Expert Elicitation and Its Role in RBI

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It's use:

For ranking the relative public health risk of FSIS inspected products

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Goal of Risk Based Inspection

- To allocate FSIS resources in a manner that best protects public health
  - Estimations of the contribution of a particular food to a subsequent human illness is difficult
  - There are several ways to attribute food to illness; each has its own strengths and caveats

Methods for Attribution

- Three different methods for illness attribution.
  - Expert elicitation
  - Predictive models
  - Epidemiological data analysis
- By comparing the results of multiple methods FSIS can improve the final rankings.

Please Note:: Many of the following ideas were summarized by the [illegible]ood attribution working group and published in Emerging Infectious Diseases, Michael [illegible]tz, Michael P. Doyle, J. Glenn Morris, Jr., John Painter, Ruby Singh, Robert V. Tauxe, [illegible]ael R. Taylor, and Danilo M.A. Lo Fo Wong, for the Food Attribution Working Group

Expert Elicitations

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FSIS recently conducted two independent expert elicitations to define the relative risks posed to public health by processed meat and poultry products

- Two elicitations:
  - One with 22 experts and the other with 12 experts from industry, academia and public health sector
  - Both generally defined 24 meat and poultry product categories
  - Both ranked these foods to relative risk to public health
- Strengths
  - Can be performed even when there is little available data
  - Can help to resolve discrepancies between other methods
- Caveats:
  - Judgment based
  - May be less objective than data driven decisions

Predictive Models

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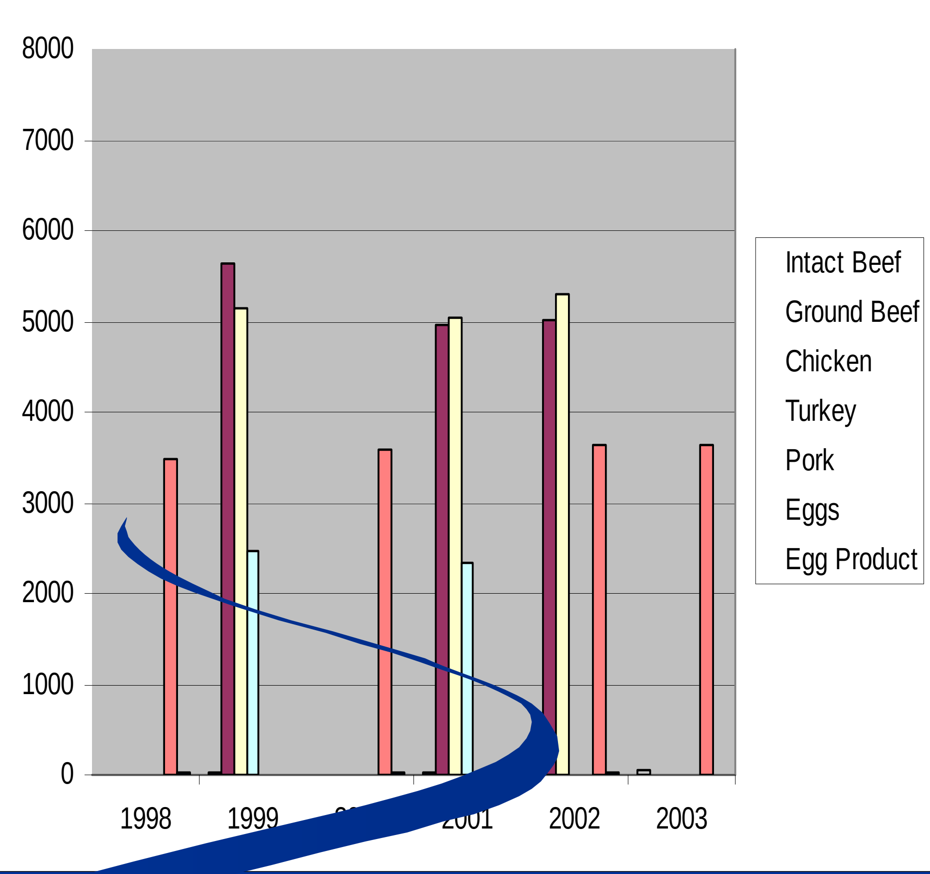
- Estimate the public health risk of a food based on a variety of data inputs. By estimating illnesses attributed to each product a ranking of FSIS foods can be determined.
  - FSIS has developed predictive models to estimate the number of illnesses attributed to meat, poultry, egg products (including raw and ready-to-eat products).
- Strengths:
  - Objective
  - Based on observable data
  - Can help identify data needs
- Caveats:
  - Reliance on human dose-response curves or surveillance data can create uncertainty in predictions of human illness
  - Modeling post production mitigations (i.e. consumer handling and cooking) is complex

