Why are we concerned?

Dr. Angela Shaw
Assistant Professor/Extension and Outreach Specialist Food Safety
WHY?: IMPACT FACTOR
Basic Statistics

- 48 million Illnesses
- 127,000 Hospitalizations
- 3,000 Deaths

Table 1: 2011 Estimate of Foodborne Illness Acquired in the United States

<table>
<thead>
<tr>
<th></th>
<th>Illnesses</th>
<th>Hospitalizations</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Pathogens</td>
<td>9,400,000 (20%)</td>
<td>55,961 (44%)</td>
<td>1,351 (44%)</td>
</tr>
<tr>
<td>Unspecified Agents</td>
<td>38,400,000 (80%)</td>
<td>71,878 (56%)</td>
<td>1,686 (56%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>47,800,000</td>
<td>127,839</td>
<td>3,037</td>
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</tbody>
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Headlines

USA Today Early Look
Salmonella Outbreak Update

IOWA STATE UNIVERSITY
Extension and Outreach
Healthy People. Environments. Economies.
Top Five Factors Responsible for Foodborne Illness Outbreak

• Improper hot/cold holding temperature
• Improper cooking temperatures
• Dirty and/or contaminated utensils and equipment
• Poor employee health and hygiene
• Food from unsafe sources

http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5510a1.htm
WHY? GROWTH REQUIREMENTS
What Microorganisms Need to Grow

- Acronym – FAT TOM
  - F – Food
  - A – Acidity
  - T – Temperature
  - T – Time
  - O – Oxygen
  - M – Moisture
Pre-Harvest and Processing
Vegetable

- Vegetables – High Aw
- Neutral pH – except tomatoes
- Various Genera in Natural Flora
  - Environment, Season, Growth Near Soil,
Fruit

- Fruits usually have lower pH than Veg (except melons)
  - Thicker Skin than Veg. and High Aw
- Sources of Natural Flora
  - Air, soil and insects
KEY MICROORGANISMS
Major Pathogens of Concern

- Norovirus
- *Campylobacter*
- *Listeria monocytogenes*
- *Salmonella*
- *Escherichia coli O157* and STEC
- *Clostridium* spp.
- *Shigella*
- Hepatitis A
- *Staphylococcus*
- *Giardia lambia*
Norovirus

- 5,500,000 cases of disease (#1), 15,000 hospitalizations (#2), and 150 deaths (#4)
- Can spread through **food and workers hands**
- Survival
  - Easy to uptake in plants and hard to kill
  - Emerging Threat for Food Microbiologist
  - Research out of North Carolina State University
Campylobacter jejuni

- #1 cause of bacterial foodborne illness in U.S.
- 2.4 million persons every year, or 0.8% of the population
- Survived at 37C in bile
- Feces (3 wks), water (4 wks), and urine (5 wks) held at 4C was able to survive better than 25C
- Freezing to -20C still had remaining population in frozen poultry
**Listeria monocytogenes**

- Onset: 3 to 70 days
- Occurs most frequently in at risk populations
- Ubiquitous in water and soil
- Moist and cold places are its favorite
- 20-30% Fatality Rate
- Survival
  - Ability to adapt to conditions containing acetic acid, lactic acid, citric acid, malic acid and chlorine bleach
  - pH 4.6 at 35C for 1-3 days
  - Cabbage juice at pH 4.1 for 8 days
  - Cottage cheese at pH 5.05 and 5C
Salmonella spp.

- 2,463 serovars: 5 subgroups
- Adaptability is a key characteristic
- Intestinal tract of birds, reptiles, farm animals, humans, and some insects
- Organs of animals: liver, spleen, bile, lymph nodes, feces
- Outbreaks with low Aw products
ESCHERICHIA COLI
Escherichia coli

- Both pathogenic and non-pathogenic serotypes
- Habitat: GI tract of humans and animals
- 5 types of Enterovirulent *E. coli*
  - *Enterotoxigenic*  --  *Enteroinvasive*
  - *Enteropathogenic*
  - *Enteroaggregative*
  - *Enterohemorrhagic*
Enterotoxigenic (ETEC): Travelers Diarrhea

Colonization of Intestinal Wall
Enteropathogenic (EPEC): Infant Diarrhea

On Human RBC

Human intestinal cell

THE COVER OF MICROBIOLOGY AND IN ARTICLE
Enteroinvasive (EIEC)
Enteroaggregative (EAEC): Tropical Countries

Aggregative pattern of adherence
Enterohemorrhagic: Most Publicized
Clostridium Perfringens

