Strengthening the safety of the food supply: challenges and opportunities

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Salmonella Typhimurium Infection Associated with Raw Milk and Cheese Consumption — Pennsylvania, 2007

ConAgra Shuts Down Pot Pie Plant Over Salmonella Link

Wednesday, October 10, 2007
Associated Press

Sale of Mexican Green Onions Plummet After U.S. Hepatitis Outbreak Traced to Northwestern Mexico
• Three main points
  – Food safety challenges will continue to emerge
  – To predict and prevent new challenges, we must apply modern scientific tools to (i) improve our understanding of food microbial ecology and (ii) track pathogen transmission in food systems
  – We must build a global “food safety system” that enables and rewards electronic data sharing

Food protection is a moving target…
Food system factors that affect the presence and persistence of bacterial pathogens in the food supply

- Expansion of international trade
- Consumer demand for “lightly processed” foods
- Unknown limits for refrigerated perishable foods
- Mass production of foods
- Changes in eating habits

Traditional lines of responsibility for safety of foods of animal origin in the US: our system is fragmented

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Microbial foodborne diseases

• CDC estimates (1999) the following annual burdens due to foodborne diseases in the US:
  – 76 million cases of gastrointestinal illnesses
    • 25 to 30% of population in most developed countries experience a foodborne illness in a given year
  – 325,000 serious illnesses resulting in hospitalizations
  – 5,000 deaths

Mead et al., 1999

Causative agents are not identified for the majority of foodborne illness cases

• Identified bacteria:
  – 4.2 million cases; 1,300 deaths
• Identified parasites:
  – 400,000 cases; 380 deaths
• Identified viruses:
  – 9.3 million cases; 130 deaths

Mead et al., 1999
Foodborne bacterial pathogens

• *Campylobacter*: 2 million cases; 100 deaths
• *Salmonella*: 1.4 million cases; **550 deaths**
• *Listeria monocytogenes*: 2,500 cases, **500 deaths**
• *E. coli* O157:H7: 60,000 cases; 50 deaths
• *E. coli* STEC, non-O157:H7: 31,000; 26 deaths

Mead et al., 1999

Foodborne parasitic pathogens

• *Toxoplasma*: 225,000 cases and 750 deaths (50% of them foodborne)
• *Cryptosporidium*: 300,000 cases and 66 deaths (10% of them foodborne)
• *Giardia*: 2 million cases and 10 deaths (10% of them foodborne)

Mead et al., 1999
Foodborne viral pathogens

• *Norwalk-like viruses*:
  - Total: 23 million cases and 310 deaths
  - Foodborne: 9.2 million cases and 120 deaths

Molecular methods in microbiological food safety

Application of modern tools is essential for:
  - improving our understanding of food microbial ecology
  - tracking movement of pathogens in food systems
Whole cell

Toxins and other Metabolites

Protein/Enzymes

Molecular methods

mRNA

DNA

ELISAs & other antibody-based methods

Bacteria grouped within a species may have as little as 70% genetic identity, but are visually indistinguishable
Examples of different *L. monocytogenes* ribotypes

We can use genetic diversity among bacterial pathogens to our advantage

Application of tools for rapid identification and tracking of bacterial pathogens
Food isolates

- **November 18 and 19:** NYS Dept. of Agriculture and Markets Laboratory isolated *L. monocytogenes* from a food product
- We determined that the genetic “fingerprints” from these bacteria matched those obtained from patients
  - *L. monocytogenes* were from product manufactured by Bil Mar plant in Zeeland, MI

Subtyping of human isolates - summary

- 101 human cases and 21 deaths in 22 US states linked to infection by the same sub-type of *Listeria monocytogenes*
A second outbreak?

- Connecticut DOH observed increase in human listeriosis cases above the typical baseline which was not attributable to bacteria with the same genetic “fingerprint”
- Significant number of cases were of Polish/Eastern European ethnicity
- Infection with this strain was linked to consumption of an imported Polish cheese

- Identification of sources of contamination in food systems to reduce the incidence of contaminated foods entering the marketplace
  - e.g., Hispanic-style cheese manufacturers; smoked seafood industry
- Improve our overall understanding of the microbial ecology of food systems
  - e.g., identify the presence of potential pathogens associated with commodities BEFORE they become a problem
To prevent and control foodborne outbreaks

- Data on pathogen prevalence, and specifically on the bacterial strains present in commodities, must be shared within industry and among industry and regulatory agencies responsible for protecting the public.
- Data sharing will require development and use of compatible electronic databases (e.g., PulseNet).

- Foodborne disease burdens around the globe cause considerable human suffering.
- Molecular tools help control and reduce foodborne diseases.
- Prevention and control of contamination is needed systematically, throughout the food continuum:
  - On the farm
  - Processing and retail
  - Consumer homes
  - Regulatory agency surveillance.