Interagency Food Safety Analytics Collaboration (IFSAC)

Strategic Plan for Foodborne Illness Source Attribution

January 2012

1. Introduction

Estimating the number of illnesses, hospitalizations, and deaths caused by major pathogens is an important step in the prioritization of pathogens for disease control programs. Estimating the proportions of these illnesses that are due to specific food sources (foodborne illness source attribution) is a necessary second step to determine the specific interventions needed to reduce illness and to measure progress toward public health goals resulting from food safety policies and interventions. Estimates of foodborne illness source attribution are used for many purposes, including informing strategic planning, informing risk-based decision-making, estimating benefits of interventions, and evaluating the impact of interventions.

Presently, Scallan et al (2011)[1] provides estimates of the annual number of foodborne illnesses caused by 31 major pathogens. However, to prioritize resources and inform food safety strategic planning and policy decisions, illnesses must be attributed to a food source. Foodborne illness source attribution estimates rely on a variety of data sources and methodologies. Data from outbreak investigations, studies of laboratory-confirmed illnesses, expert elicitations, and risk assessments can all help to determine sources of human infection. However, estimation of foodborne illness source attribution for each pathogen is hampered by a number of methodological and data limitations. For example, determining the proportion of illnesses reported to public health authorities that are directly attributable to contaminated foods is complicated by the fact that foodborne pathogens can also be transmitted through a variety of other exposure pathways, such as exposure to contaminated water and direct contact with animals or other infected persons. Data on food vehicles that cause illness are obtained through interviews during outbreak investigations or special epidemiologic studies (e.g., case-control studies), but most ill persons are not interviewed, and if they are interviewed they are unlikely to know the source of their infection. Analytic methods used to estimate foodborne illness source attribution are complex and rely on many assumptions. Considering these challenges, the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), and the Food Safety and Inspection Service (FSIS) have joined together to form the Interagency Food Safety Analytics Collaboration (IFSAC), with the initial objective of estimating the source attribution of infections associated with specific foods and settings. A process for determining IFSAC analytic priorities, identifying specific analytic projects that address priorities, and providing resources and oversight for approved projects has been outlined in the IFSAC charter.[2] This tri-agency group is operating with the understanding that data improvements and the development of multiple analytic methods are needed to generate more accurate estimates of foodborne illness source attribution across the broad range of commodities and points in the food supply chain. These improved estimates of foodborne illness source attribution will provide informational critical to effective food safety initiatives and polices will contribute to reducing the number of foodborne illnesses in the U.S. population.

[1]Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson M-A, Roy SL, et al. Foodborne illness acquired in the United States—major pathogens. Emerg Infect Dis [serial on the Internet]. 2011 Jan [*cited 1.1/2012*]. http://www.cdc.gov/EID/content/17/1/7.htm

[2] The IFSAC Charter was signed by CDC, FDA, and FSIS in February 2011 and will be available at the January 31, 2012 IFSAC public meeting.

IFSAC was created to address complex analytical issues that require cross-agency cooperation and agreement. By working together to address these challenges, FDA, CDC, and FSIS can ensure that methods and results produced as a result of this collaboration are appropriate, meaningful, and useful to all parties. For this group, analytic collaboration can take many forms. In cases where one federal agency possesses particular analytical skills or unique expertise in a specific data source, that agency might take the analytical lead for an IFSAC project, but technical workgroup members from the other two agencies will serve on the general project workgroup to provide additional resources and relevant expertise pertaining to data, methods, and results. In other situations, the analytical workload may be equally shared by all federal agencies. Maintaining a flexible approach to project development and execution allows for the most appropriate technical workgroup members to participate in each project while ensuring that the final product is produced in a time-efficient manner and provides the desired outcomes outlined by all parties.

Four priority pathogens were identified by the regulatory agencies as the initial focus of foodborne illness source attribution work: *Salmonella, E. coli* O157:H7, *Listeria monocytogenes* (*Lm*), and *Campylobacter*. IFSAC has chosen to focus on these key pathogens in its attempt to better characterize foodborne illness source attribution for a number of public health and regulatory reasons. Recent estimates from CDC indicate these four pathogens are responsible for 21% of foodborne illnesses caused by major known pathogens acquired annually in the United States, 56% of hospitalizations, and 54% of deaths.[3] They also represent pathogens for which the estimated percentages of illnesses that are foodborne are high; thus, targeted food safety policies will be effective in reducing a significant proportion of the total number of illnesses, hospitalizations, and deaths caused by these pathogens. For these reasons, federal regulatory agencies already have a strong focus on these four pathogens, and share a need for measuring progress toward food safety goals targeting them. FSIS maintains regulatory sampling programs for all four pathogens, including a recently implemented sampling program for *Campylobacter*, as well as it tightened performance standard for *Salmonella.* FSIS also has developed a foodborne illness performance measure using foodborne illness source attribution estimates, with the goal of reducing foodborne illnesses from FSIS-regulated pathogens. Finally, FDA recently implemented the Shell Egg rule that focuses specifically on *Salmonella* serotype Enteritidis.

