



Attribution

February 5, 2008

Curtis Travis, PhD
Science Applications International Corporation

NACMPI February 5-6, 2008



Foodborne Disease Attribution

- Attribution = Pathogen-specific percent contribution of specific food items to human disease
- Examples
 - 63 percent of *Lm* illnesses attributable to RTE foods
 - 34 percent of *E. coli* O157 illnesses attributable to ground beef



Approaches to Attribution

- Risk Assessments
 - Generally focuses on single product or process
- Expert Elicitation
 - Based on perception, not verifiable data
 - Often the best source for guidance when other data are sparse
- Disease Outbreak Data
 - Real illnesses data, but does not include sporadic illnesses
- Serotypes
 - Not well developed for use in attribution

Expert Elicitations

- **FSIS Expert Elicitation**
 - 17 experts equally divided among the public health community, industry, and academic institutions
 - Only FSIS food products
- **RFF Expert Elicitation**
 - 42 food safety experts
 - FDA plus FSIS food products



FSIS Expert Elicitation Attribution (%)

Product Type	Salmonella	E. coli	LM
Raw ground chicken	8.9	0.4	1.3
Raw ground turkey	6.8	0.3	1.2
Raw ground poultry, not C or T	2.8	0.4	0.9
Raw ground beef	8.4	57	1.9
Raw intact chicken	22.0	1.1	1.3
Raw intact turkey	14.1	0.3	0.8
Raw intact poultry, not C or T	3.7	0.7	1.4
Raw otherwise processed poultry	5.6	0.6	1.4
Raw ground meat, not beef or pork	2.7	13.8	0.8
Raw otherwise processed meat	3.5	2.9	1.5
Raw ground pork	4.3	1.4	0.9
Raw intact beef	4.6	8.4	1.4
Raw intact meat, not beef or pork	2.2	2.6	0.4
Raw intact pork	2.8	1.3	0.6
RTE acidified/fermented poultry	1.6	0.3	4.4
RTE acidified/fermented meat	1.0	4.2	6.4
RTE fully cooked poultry	1.0	0.2	25.0
RTE salt-cured poultry	0.6	0.2	4.0
RTE salt-cured meat	0.5	0.8	3.6
RTE dried meat	0.9	1.3	3.2
RTE dried poultry	1.0	0.2	3.2
RTE fully cooked meat	0.5	1.1	30.2
RTE cooked meat, no expo environ	0.3	0.3	2.1
RTE cooked poultry, no exposure environment	0.3	0.3	2.0
Commercially sterile	0.0	0.0	0.1



RFF Expert Elicitation Attribution (%)

Food Type	<i>Salmonella</i>	<i>E. coli</i> O157:H7	Lm
Beef	10.9	67.9	1.6
Poultry	35.1	0.9	2.7
Pork	5.7	0.6	1.3
Deli meats	1.9	1.8	54
Eggs	21.8	0.03	0.3
Seafood	2.0	0.05	7.1
Produce	11.7	18.4	8.7
Breads	0.03	0	0.2
Dairy	7.3	4.0	23.6
Beverages	1.7	3.2	0.2
Wild game	1.6	3.2	0.3

Comparison of Two Expert Elicitations

Finished Product Type	<i>Salmonella</i>		<i>E. coli</i> O157:H7		<i>Lm</i>	
	FSIS	RFF	FSIS	RFF	FSIS	RFF
Meat	21.4	20.4	84.7	95.5	6.0	2.7
Poultry	63.1	65.5	3.8	1.2	8.3	4.5
Pork	7.1	10.6	2.7	0.8	1.5	2.2
Deli meats	7.7	3.5	8.9	2.5	84.2	90.6



Outbreak Database Center for Science in the Public Interest (CSPI)

- Data for the years 1990-2004 covering 5,000 outbreaks
- Includes CDC outbreak data
- Additional data from state health departments, peer-reviewed medical journals, and verified media reports



CSPI Attribution (%)

	<i>E. coli</i>	<i>Salmonella</i>	<i>Lm</i>
Beef	54.2	5.8	
Poultry	1.9	15.6	
Deli Meats	2.5	3.6	63.4
Pork		5.4	
FSIS Total	58.7	30.4	63.4
Seafood	6.4	2.6	
Produce	14.4	18.5	
Eggs	0.2	25.8	
Dairy	4.6	6.4	28.3
Breads	0.7	3.2	
Game	0.3		
Multi-ingredient	11.7	11.5	8.5
Beverages	2.8	1.5	
FDA Total	41.3	69.6	36.6



Comparison of Three Studies

Finished Product Type	<i>Salmonella</i>			<i>E. coli</i> O157:H7			<i>Lm</i>		
	FSIS	RFF	CSPI	FSIS	RFF	CSPI	FSIS	RFF	CSPI
Beef	21.4	20.4	19.2	84.7	95.5	92.7	6.0	2.7	0.0
Poultry	63.9	65.5	51.2	3.8	1.2	3.2	8.3	4.5	0.0
Pork	7.1	10.6	17.8	2.7	0.08	0.0	1.5	2.2	0.0
Deli meats	7.7	3.5	11.8	8.9	2.5	4.1	84.2	90.6	100

Attribution Application: FSIS Performance Objectives

- Goal: Relate FSIS performance objectives to CDC public health goals

CDC 2010 Healthy People Objectives

Pathogen	Cases per 100,000	
	1997 Baseline	2010 Target
<i>Campylobacter</i>	24.6	12.3
<i>E. coli</i> O157:H7	2.1	1.0
<i>Lm</i>	0.47	0.24*
<i>Salmonella</i>	13.7	6.8

* By executive order 0.25 was to be met by 2005



Outline of Approach

- FSIS performance objective =
CDC 2010 Health People Goal x fraction
of illness attributable to FSIS product
category



Health-Based Performance Objectives: Examples

- Health-based performance objective for *Salmonella* on broilers = 6.8 case/100,000 x 0.10 attributable to broilers = 0.68 cases/100,000
- Health-based performance objective for *E. coli* O157:H7 in ground beef = 1.0 case/100,000 x 0.34 attributable to ground beef = 0.34 cases/100,000
- Health-based performance objective for *Listeria monocytogenes* in deli meats = 0.24 case/100,000 x 0.57 attributable to deli meats = 0.14 cases/100,000.



Conclusion on Attribution

- Best estimates of attribution come from one combined approach
- Two expert elicitations and one outbreak database produce similar estimates of attribution
- Attribution can be used to link FSIS performance objectives with CDC public health goals