Predictive Models: Molecular Subtype Data

- Molecular markers for microbial source tracking
  - PFGE, serotypes, subtypes, phage types, and genotype assays
- Denmark *Salmonella* process
  - A working model for how *salmonella* serotypes are used to attribute salmonellosis to particular foods
- Caveats:
  - Some cases of salmonellosis do not have a serotype or subtype strongly associated with a single food or species of source animal

Predictive Models:
Estimated Human Salmonellosis Cases from Meat, Poultry, and Eggs, 1998-2003*

- Human case data, by serotype
  - CDC Public Health Laboratory Information System, 1998 – 2003
- Food prevalence data, by serotype
  - FSIS in-plant samples of beef, ground beef, chicken, turkey, pork, and processed egg products, 1998 – 2003
  - Pennsylvania Pilot Project samples of shell eggs, ca. 1995
- Food consumption data
  - USDA Economic Research Service, 1998 – 2003



Approximately 28,000 to 30,000 culture-confirmed salmonellosis cases per year, 1998-2003

Attribution of the Predicted Median Cases of Listeriosis for US Population on per Serving and per Annum Basis

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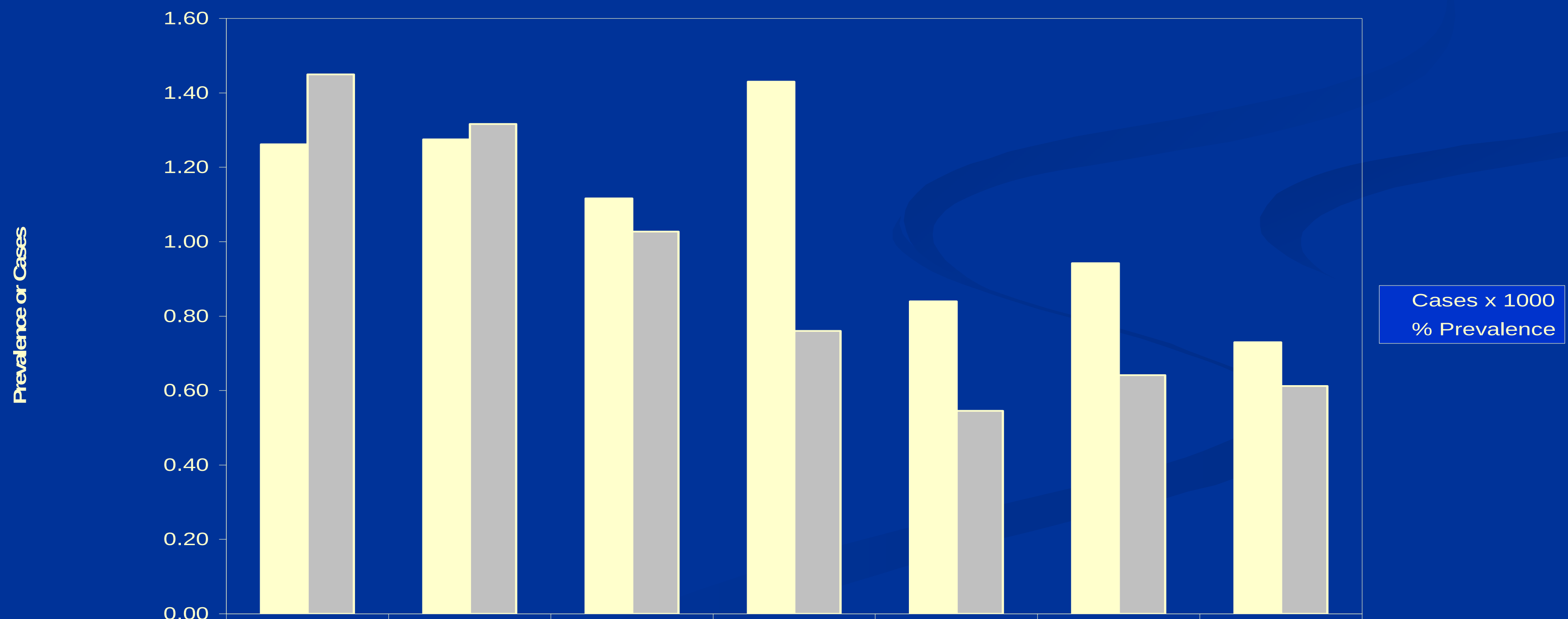
Relative Risk Ranking	Predicted Median Cases of Listeriosis for 23 Food Categories					
	Per Serving Basis[a]			Per Annum Basis[b]		
		Food	Cases		Food	Cases
1	High Risk	Deli Meats	7.7×10^{-8}	Very High	Deli Meats	1598.7
2	High Risk	Frankfurters, not reheated	6.5×10^{-8}	High Risk	Pasteurized Fluid Milk	90.8
3	High Risk	Pâté and Meat Spreads	3.2×10^{-8}	High Risk	High Fat and Other Dairy Products	56.4
4	High Risk	Unpasteurized Fluid Milk	7.1×10^{-9}	High Risk	Frankfurters, not reheated	30.5
5	High Risk	Smoked Seafood	6.2×10^{-9}	Moderate Risk	Soft Unripened Cheese	7.7
6	High Risk	Cooked Ready-to-Eat Crustaceans	5.1×10^{-9}	Moderate Risk	Pâté and Meat Spreads	3.8
7	Moderate Risk	High Fat and Other Dairy Products	2.7×10^{-9}	Moderate Risk	Unpasteurized Fluid Milk	3.1
8	Moderate Risk	Soft Unripened Cheese	1.8×10^{-9}	Moderate Risk	Cooked Ready-to-Eat Crustaceans	2.8
9	Moderate Risk	Pasteurized Fluid Milk	1.0×10^{-9}	Moderate Risk	Smoked Seafood	1.3

