Food Safety Risk Management

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Discussion Overview

- Food safety trends and data
- Need risk management focus
  - Risk based preventive controls
  - Effective risk communication
- Collaboration needed for success
Basic Needs for Human Survival

- Shelter
- Water
- Food
Foodborne Illness Estimates

United States
- 48 million cases
- 120,000 hospitalizations
- 3000 deaths

EU
- 45.5 million cases

China/Asia
- Surveillance beginning

Global (food and water)
- 1 billion cases
- 2.2 million deaths

Australia
- 5.4 million cases
- 120 deaths
## US FoodNet Estimates of Foodborne Illness
### 1996 to 2011

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>2011 Illness/100,000</th>
<th>Change since</th>
<th>2020 National health objective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pathogen</strong></td>
<td>2011 Illness/100,000</td>
<td>Change since</td>
<td>2020 National health objective</td>
</tr>
<tr>
<td><strong>Salmonella</strong></td>
<td>16.47</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Campylobacter</strong></td>
<td>14.31</td>
<td>22% ↓</td>
<td>14% ↑</td>
</tr>
<tr>
<td><strong>Shigella</strong></td>
<td>3.21</td>
<td>65% ↓</td>
<td>43% ↓</td>
</tr>
<tr>
<td><strong>Cryptosporidium</strong></td>
<td>2.83</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td><strong>E. coli O157</strong></td>
<td>0.98</td>
<td>42% ↓</td>
<td>25% ↓</td>
</tr>
<tr>
<td><strong>STEC non-O157</strong></td>
<td>1.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Vibrio</strong></td>
<td>0.33</td>
<td>76% ↑</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Listeria monocytogenes</strong></td>
<td>0.28</td>
<td>35% ↓</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Yersinia</strong></td>
<td>0.34</td>
<td>52% ↓</td>
<td>NS</td>
</tr>
</tbody>
</table>

Factors affecting food safety risks

- Improved detection & reporting identifies problems
- Broad distribution magnifies problems
- International sourcing complicates control
- Baby-boomer aging increases population sensitivity
- Consumption patterns changing
Risk Considerations
Risk Considerations

Risk is a function of:
- The hazard, including severity
- Probability of exposure

Varying types of risk
- Food safety risk
- Spoilage risk
- Economic risk
- Regulatory risk
- Perceived risk
Food Safety Solutions
REQUIRE INTERVENTIONS AT MULTIPLE SITES

Agricultural Production

Processing

Food Service

Retail

Home
Emerging Food Safety Management Concept

Food Safety Objectives (FSO)

- The maximum frequency and/or concentration of a hazard in a food at the time of consumption that provides or contributes to the appropriate level of protection (ALOP).
  - Codex Alimentarius

- Establishing a FSO is the responsibility of governments
  - The principles can be used by industry to establish controls

- Define how safe is safe

- Are limits, not targets

- Can be translated into performance criteria after considering process variation

ICMSF MODEL
Emerging Food Safety Management Concept

Performance Objectives (PO)

- Performance Objective (PO), which is equivalent to FSO, specifying hazard levels that are tolerable, but are set at one or more specific steps earlier in the food chain.

- POs are linked to the FSO and, when proposed by governments, can be viewed as a kind of milestones that governments provide as guidance in order to help meet the FSO.

- However, POs can also be decided on by operational food safety managers as an integral part of the design of the production of a food in a supply chain.
Given a Food Safety Objective…

- Industry can design processes to meet the FSO or PO
- Regulators can verify compliance with the FSO or PO
- The effectiveness of performance or process standards can be evaluated
- The equivalence of approaches can be evaluated, which is important for international trade
Establishing an FSO

1. Identify a need for improved hazard control
2. Conduct risk assessment (qualitative or quantitative)
3. Articulate public health goal or Appropriate Level of Risk (ALOP)
4. Calculate level of exposure that would achieve goal (FSO)
5. Evaluate the FSO for feasibility
6. Implement control systems that achieve the FSO
2. Conduct a risk assessment