CDC, FDA, and FSIS worked jointly, based on the needs of each agency, to develop a cohesive description of specific needs related to foodborne illness source attribution, which includes both short-term needs focused on attribution estimates for the four priority pathogens, as well as long-term needs that focus on plans for reducing uncertainty, improving data, and obtaining comprehensive estimates of foodborne illness source attribution. At an April 2011 workshop, the three agencies agreed on a framework for addressing foodborne illness source attribution needs and developing the methodological building blocks for providing estimates to the framework (Figure 1). While each agency will continue to work independently on projects relating to foodborne illness source attribution to meet its individual needs, the shared IFSAC priorities and projects ensure a coordinated and effective approach by the three agencies. Furthermore, the three agencies recognize the need for estimates of foodborne illness source attribution to be derived from the best science available in order to inform food safety policy. To

[3] See footnote supra note 1.

ensure this, IFSAC is requiring a peer-review process for all attribution methods and outcomes used for decision-making, including any work used or considered by the group to inform their foodborne illness source attribution work.

IFSAC is guided by a set of objectives described below that include short-term (1-2 years) and long-term (3-5 years) efforts. Details on how the group plans to achieve these objectives are described in Section 4 of this document.

2. IFSAC Objectives Related to Foodborne Illness Source Attribution

1) Generate timely estimates of foodborne illness source attribution (that allow for evaluation of changes in attribution over time) for important foodborne pathogens and commodities at various points in the food chain that address specific agency needs for measuring progress, allocating resources, and making programmatic decisions;
    - This information can be used as input into a wide range of regulatory applications in FDA and FSIS decision-making systems, such as assessment of the impact of interventions that are targeted toward specific foods, such as eggs and poultry.
2) Identify data needs and take steps to determine how to better acquire, improve, and organize data available for foodborne illness source attribution;
3) Validate current methods and modeling approaches to estimate foodborne illness source attribution and develop improved methods;
4) Identify and obtain high-level commitments for personnel and financial resources to support efforts to estimate foodborne illness source attribution; and
5) Develop a collaborative communication plan among the three agencies and between the agencies and stakeholders to:
    - Provide updates and share foodborne illness source attribution initiatives, plans, and publications of the three agencies, including those generated by IFSAC projects as well as those from each agency, and
    - Engage stakeholders and the public regarding foodborne illness source attribution needs and uses.

3. Foodborne Illness Source Attribution Methodologies

As explained in this strategic plan, the three agencies have defined a conceptual framework to guide their approach to estimate foodborne illness source attribution (Figure 1). Multiple methodological approaches are needed because there is no single data source or set of data streams specifically designed to generate estimates of the number or proportion of illnesses attributable to each food source at the different points in the food production and distribution chain. Ideally, to accurately assign the attribution proportions of illnesses caused by an individual pathogen to specific foods, one would know what food item was responsible for transmitting infection in each instance of foodborne disease and would be able to trace that food item back to the source to determine the point of contamination. However, this information is only obtained in a very small proportion of outbreak investigations. For example, in some multi-state outbreaks, investigations across the country can definitively implicate a common food source and laboratory analysis can sometimes confirm the presence of the pathogen in the food source.

The choice of data and analytic methods may differ depending on the data available for a particular pathogen and commodity, the point of contamination (e.g., the initial source at the reservoir, production, or preparation), exposures in the population, and numerous other factors. Projects need to identify the most appropriate data and methods to achieve the best foodborne illness source attribution result for a particular pathogen-commodity pair in the desired timeframe. Several approaches have been used to provide estimates of foodborne illness source attribution. The following considerations affect the choice of method and the resulting estimates that attribute illnesses to food commodities:

a. Timeliness of the data;
b. Availability and quality of the data linking illnesses to food categories at specific points in the food production and distribution chain; and
c. Availability of estimates of illness caused by specific pathogens;

Currently available data sources and related methods for foodborne illness source attribution studies:

1) ***Foodborne outbreak surveillance data:*** This data is used to estimate the number of outbreaks and illnesses attributed to food commodities at the point-of-consumption. Outbreaks and illnesses are now assigned to one of 17 commodities when illnesses result from exposure to a simple food vehicle (e.g., a single ingredient, such as steak, is implicated, or the complex implicated food, such as fruit salad, contains multiple ingredients all belonging to the same commodity, fruit). Methods for attributing outbreaks and illnesses caused by complex foods (e.g., foods that contain ingredients from more than one commodity, such as a hamburger sandwich) have been developed and, once published, will be used as input into IFSAC projects.
   a) Advantages:
      i. CDC's national surveillance system for foodborne illness outbreaks has been in place since 1973, providing the opportunity to evaluate data and changes over an extended time period.
      ii. Outbreak investigations link human illness to specific food exposures.
      iii. The foodborne illness outbreak surveillance system includes all pathogens and toxins recognized to cause foodborne disease outbreaks.
   b) Disadvantages:
      i. Outbreak-associated illnesses represent a small subset of foodborne illnesses. Illnesses in reported outbreaks may not be representative of all illnesses because of factors related to the characteristics of food contamination, food preparation and service, pathogen transmission, and the ease of outbreak detection and investigation for certain foods and pathogens.
      ii. Data are limited by missing and incomplete data fields, resulting in a high level of uncertainty and potential errors in foodborne illness source attribution estimates.
      iii. Data may be biased toward large outbreaks, outbreaks associated with point sources, outbreaks that have short incubation periods, and outbreaks that cause serious illness.

2) ***Laboratory-based human illness surveillance data:*** Data from laboratory-based surveillance systems combined with case exposure data from interviews can be used in case series and case-control analyses to provide point-of-consumption attribution estimates for specific foods, settings, and transmission pathways. Laboratory-based surveillance data can also be

used in illness attribution models when combined with other data sources, such as consumption data and product contamination data (see below).

a) Advantages:
   i. Questionnaires can provide data on non-food transmission pathways and key food vehicle exposures for pathogen-commodity pairs rarely detected in outbreaks (e.g., *Campylobacter* and chicken).
   ii. A variety of analytic tools are available to improve foodborne illness source attribution estimates derived from case-control studies.
   iii. These surveillance systems include a variety of nationally representative passive reporting systems as well as active surveillance in sentinel FoodNet sites.

b) Disadvantages:
   i. Laboratory-based surveillance systems for major causes of foodborne illness include a limited number of pathogens. The following website list surveillance systems and pathogens under surveillance: http://www.cdc.gov/foodborneburden/surveillance-systems.html.
   ii. Laboratory-based surveillance data for many pathogens are limited in scope across time, which can make measuring change difficult, as well as drawing inferences to the U.S. population as a whole.
   iii. Case-control studies and complex mathematical models using laboratory-based surveillance data are resource-intensive and require a long time to design and complete.
   iv. Population attributable fractions estimated by case-control studies using logistic regression have many limitations related to the design and analysis of the studies.

3) **Data describing food contamination**: A variety of datasets describe food contamination, including FSIS and FDA product testing data, routine surveillance and investigative data, as well as data from designed experiments. Quantitative microbial risk assessments and source subtyping models (e.g., Hald model) rely on data describing food contamination.

a) Advantages:
   i. Such models can be used to estimate foodborne illness source attribution at varying points along the farm-to-table continuum as long as data are available to model food contamination levels across steps in the continuum.
   ii. When data are available, these models may provide per-serving-based risk estimates.

b) Disadvantages:
   i. Comprehensive data on microbial contamination at various points in the food production and distribution system is lacking for most food commodities.
   ii. Methods are analytically complex, so designing and validating models can take a long time.

4) **Data describing food consumption**: A variety of datasets describe consumption patterns of specific foods (e.g., National Health and Nutrition Examination Survey, U.S. Department of Agriculture's (USDA) Economic Research Service product disappearance data, USDA Agriculture Research Service food consumption data, and private market research data). These can be incorporated into illness attribution models. Food consumption data are used in

what is known as the Hald model,[4] which links laboratory-based human illness surveillance data to food contamination data using estimates of food exposure frequency.

a) Advantages
   i. Knowledge of food consumption provides a baseline for food exposure frequencies, which can be examined with a view to identify boundaries for commodity-specific human illness attribution. For example, food consumption data can determine that boysenberries can be a source of only so much foodborne illness at the point of consumption.
   ii. Hald-like models can be used to estimate illness attribution at varying points along the farm-to-table continuum if data are available to model food contamination at those points.
   iii. When data are available, models based on food consumption can be extended to provide per-serving-based risk estimates.

b) Disadvantages
   i. Many surveys of food consumption are not continuously conducted and lack comprehensive demographic data or data collected on a relevant time scale.
   ii. Methods like the Hald model are analytically complex, so designing and validating initial models can take a long time.

