# Attributing Illness to Disaggregated Food Categories Using Expert Opinion and Consumption Data

Methods for Research Synthesis: A Cross-Disciplinary Approach

October 3-4, 2013

# Motivation

- Regulators make decisions about how to target scarce inspection resources
- Need to understand prior to consumer or food service handling the likelihood that a food
  - Is contaminated and
  - Will cause illness
- Available data is very limited
  - Most data are from outbreak investigations
    - Non-representative
    - Biased toward large outbreaks, short incubation periods, and more serious illnesses

# Task Objectives

- Utilize expert elicitation to:
  - Develop disaggregated food categories into smaller homogeneous groups with respect to microbiological contamination likelihood
  - Generate estimates of % of FBI attributable to contamination that occurs before the product reaches the store shelf (excluding contamination resulting from inappropriate handling at retail and/or the home
- Calculate attribution rates for each disaggregated food category and pathogen pair using
  - Expert opinion data collected, AND
  - Consumption data

# Why Expert Elicitation?

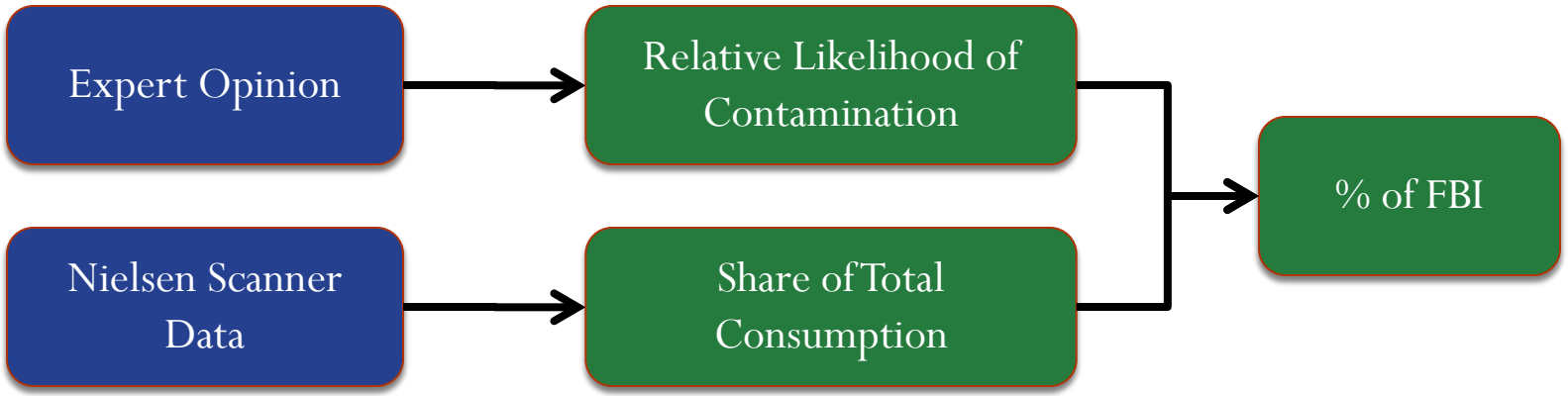
- Lack of studies with directly relevant data
- Other methods of research synthesis not feasible
- Considerable amount of related data and knowledge
  - Overall prevalence of foodborne illness in the United States
  - Understanding of microbial growth under different conditions and in different food types
  - Effectiveness of "kill steps" between manufacturer and the consumer
- Synthesis of inputs from multiple types of experts

# Methods

- Modified Delphi technique
  - Panel of 16 experts
  - Experts interact through a moderator
  - Iterative approach to eliciting opinion
  - Mathematical aggregation of opinions
  - Accounts for uncertainty through self-assessed confidence ratings
- Combine expert elicitation data with consumption data
- Avoids "anchoring" on outbreak-based studies

# More on Attribution Method

- Even very high-risk foods may account for very few FBI if rarely eaten
- Percentage of FBI attributable to a specific food-pathogen pair is a function of relative likelihood of contamination AND share of consumption



