 - Rub hands together to create working lather (3)
 - Rinse completely with warm water (2)
 - Dry with a paper towel (4)

(1) Adequate amount of soap

- **How much is “adequate”?**
 - Depends on:
 - what kind of soap used
 - how dirty your hands are
 - “Rule of Thumb” – enough soap to maintain a working lather for as long as you need to wash your hands

(2) Warm water

Well, not necessarily *warm to “hot”*

CDC says cold water works fine!!

40F (4C)– refrigerator temperature

(3) Rub hands together

- **Process**
 - Up to the wrists, front and back of the hands, between the fingers & around the thumbs, under the nails
 - Use a nail brush, if needed
- **For how long?**
 - at least 20 seconds
 - *SING!!*

(4) Dry with a paper towel

- **Additional friction to remove residual oils & germs**
- **Dries hands well!!**
- **Can then be used to turn off the faucet and open the bathroom door**

***Hand Washing –
Triclosan: to use or not to use***

- **American Chemical Society (ACS) – NO!!**
- **Proctor & Gamble (P&G) – No**
- **Listerine – No**
- **Johnson & Johnson/Crest – No**
- **Minnesota – banned!!**
- **Centers for Disease Control (CDC) – not needed as an additive**
- **Food & Drug Administration (FDA) – was a “maybe” for ~40 years, finally changed to “no” effective 2015**

Hand Sanitizer – Alcohol based

- **CDC recommends at least 60% alcohol**
- **Procedure**
 - Adequate amount of hand sanitizer
 - Rub hands together
 - Up to the wrists, front and back of the hands, between the fingers & around the thumbs, under the nails

Guinness World Record

Watch while 2,151 people all use hand sanitizer at the same time!!!

<https://www.youtube.com/watch?v=DTKpOIBUOI8>

Hand Sanitizer– Non–alcohol Benzalkonium Chloride

- More favorable than alcohol (FDA) especially for young children
- Used in *Bactine* for decades – doesn't "sting"

Educational Materials

- Centers for Disease Control CDC
 - "An Ounce of Prevention" (brochure & packet)
 - <http://www.cdc.gov/ounceofprevention/>
- American Society for Microbiology (ASM) & American Cleaning Institute (ACI)
 - "Get a Grip on Handwashing"
 - https://www.cleaninginstitute.org/clean_living/hands_publications.aspx

Get Everyone involved– Make It Fun!!

- Henry the Hand – advocates for "Hand Awareness"
 - <http://www.henrythehand.com/>
- "Tips" – T–zone, Respiratory Etiquette, Sniff Test
- Educational materials – posters, songs, videos
- Events
 - **Global Handwashing Day : October 15**
 - <http://globalhandwashing.org/global-handwashing-day/>
 - CDC site: <http://www.cdc.gov/features/globalhandwashing/>
 - **National Handwashing Awareness Week: December 2–8, 2018**

Share the Information

- Display information in key areas of the institution:
 - Bathrooms
 - Waiting rooms
 - Break room/lounges

Reminder – In the Bathroom Stall



Reminder - On the Bathroom Door



Websites

- ▶ www.cdc.gov - Centers for Disease Control
- ▶ www.who.org - World Health Organization
- ▶ www.dhss.mo.gov - Department of Health and Senior Services (State of Missouri)
- ▶ www.henrythehand.com - Henry the Hand Foundation

Questions??

Thank you!!