5) **Expert elicitation*:*** Foodborne illness source attribution estimates can be made by a panel of subject matter experts in food safety and foodborne diseases. Approaches can vary, such as the use of a small panel that iteratively undergoes facilitated rounds to converge on a discrete answer. Alternatively, a large panel survey approach may use statistical methods to estimate probabilistic distributions across experts. Likewise, participants in an elicitation might be asked to provide their own estimates for specific variables based upon their analysis of a collection of relevant studies, or simply to provide probability weights to a set of alternative estimates for that variable.

a) Advantages
   i. Can be done relatively quickly, depending upon the format and estimates required.
   ii. Can be tailored to specific food categories and points in the food supply chain for which data cannot be obtained in other ways.
   iii. Provides for an informed synthesis of available information that may not be amenable to analytical synthesis.

b) Disadvantages
   i. Not recommended when analytical approaches based on empirical data are sufficient.
   ii. Results are dependent on the expertise of participants, and may be difficult to reproduce.

4. Planned Path Forward

Working with this set of data sources and methodological options, IFSAC has developed a path forward to address both the short-term and long-term needs identified by the agencies.[5]

[4] Hald T, Vose D, Wegener HC, Koupeev T. A Bayesian approach to quantify the contribution of animal-food sources to human salmonellosis. *Risk Anal.* 2004 Feb;24(1):255-69.

[5] To ensure that projects remain on track and produce the anticipated products, a series of performance measurement activities and reporting has been built into each project. These performance measurement events will occur every four months until the completion of the project. Timelines and deliverables will be modified following development of the project plan. It is

Shared Needs

The three agencies have identified a short-term need (within 1-2 years) to develop an initial tri-agency consensus on the "best current" estimates of foodborne illness source attribution with uncertainty bounds for *Salmonella* spp., *E. coli* O157:H7, *Lm*, and *Campylobacter*. The shared long-term needs (3-5 years) are to improve these estimates using updated data and improved quantitative methodological approaches. In addition, methods to measure changes in illness attribution over time will be assessed. An overview of the planned steps to generate pathogen-specific illness attribution estimates with uncertainty bounds, using the most appropriate methods and data sources determined for each, is provided below. Peer review will be conducted as part of this process (see Appendix for details on IFSAC-approved projects).

Communication has been identified as a crucial component of IFSAC's efforts. Foodborne illness source attribution is a complex issue, and ensuring that the work and its results are properly communicated to federal leadership, advocacy groups, industry, and the general public is an important element of the group's work. A major challenge is how to communicate changing attribution estimates over time that result both from changes in food safety and food consumption patterns and also from improvements in data sources and methods that improve the accuracy of the estimates. Further, as all three agencies are working both together and independently on illness attribution projects, the development of a cross-agency communication strategy is needed to ensure clarity with stakeholders.

Short-Term Plan (1-2 years)

1) **Improve methods to identify and commoditize foods implicated in outbreaks**

Currently, CDC provides annual reports of outbreaks and illnesses caused by specific pathogens attributed to 17 food commodities using information from outbreaks caused by simple food vehicles (see 2.1 above). This project will improve the methods used to determine and assign reported foods to commodities. The current scheme (Painter et al., 2009)[6] used to identify and bin foods implicated in outbreaks into commodities will be modified to increase the accuracy and utility of food commodity assignments used to generate attribution estimates reflecting FDA and FSIS' regulatory perspectives on food. Additional details are provided in Appendix, Project II.

2) **Use estimates from outbreak-based foodborne illness source attribution**

IFSAC will use data derived from the improved methods of outbreak-based foodborne illness source attribution described above to develop "best current" estimates for *Salmonella* spp., *E. coli* O157:H7, *Lm,* and *Campylobacter*. This represents a first step in tri-agency use of illness attribution estimates using the best data currently available and transparent methods. Project VI in the appendix describes this activity.