**U.S.A.**
- *Salmonella* Enteritidis: eggs (USDA 1998)
- *Vibrio parahaemolyticus*: raw shellfish (FDA 2001)
- *Escherichia coli* O157:H7 (USDA/FDA 2001)

**FAO/WHO Expert Panels**
- *L. monocytogenes*: RTE foods
- *Salmonella* Enteritidis: Eggs and egg products
- *Salmonella*: Broilers
- *Vibrio*: Shellfish
- *Campylobacter*: Broilers

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3. Articulate a Public Health Goal (ALOP)

Appropriate Level of Protection (ALOP) concept introduced by World Trade Organization SPS agreement

- “Level of protection deemed appropriate by the member [country] establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within a territory”

- “Healthy People 2020” report is an US example
Public Health Goals: Healthy People 2020

FS1 Reduce infections by key pathogens commonly transmitted through food

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Baseline (cases/100,000)</th>
<th>Target (cases/100,000)</th>
<th>Target-setting Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em> O157:H7</td>
<td>1.2</td>
<td>0.6</td>
<td>50%↓</td>
</tr>
<tr>
<td>HUS in children &lt;5</td>
<td>1.8</td>
<td>0.9</td>
<td>50%↓</td>
</tr>
<tr>
<td><em>Campylobacter</em></td>
<td>12.7</td>
<td>8.5</td>
<td>33%↓</td>
</tr>
<tr>
<td><em>L. monocytogenes</em></td>
<td>0.3</td>
<td>0.2</td>
<td>25%↓</td>
</tr>
<tr>
<td><em>Salmonella</em></td>
<td>15.2</td>
<td>11.4</td>
<td>25%↓</td>
</tr>
<tr>
<td><em>Vibrio</em></td>
<td>0.3</td>
<td>0.2</td>
<td>25%↓</td>
</tr>
<tr>
<td><em>Yersinia</em></td>
<td>0.4</td>
<td>0.3</td>
<td>25%↓</td>
</tr>
</tbody>
</table>
4. Calculate level that will achieve goal (FSO)

- Food operators cannot effectively respond to an ALOP in terms of “number of cases per year” or “probability of disease”

- Regulatory authorities cannot use an ALOP to evaluate a food operation for compliance

- Food Safety Objectives can be a bridge between an ALOP and performance/process criteria
5. Evaluate the FSO for feasibility

To avoid undue societal costs, feasibility must be addressed
Poultry Supply Chain Example

Performance objective

PO

primary production

PO

manufacturing

PO

transport

PO

retail

PO

preparation

PO

consumption

Exposure

Public health burden

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Food Safety Objective

FSO
Sanitizer Evolution – Food Treatments

US *Salmonella* Prevalence in Broilers
- “Persistent upward trend in positive verification samples provides reason for concern”
- FSIS, 2006
Typical Chicken Process Flow

- Receiving → Killing → Bleeding
- Washing → Defeathering → Scalding
- Eviscerating → Washing
- Washing
- Off Line Reprocessing
- Shipping → Packaging → Chilling
Chicken Process Flow – Antimicrobial Enhancements

1. Receiving
2. Washing
3. Defeathering
4. Scalding
5. Killing
6. Bleeding
7. Eviscerating
8. Inside/Outside Bird Wash
9. On Line Reprocessing
10. Shipping
11. Packaging
12. Post-Chill Dip
13. Antimicrobial Chilling
Incoming Birds
Scalding
Defeathering
Evisceration
Major Antimicrobial Treatments

- Hypochlorite
- Tri sodium phosphate (TSP)
- Chlorine dioxide ($\text{ClO}_2$)
- Peracid treatments
- Acidified sodium chlorite (ASC)
- Cetylpyridinium chloride (CPC)
Inside/Outside Bird Washer (IOBW)
ASC Poultry Spray Cabinet
ASC Poultry Carcass Spray System
Post Chill Dip Tank
# Antimicrobial Treatments Application