# Questionnaire Design

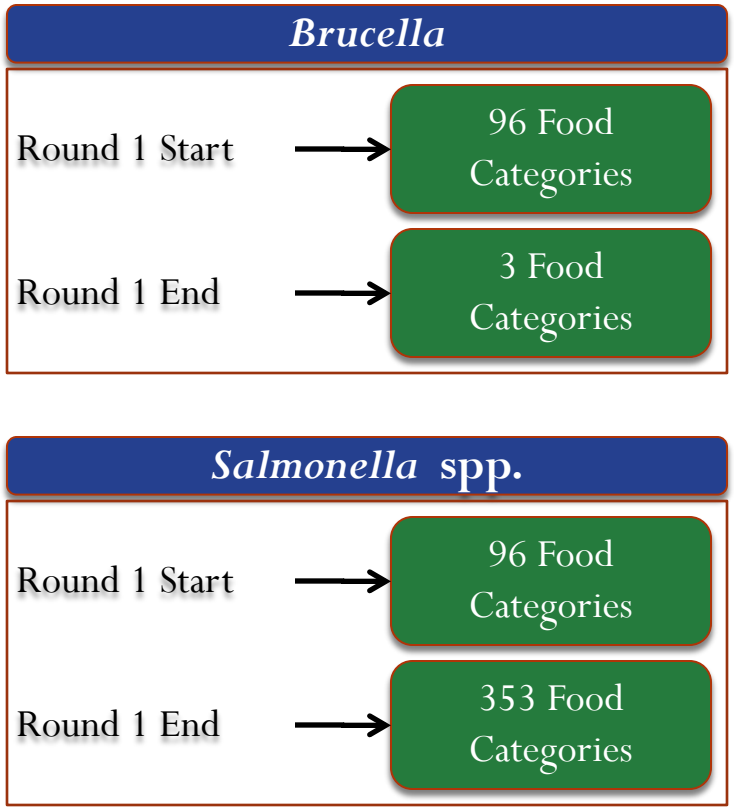
- Supermarket concept
  - Offers natural groupings of products
  - Reduce cognitive burden on experts
- MS Excel-based self-administered questionnaire

# Round 1

- **Objective:** Identify food-pathogen combinations of ***most concern*** for further evaluation in the next round
- **Questions:**
  - Pathogens that are of most concern for a given food product category
  - Product subcategories for which the likelihood of contamination is higher than average

# Relevant Food Categories by Pathogen from Round 1

| Pathogen | Number of Relevant Food Categories |
|---|---|
| Astrovirus | 14 |
| *Bacillus cereus* | 121 |
| *Brucella* | 3 |
| *C. botulinum* | 110 |
| *Campylobacter* | 45 |
| *Clostridium perfringens* | 67 |
| *Cryptosporidium parvum* | 102 |
| *Cyclospora cayetanensis* | 71 |
| *Escherichia coli* spp. | 231 |
| *Giardia lamblia* | 31 |
| Hepatitis A | 138 |
| *Listeria monocytogenes* | 172 |
| Norwalk-like viruses | 135 |
| Rotavirus | 26 |
| *Salmonella* spp. | 353 |
| *Shigella* | 116 |
| *Staphylococcus* | 96 |
| *Streptococcus* | 14 |
| *Toxoplasma gondii* | 14 |
| *Trichinella spiralis* | 4 |
| *Vibrio* spp. | 35 |
| *Yersinia enterocolitica* | 32 |



# Round 2

- **Objective:** Compare the relative likelihood of contamination for all food categories associated with each pathogen
- **Question:**
  - Group food categories provided according to relative likelihood of contamination into following bins
    - Negligible
    - Low
    - Medium:Low
    - Medium:Medium
    - Medium:High
    - High:Low
    - High:Medium
    - High:High

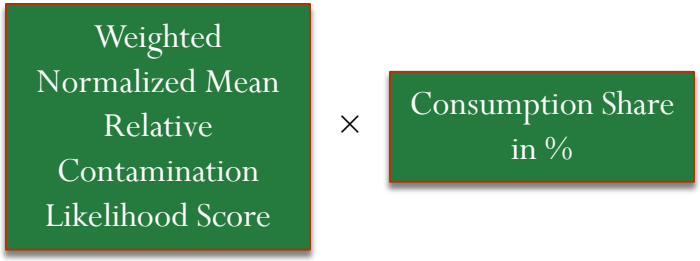
# Round 3

- **Objective:** Estimate FBI due to contamination that happens during harvest, processing, and/or distribution stages of the farm-to-fork continuum, i.e., relevant at time of importation
- **Question:**
  - Estimate % of FBI that might occur due to events after the product is sold, e.g., due to improper handling at retail and/or home

% FBI due to Contamination that Occurs Before the Product Reaches the Store Shelf = 1 - % FBI due to Contamination that Occurs After the Product Leaves the Store Shelf

# Attribution Rate Methodology

- **Step 1:** Map expert defined food categories to Nielsen scanner food categories
- **Step 2:** Normalize weighted mean contamination likelihood scores such that the sum of the scores across food categories for a food pathogen equals 100%
- **Step 3:** Use Nielsen sales equivalent units as proxy for consumption volume
- **Step 4:** Calculate raw attribution rate as:




- **Step 5:** Normalize raw attribution rate such that the sum of the attribution rates for each food for a given pathogen equals 100%

# Considerations

- Other research methods are not feasible due to lack of studies
- Government analysts are time and budget constrained
- Expert elicitation is challenging and requires innovative approaches
- Integration of expert elicitation with other data sources
- Continued development of better methods to meet these challenges is needed