3) **Examine the uncertainties associated with current foodborne illness source attribution estimates**

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recognized that "ad hoc" or unanticipated data analysis or review efforts may disrupt IFSAC-dedicated resources, and possibly delay IFSAC attribution efforts. These will be defined and communicated to IFSAC partners so that priorities and timelines can be adjusted.

[6] Painter JA, Ayers T, Woodruff R, Blanton E, Perez N, Hoekstra RM, et al. Recipes for Foodborne Outbreaks: A scheme for categorizing and grouping implicated foods. *Foodborne Pathog Dis*. 2009 6(10):1259-64.

Several sources of uncertainty are associated with outbreak-based illness attribution. Among these are a) the representativeness of food vehicles implicated in outbreak reports to the foods causing illness in the general population; b) the relative similarities between the distribution of pathogens causing illnesses in foodborne disease outbreak surveillance and in laboratory-based surveillance of sporadic illnesses; and c) the sensitivity of outbreak-based illness attribution estimates to changes in food vehicle categorization. IFSAC will conduct a series of analyses assessing these uncertainties to determine the level of confidence in using outbreak data to estimate foodborne illness source attribution. See Project III in the Appendix for more information on this project.

4) **Determine gaps and identify solutions to improve foodborne illness source attribution estimates**

As illness attribution estimates are updated and new data and method become available, IFSAC will determine the pathogen-food source pairs for which outbreak-based attribution estimates are not of sufficient quality and will identify methods for better estimating these. In addition, IFSAC will characterize uncertainty around the "best current" foodborne illness source attribution point estimates for each pathogen-food source pair prioritized by the group.

Long-Term Plan (3-5 years)

CDC, FDA, and FSIS have agreed that a clear, step-wise path forward is needed to develop scientifically sound methods to generate foodborne illness source attribution estimates that are timely, accurate, current, and specific. In addition to meeting the short-term need for tri-agency agreement on attribution estimates and their respective uncertainty bounds, IFSAC will maintain descriptions of the data needs, time, and resources needed to validate and inform current and evolving methodologies for each project plan. The agencies agree that sustaining and enhancing methods and data to generate estimates are needed, and that peer review of results should also be a part of the strategic plan. The group recognizes that in developing tools to both improve "best current" attribution estimates and measure changes in attribution over time, it is important to remain aware and communicate effectively potential differences with estimates generated using previous data sources and methods compared with those generated with more recent data sources and methods.

To achieve these goals, and to harmonize the variety of methods and data sources that exist to estimate foodborne illness source attribution, the group intends to use a variety of data sources and to refine and develop several methods. The group will also determine a process for synthesizing results across projects. The long-term plan will include:

1) **Develop foodborne illness source attribution models using a variety of data sources**

These approaches will act as an alternative and supplement to outbreak-based approaches described in the short-term plan. Developed models will include improving the use of surveillance data in combination with consumption data and other data sources to estimate illness attribution based upon U.S. food consumption patterns. One of these has been previously described (Hald et al. 2004; Guo et al. 2011) and will be improved (See Appendix, Project IV) to generate additional illness attribution information.[7, 8] Other models will be identified, based

[7] Supra footnote 4.

upon the data sources available for specific pathogens and their reservoirs. Discrepancies between the different approaches will be evaluated based upon their strengths and limitations and the need for additional efforts to gain further precision in some attribution estimates will be identified.

2) **Determine most appropriate methods for generating both "blended" and harmonized food source attribution estimates**

There is a need to develop foodborne illness source attribution models that combine ("blend") data from both laboratory-based and outbreak-based human illness surveillance systems. IFSAC will continue to support work initiated by CDC to generate attribution estimates by combining data generated by case-control studies with foodborne illness outbreak data. Similarly, in the long term, there will likely be a need to develop harmonized quantitative "best current" illness attribution estimates with uncertainty bounds that incorporate information from multiple attribution methods. It should be noted, that different pathogens may require different methodological approaches. Harmonized estimates generated periodically will provide updated "best current" foodborne illness source attribution estimates and their uncertainty bounds as new methods and estimates become available over time.

Communication Plan

Under IFSAC, CDC, FDA and FSIS are committing communication, program, and subject matter experts to develop a shared process for communicating foodborne illness source attribution information and are seeking peer review of group outputs. The following is a brief description of the initial steps identified for developing, refining, and sharing a unified communication plan.

1) **FDA Risk Communication Advisory Committee**

In 2011, members of IFSAC provided an overview of group activities to the FDA Risk Communication Advisory Committee in a public meeting and solicited input and feedback on how to effectively engage a variety of stakeholders and communicate the challenging topic of foodborne illness source attribution. This feedback will be incorporated into the overarching communication plan and will guide future efforts by the group to communicate new findings and other material related to attribution to the public and stakeholders.