<table>
<thead>
<tr>
<th>Process step</th>
<th>Chemical treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside-outside bird wash</td>
<td>Typically chlorine</td>
</tr>
<tr>
<td>On-line reprocessing</td>
<td>Peracid, ASC, TSP, ClO₂, CPC</td>
</tr>
<tr>
<td>Chiller</td>
<td>Chlorine, peracid, ClO₂</td>
</tr>
<tr>
<td>Post-chill spray or dip</td>
<td>ASC, ClO₂</td>
</tr>
</tbody>
</table>
Poultry Plant *Salmonella* Interventions

![Graph showing *Salmonella* spp. Prevalence (%) from incoming and post-chill samples for various interventions.](image)

- **ASC Post-Chill Dip + Peracid in Chiller**
- **Peracid in Chiller**
- **CPC Pre-chill Spray**
- **CPC Pre-chill OLR**
- **ASC Pre-chill Spray OLR**
- **Bromitize System OLR**
- **TSP OLR**
- **CIO2 OLR**

*Adapted from: Danilson. 2005. US Poultry & Agr Assoc, Salmonella Control Conference, March 17, 2005*
Multi-hurdle antimicrobial treatment

*Salmonella* prevalence

<table>
<thead>
<tr>
<th></th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before ASC spray</td>
<td>60</td>
</tr>
<tr>
<td>After ASC spray</td>
<td>40</td>
</tr>
<tr>
<td>After peracid chiller</td>
<td>15</td>
</tr>
<tr>
<td>After ASC dip</td>
<td>5</td>
</tr>
</tbody>
</table>

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Reductions in *Salmonella* achieved

- Prevalence of *Salmonella* on raw poultry products has been significantly reduced

- Why?
  - Performance standards were implemented
  - Effective controls put in place
Yet, *Salmonella* still causes illnesses?
Need Collaborative Approach to Continue to Achieve Food Safety

- What other factors contribute to risk?
  - Broad distribution
  - Environmental harborage
  - Aging population
  - Shelf life extension
  - Run time extension

- Apply FSO/PO concept more broadly
Poultry Supply Chain Example

Performance objective

PO

primary production

PO

manufacturing

PO

transport

PO

retail

PO

preparation

PO

consumption

Food Safety Objective

FSO

Exposure

Public health burden

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Where Was Contaminated Food Consumed?

WHEN LOCATION IS KNOWN

USA 2010

- Restaurant or deli: 44%
- Private home: 20%
- Workplace, office, not cafeteria: 8%
- Banquet facility: 7%
- School: 3%
- Church, temple, etc: 3%
- Caterer: 2%
- Prison, jail: 2%
- Other*: 11%

Source: CDC 2012 http://www.cdc.gov/foodborneoutbreaks/
Contributing Factors to Restaurant Outbreaks
USA 2002-03

- Handling by infected person
- Bare hand contact
- X-contamination from raw ingredient
- Food at room temp. for several hours
- Raw product or ingr of animal origin
- Preparing food >12hr in advance
- Gloved-hand contact
- Inadequate cleaning of equipment

Contamination
Growth
Survival (all <5%)

Percent of Outbreaks

Hedberg et al. 2006 JFP 69:2697
Multiple Interventions
FOODSERVICE AND RETAIL

Facility and Equipment Hygiene

Personal Hygiene [Compliance]

Pest Elimination

Supplier GFSI Training

Health Department Intelligence (HDI\textsuperscript{SM})

Audits/Assessments

Food Tissue Treatment

Equipment Maintenance

Color Coded Equipment

Date Labels

Temperature Monitoring Training

Sample Collection
Parting thoughts…

- Foodborne illness happens
- Traditional hazards continue & new hazards emerge
- Stay aware of changes in society that can impact illness
- Need to respond quickly and effectively with considerations across the whole food supply chain
- Must have effective risk communication and share responsibility
Questions?

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Because what we do - and how we do it - matters everywhere.