- Institutional Feedings
- Implicated foods
  - Food prepared in advanced and then temperature abuse
- Spore Former
  - Spores survive high temperatures and during cooling spores germinate and bacteria grow
  - Bacteria contain the toxin
Clostridium Botulinum

- Low oxygen and high pH foods
- Spores are the key
- Implicated foods -
  - RTE temperature abused meat, baked potatoes, cooked onions, home canned foods, garlic and oil untreated (not acidic)

http://www.sanger.ac.uk/Info/Press/gfx/070523_botulinum_300.jpg
LESSONS LEARNED FROM OUTBREAKS
Direct to Market Outbreaks

• In 2011, *E.coli* O157:H7 linked to strawberries
  – Sold at multiple farm stands, and farmers markets in Oregon
  – 16 people ill, 4 hospitalized, and 2 suffer kidney failure
Direct to Market Outbreaks

• In 2010, *Salmonella* linked to guacamole, salsa, and uncooked tamales
  – Farmers market in east central Iowa
  – 44 people sick and 5 hospitalized
Direct to Market Outbreaks

• In 2000, *E. coli* O157:H7 linked to produce samples offered
  – Farmers market in Fort Collins, CO
  – 14 people ill and 2 children require dialysis
Recalls: Lettuce

- September 2011: Alaska where officials said bags of chopped romaine lettuce
- October 2011: California farm voluntarily recalling bags of chopped romaine lettuce due to possible contamination
- May 2012: Pacific Coast Fruit and River Ranch Fresh Foods in Salinas Valley, California recalled bagged lettuce
Campylobacter in two Raw Milk

1. February 2012 Claravale Farm
   - Distributed in Bay Area to San Diego
   - voluntarily stopped distributing to the many stores that sell its products, which include cream and raw cow and goat milk

2. Your Family Cow dairy in Chambersburg, PA
   - Pennsylvania (70 illnesses), Maryland (5), West Virginia (3), New Jersey (2)
Source of Raw Milk

• Sources was linked to
  – Cow has an infection with *Campylobacter* in her udder
  – Milk is contaminated with manure

• 93 outbreaks from 1998 through 2009 resulting in 1,837 illnesses, 195 hospitalizations and two deaths
Waterborne Outbreak

- 1st outbreak of *Campylobacter jejuni* in a farming community in southern Ontario, Canada, in 1985
- 2nd outbreak in May 2000 *Escherichia coli* O157:H7 and *Campylobacter* occurred in Bruce County, Ontario
  - 116 persons were positive for the organism
  - Contaminated by surface water carrying livestock waste immediately after heavy rains
Cantaloupe: 2011

- 147 persons infected, 30 deaths (Iowa miscarriage) in 28 states
- *L. monocytogenes* was traced back to the grocery store and the ill persons households
- Bought used equipment that was used for washing and drying potato's
- Unsanitary conditions within the packing house and poor farm management
Eggs in Iowa

- May 1\textsuperscript{st} to Nov 30\textsuperscript{th}, 2010
- 3,578 illnesses (1,519 illnesses)
- Wright County Egg and Hillandale Farms in Iowa
- 380 million of their shell eggs are being recalled
- Linked
  - Positive sample in wash water
  - Cross contamination was the cause
  - Unsanitary conditions in the bird houses
Strawberry

• Oregon outbreak
• Illness occurred between July 10\textsuperscript{th} and July 29\textsuperscript{th}, 2011
• 15 people ill: age 4 to 85 (5\% hospitalized)
• Source: deer droppings
Spinach

- *Escherichia coli* O157:H7 outbreak in 26 states
- 199 illnesses; 102 hospitalizations (31 with HUS); 3 death
- Five firms have initiated recalls
- Previously used fields with cattle
Hepatitis A with Green Onions

- November 2003 in Pennsylvania restaurant
- 601 patients identified: 3 died, 124 hospitalized
- Green onions served in mild salsa dip
- Outbreaks with Hepatitis A in 1999, 2000, and 2003 with same sequence cluster
- Linked to either
  - Irrigation water contamination
  - Packing house water contamination
  - Contaminated personnel
Unpasteurized gouda cheese

- Alberta in December of 2002
- 10 cases of *E. coli* O157:H7
  - 77% bloody diarrhea; 42% hospitalized
  - 2 cases of HUS (22 month old and 4 yr. old)
- 3 local farmers markets, specialty stores and restaurants
RECAP
Recap

- Impact Factor
- Growth Needs
- Key Microorganisms
- Lessons from Outbreaks
Final Thoughts

- Simple changes can save lives
- If something is not documented then it never occurred
- If you haven’t tested something then how can you say something is not present
- Not all microorganisms cause illness
- More is not always better (resistance)
QUESTIONS