2) **Public Engagement**

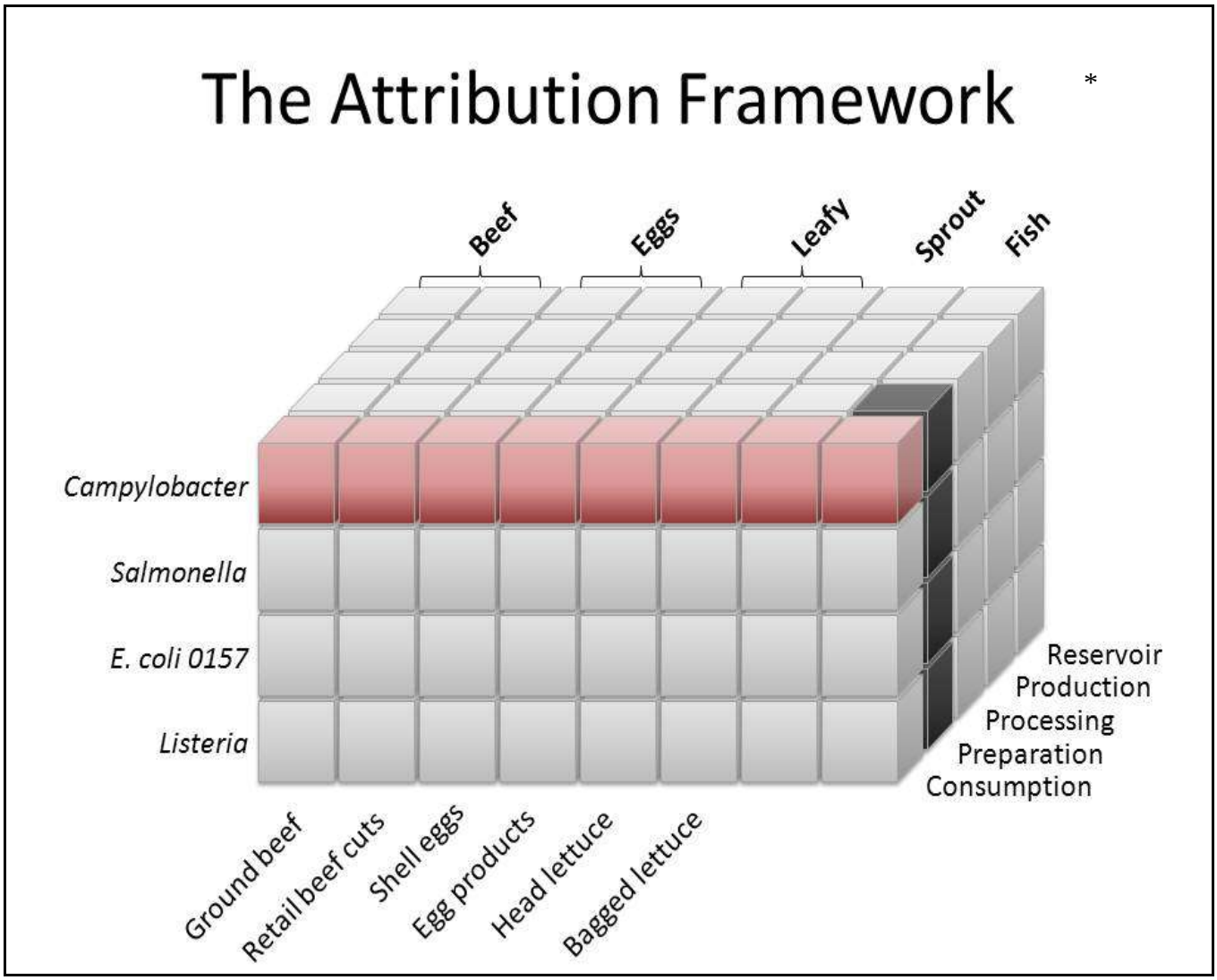
In addition to an approach for using existing internal communications processes between agencies in a coordinated way, this project will include various mechanisms of sharing information about IFSAC and its outputs with the public, industry, academic partners, and other stakeholders, as well as soliciting feedback on the group's activities and approaches to foodborne illness source attribution. Public engagement will be guided by best practices and likely include a variety of formats, such as public meetings and other audience-targeted meetings geared

[8] Guo C, Hoekstra RM, Schroeder CM, Pires SM, Ong KL, Hartnett E, et al. Application of Bayesian techniques to model the burden of human salmonellosis attributable to U.S. food commodities at the point of processing: adaptation of a Danish model. *Foodborne Pathog Dis*. 2011 8(4):509-16.

towards the interest level and scientific literacy of various audiences—ranging from consumer groups to industry partners.

