Public Health Impact of Food Safety Control Programs: Process Indicators, Microbiologic Testing, and Disease Surveillance

Preventing Foodborne Disease

- Identify relevant foodborne hazards
- Locate points of introduction and control
- Establish control measures necessary to achieve desired level of safety
- Monitor food management system to assure control measures are in place
- Conduct surveillance of human illnesses to measure progress toward public health objectives
Why We Evaluate

- Make certain we are protecting the public
  - Effectively
  - Efficiently
- Obtain program resources
- Support or change program priorities
- Reassure staff and stakeholders that efforts are working

Evaluating the Effectiveness of Food Safety Programs

Food and non-food sources of hazards
- Multiple points of foodborne hazard introduction
- Multiple points of intervention
- Concurrent risk reduction procedures
Public Health Impact of Food Safety Control Program

• Where are we now?
  – Monitoring of products
  – Surveillance of disease
  – Investigation of outbreaks

• ALOP--Where do we want to be?
  – Healthy People 2010
  – Other foodborne disease prevention objectives

• Are we making progress, and is it because of the food safety system?

Elements of a Food Safety Control Program

Inputs

- staff
- funding
- laboratory resources
- performance criteria
- policies
- regulations

Activities

- monitoring
- surveillance
- physical measurements
- laboratory testing

Outputs

- frequency & level of contamination
- achievement of time & temperature parameters

Outcome

- public health impact described as frequency of cases & outbreaks due to food
Evaluating a Food Safety Control Program for Fruit Juice

- Process output indicator = % plants correctly applying 5 log reduction process
- Process output indicator = % samples that do not contain > 1 cfu Eco157 or Salmonella per 100 ml

Problem identification and options assessment → Regulation and industry application

Public health surveillance to determine incidence of Eco157 and Salmonella infections
Studies to determine proportion of disease that is attributable to juice

Potential public health outcome indicators:
- Trend in juice-associated incidence of infections in FoodNet sites
- Trend in number of outbreaks of treated/untreated juice-associated infections

Annual Incidence of Listeriosis, United States

Incidence per Million Population

Year: 1985-2004
Reported Juice-Associated Outbreaks by Type of Fruit, United States, 1995 - 2004

Juice HACCP Reg.

Juice Labeling Reg.

Year


Apple juice or cider
Orange juice
Lemonade
Other fruit juice

Prevention Effectiveness Assessment of a Food Safety System Based on Temperature Control to Prevent Scombrotoxin Illness in Consumers

Process Output Indicators

Outcome Indicators

Harvest
Commercial
- Track method of capture, time from death to cooling, method of cooling, time from landing on board to internal temperature ≤ 4°C
- % fish within seafood HACCP time/temperature guidance
- % lots containing fish with > 50 ppm histamine

Transport
- Monitor time/temperature conditions at off-loading
- % lots containing fish outside seafood HACCP time/temperature guidance

Home Use
- Monitor time/temperature conditions during freezing, butchering, packing, and storage
- % lots within seafood HACCP guidance

Fresh Processing
- Monitor time/temperature conditions during thawing, butchering, packing, and storage
- % lots within seafood HACCP guidance

Retail
- Surveys of firms in compliance with Food Code time/temperature provisions
- % markets in compliance
- % food service establishments in compliance

Track histamine intoxications reported to national foodborne disease outbreak surveillance system
- ER-based active surveillance for histamine intoxications with local health department follow-up to determine source of intoxication and, if seafood, conditions of seafood handling and commercial vs. recreational source

Jazmin Vojdani, IAFP 2005
Prevention Effectiveness Assessment of the Egg Safety Program Based on Prevention of SE Outbreaks and Sporadic Cases

**Process Output Indicators**

- Egg Production
  - Farm practice surveys
    - % and characteristics with control program with environmental micro testing
    - % and characteristics with control program without environmental micro testing
    - % and characteristics not enrolled in recognized control program

- Commercial food service
  - Compliance with requirements for
    - wash water sanitation and temperature
    - post-wash egg cooling
    - proper use of safe handling labels

- Retail sale
  - Compliance with Food Code provisions on safe egg handling practices in commercial food service establishments

- Home use
  - Surveys of use of pasteurized egg and egg safety practices in the home

**Outcome Indicators**

- SE outbreak surveillance
  - % egg-associated OOs and cases traced to 3 categories of producers
  - % egg-associated OOs and cases traced to commercial food service by egg source, temperature control, and improper pooling
  - % egg-associated OOs and cases traced to home use

- Active population-based surveillance for general population trends

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**Evaluation Based on Co-variation**

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- policies
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**Activities**
- monitoring
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- physical measurements
- laboratory testing

**Outputs**
- frequency & level of contamination
- achievement of time & temperature parameters

**Outcome**
- public health impact described as frequency of cases & outbreaks due to food
Study Design and Evaluation: Co-variation and Causality

• Experimental: analysis of data from random assignment of subjects to risk groups
• Observational: inferences drawn from uncontrolled data
• Quasi-experimental: comparisons of groups with and without intervention in place
Study Design and Evaluation: Co-variation and Causality

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Study Design and Evaluation

Food Safety Control Test Group
Sample 1 → Sample 2 → Food Safety Control → Sample 3 → Sample 4

Food Safety Control Comparison Group
Sample 1 → Sample 2 → Sample 3 → Sample 4

Time
Evaluating the Effectiveness of Food Safety Programs

- Phylogenetic relatedness
  - Food isolates
  - Clinical isolates
- Distinguish illnesses related to specific foods or processes

Quasi-Experimental Studies

- Pre-test/post-test comparison group design
  - Pre-intervention baseline
  - Foods and consumers otherwise comparable in populations with/without intervention
- Industries can compare process outputs of lines with/without intervention to evaluate performance
- Governments can invest in systematic data collection before and after regulatory change and use comparison groups to attribute disease to specific foods/processes
- Better data will make more convincing evaluations
Evaluating the Effectiveness of Food Safety Programs

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- staff
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**Activities**
- monitoring
- surveillance
- physical measurements
- laboratory testing

**Outputs**
- frequency & level of contamination
- achievement of time & temperature parameters

**Outcomes**
- public health impact = frequency of cases & outbreaks due to food

**Conclusions**

Establish datasets on important variables
Track control program activities and outputs
Track public health outcomes
Look for co-variation in trends
Conclusions

Evaluating the Effectiveness of Food Safety Programs

Food and non-food sources of hazards
Multiple points of introduction and intervention
Concurrent risk reduction procedures

Active surveillance and enhanced food attribution
Measurements before and after application
Comparisons to foods produced without program
Microbial/epidemiologic categorization
Why We Evaluate

“... The gods condemned Sisyphus to endlessly roll a rock up a hill, whence it would return each time to its starting place. They thought, with some reason, that there was no punishment more severe than eternally futile labor....”

*The Myth of Sisyphus*