Predictive Models:

The Lm model predicts which RTE establishments are likely to produce contaminated product based on prevalence in FSIS testing

- Factors in volume production, product risk, plant sanitation practices, and historical culture results from product, food contact surfaces, and the production environment
- Model is updated on a monthly basis using current culture results and ranks all eligible RTE establishments according to Lm risk for the purpose of sample allocation
- Model can be used to predict the total number of illnesses expected annually for each level of sanitation



	2000	2001	2002	2003	2004	2005	2006
Cases x 1000	1.262	1.275	1.116	1.430	0.840	0.942	0.730
% Prevalence	1.450	1.316	1.027	0.760	0.545	0.641	0.612

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Epidemiological Data Analysis

- Uses actual human illness events clinically diagnosed and attributed to a food vehicle by epidemiological evidence
  - Foodborne Outbreak Reporting System (eFORS)
  - CDC FoodNet (active surveillance of foodborne illness)
- Strengths:
  - Objective
  - Based on observed human illnesses
- Caveats:
  - Foodborne illness grossly under diagnosed
    - Uncertainty about the coefficients used to compensate
  - Interviews, surveys, and case control studies used to attribute clinical cases to foods rely on human reporting and can be "anecdotal"
  - Data sets tend to be small. (see first caveat).

Epidemiological Data Analysis:

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Estimating illnesses due to young chickens using epidemiological data from the United States 2003

Step	Input	*Salmonella*	*Campylobacter*	Data Source
1	Incidence	14.4/100,00	12.6/100,000	FoodNet Annual Report for 2003[6]
2	Population estimate 2003	290,788,976	290,788,976	US Census Bureau[16]
3	Underreporting multiplier	38	38	Mead et al.[7]
4	Foodborne fraction	0.95	0.80	Mead et al.[7]
5	Poultry attribution fraction	0.3351	0.6936	Food Safety Research Consortium[17;18]
6	Young poultry fraction	0.838	0.838	ERS[19]
7	Total illnesses	1,591,197	1,392,297	Step = (1)(2)(3)
8	Total foodborne illnesses	1,511,637	1,113,838	Step = (4)(7)
9	Total foodborne illnesses from poultry	498,840	772,558	Step = (5)(8)
10.	Total foodborne illnesses from young chickens	424,389	647,251	Step = (6)(9)
11.	Costs per illness	$1800	$610	ERS[19]
12.	Total Cost of illnesses from product and pathogen	$759 million	$390 million	Step = (10)(11)

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Summary: Current Status

- In the immediate future, FSIS intends to base estimates of food item inherent risk on the results of the first expert elicitation
  - The risk rankings in RBI are currently based on the results of two expert elicitations with close agreement

- FSIS will continue to combine expert rankings with other information (e.g., volume) to arrive at an overall establishment's inherent risk

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Summary: FSIS Next Steps

- FSIS will continue to assess expert elicitation results with current knowledge from epidemiological studies and predictive modeling via risk assessments regarding attribution of foodborne disease risk
  - FSIS is further assessing whether/how to collapse/expand the 24 food categories from the expert elicitations into categories more closely informed by other work (e.g., the Center for Science in the Public Interest outbreak groupings)

Summary: FSIS Next Steps (continued)

- FSIS will assess the use of epidemiological data to incorporate severity of illness
- FSIS will evaluate methods to incorporate cost of illness into expert risk rankings
- FSIS will conduct sensitivity analyses to ensure appropriate weights are given to components of RBI, including the expert risk rankings
- FSIS will update the algorithm, its components, and the expert risk rankings, as appropriate (e.g., to incorporate emerging pathogens, as warranted)
- FSIS will maintain ongoing communication with all stakeholders, state and local partners in order to maintain a shared understanding of attribution