Communication to engage the wide variety of public interests will depend on resources. Plans include, but are not limited to Federal Register Notices, press releases, fact sheets, graphically designed charts and tables, dedicated web presence, web seminars, video vignettes and short stories, depending on available resources devoted to communications. Manuscripts generated from IFSAC projects will be submitted to scientific journals for peer review and publication to ensure that processes and data used for decision-making are scientifically reviewed and available to stakeholders and the public.

Figure 1: IFSAC Framework for foodborne illness source attribution (subset of foods, commodities and pathogens illustrated).



*The foodborne illness source attribution framework provides a conceptual outline of the spectrum of foodborne illness source attribution in the entire food chain. Individual blocks represent the estimated number of foodborne illnesses attributed to each pathogen-food pair at each point in the food chain—from initial source at the reservoir level (e.g., farm), through production and processing, food preparation, and consumption. Foodborne illness source attribution estimates for each pathogen-food pair at various points in the food chain can help to target the best points for interventions. Row totals estimate the total number of foodborne illnesses caused by a specific pathogen attributable to a specific point in the food system, such as the total number of *Campylobacter* illnesses attributable to contamination at the point of consumption (red blocks). Column totals estimate the number of foodborne illnesses associated with a particular food source at a specific point in the food system, such as the total number of illnesses associated with contaminated fish at the point of preparation (black blocks). Individual foods (e.g., ground beef and retail beef cuts) can be aggregated into food commodities (e.g., beef).

Appendix to IFSAC Strategic Plan:
Current Projects as of December 31, 2011

The Interagency Food Safety Analytics Collaboration (IFSAC) was established in 2011 to improve coordination of federal food safety responsibilities by the Centers for Diseases Control and Prevention (CDC), the Food Safety and Inspection Service (FSIS), and the Food and Drug Administration (FDA), beginning with foodborne illness source attribution. This group, directed by a steering committee, will enhance federal collaboration by addressing cross-cutting priorities for food safety data collection, analysis and use, as outlined in the key findings of the President's Food Safety Working Group. The following are project descriptions, key outputs, and timelines of foodborne illness source attribution priorities developed by IFSAC.

I. Align thinking of foodborne illness source attribution and methods

Description: Held a multiple-day workshop with IFSAC Technical Group members in April 2011 to (1) develop a shared understanding of historic and current methods and data sources used for foodborne illness source attribution, (2) develop a shared understanding of short- and long term needs, (2) review, compare and select a method for estimating foodborne illness source attribution in the short term, (3) develop a plan for applying the method(s) to each prioritized pathogen by April 2012.

Key output: A shared statement of needs was developed. Project VI, described below, was developed by the Technical Group as a direct result of this workshop. This project is currently under review by the IFSAC Steering Committee.

Timeline: Workshop held in April 2011.

II. Improve how foods are categorized into commodities

Description: Currently, CDC assigns outbreaks associated with simple implicated food vehicles (a single contaminated ingredient, such as steak, is implicated, or implicated food contains multiple ingredients, such as fruit salad, all belonging to the same commodity to one of 17 food commodities (available at http://www.cdc.gov/outbreaknet/surveillance_data.html). However, the current way of determining and assigning foods to commodities needs to be changed to improve the accuracy and specificity of food categorization to meet the needs of regulatory agencies for decision-making.

The project will determine more precisely the specific implicated food causing outbreak-associated illnesses in individual outbreak reports, and will create additional commodity categories and sub-categories so that implicated foods that are regulated by the FDA can be better distinguished from those that are regulated by FSIS. Customized foodborne illness source attribution reports will be provided to regulatory agencies for risk-based decision-making.

Key Output: The key outputs of this project will be more precise characterization of implicated foods and more specific assignments of food vehicles to commodities.

Timeline: January 2012: finalize decision matrix and hierarchical commoditization tree. Determine foodborne illness source attribution estimates derived from simple foods for calendar years 2009 and 2010.

III. Evaluate potential limitations with current foodborne illness source attribution estimates obtained from outbreak reports

Description: Data from foodborne disease outbreak surveillance are used to determine the best foodborne illness source attribution estimates currently available to regulatory agencies for decision-making. Outbreak-associated illnesses account for less than 25% of human foodborne illness; therefore, we do not know how well foodborne illness source attribution estimates based on outbreak reports characterize the common causes of foodborne illness in the general population.

This project uses data from multiple human illness surveillance systems to evaluate how likely the foodborne pathogens and food risks identified in outbreak investigations reflect those of the entire population.

Key Output: The key output of the project will be a better understanding among the three agencies (CDC, FDA, FSIS) of how well the pathogens and foods commonly associated with outbreaks reflect those that cause most foodborne illnesses in the general population. This description will provide the basis for identifying potential gaps in our current foodborne illness source attribution estimates.

Timeline: April 2012: Submit technical report to IFSAC steering committee summarizing the results of evaluation.

IV. Investigation of the Hald model as a method to improve foodborne illness source attribution estimates

Several different methodologies are being investigated for their potential to improve foodborne illness source attribution estimates. One has been approved as a project by the IFSAC Steering Committee, and that one is described below. This project concept was already well-developed when IFSAC began because of previous work at CDC and FSIS. Proposals to explore and further develop other methods for illness attribution are in the proposal phase, and will be shared with the public and stakeholders once they are approved by the IFSAC Steering Committee.

Description: CDC, FDA, and FSIS have many data sources that may be used to determine estimates of foodborne illness source attribution. A method was developed in Denmark (Hald, T. et al, A Bayesian approach to quantify the contribution of animal-food sources to human salmonellosis) that uses information about food contamination, consumption patterns of the population, and human foodborne illnesses to estimate the number of illnesses associated with specific food reservoirs. This method has been adapted in several countries for foodborne illness source attribution of several pathogens.

This project will use food contamination data collected by FDA and FSIS, food consumption data collected by the USDA and from the National Health and Nutrition Examination Survey, and human illness data collected by CDC to evaluate how effectively these data may be used to estimate foodborne illness source attribution using the Hald method.

Key Output: The key output of the project will be an evaluation of a method of foodborne illness source attribution of *Salmonella* in the United States that has been successfully used in other countries.

Timeline: November 2012: Generate preliminary foodborne illness source attribution estimates of *Salmonella* serotypes for specific FDA and FSIS-regulated commodities.
January 2013: Finalize evaluation of model and determine utility of model for generating foodborne illness source attribution estimates using U.S. data.

V. Improve and advance communications about foodborne illness source attribution

Description: CDC, FDA, and FSIS will develop a joint process for sharing foodborne illness source attribution data among agencies and with stakeholders and the public. This process will be related to, and informed by, feedback and participation of both scientific and non-scientific audiences.

Several communications efforts have begun under IFSAC:

- Feedback from FDA Risk Communication Advisory Committee public meeting held August, 2011 will guide the IFSAC communication plan. Materials are available at http://www.fda.gov/AdvisoryCommittees/CommitteesMeetingMaterials/RiskCommunicationAdvisoryCommittee/ucm249108.htm);
- A symposium about IFSAC was provided at the Society for Risk Analysis (SRA) annual meeting on December 5, 2011;
- A public meeting about IFSAC is scheduled for January 31, 2012 in Washington, DC.

Key Output: The key output of the project will be a jointly developed communications plan that will develop and monitor communication priorities and dates of execution. It includes messages and products, audiences, media, partners, progress, and, hot issues.

VI. Development of shared illness attribution estimates using tri-agency methods and simple food outbreak data

Description: Currently, CDC, FSIS, and FDA do not have an agreed-upon method to derive foodborne illness source attribution estimates and confidence bounds. Following on the work of the IFSAC project described in II above, this project (Phase 1) will develop foodborne illness source attribution estimates in 2012 based on the re-categorized simple food data and will identify uncertainty issues pertaining to each estimate. Phase 2 of will determine whether a method for estimating outbreak-based illness attribution based upon both simple and complex foods will be an improvement and can be implemented. If so, Phase 2 will update the "best current" attribution estimates and generate uncertainty bounds, based on the most appropriate methods and data source for each prioritized pathogen.

Key Output: "Best current" estimates of foodborne illness source attribution for re-categorized simple foods using outbreak data will be determined. Identification and exploration of uncertainty issues associated with these estimates will be documented, and an operational plan to address these will be developed.

Timeline: Phase 1 and an operational plan and timeline for completion of Phase 2 will be completed by October 2012.