

July 2007

Results of an Additional Expert Elicitation on the Relative Risks of Meat and Poultry Products

Final Report

Contract No. 53-3A94-03-12, Task Order 27

Prepared for

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Introduction

In response to comments received during a public workshop, FSIS contracted with RTI to conduct a new expert elicitation on processed meat and poultry products.

In 2005, as part of the U.S. Department of Agriculture's (USDA's) agenda to develop and implement a more robust risk-based meat, poultry, and egg inspection system, the Food Safety and Inspection Service (FSIS) contracted with RTI International to conduct an expert elicitation on the relative risks posed to public health by various types of processed meat and poultry products (Contract #43-3A94-2-0260). The description of the process and results of the expert elicitation are presented in an earlier report (Karns, Muth, and Coglaiti, 2005).

In October 2006, FSIS held a public workshop with its constituents to solicit feedback on the Agency's plans for implementing risk-based inspection. In response to feedback from the public workshop participants, FSIS contracted with RTI to conduct another expert elicitation on inherent risk from processed meat and poultry products to better understand the results of the previous expert elicitation. This follow-on elicitation was similar to the previous elicitation but had several important modifications, including the following:

- The expert panel was equally divided among scientists from the public health community, industry, and academic institutions.
- Experts with advanced knowledge in a branch of science related to both food safety *and* public health were recruited.
- A second worksheet was added to allow experts to rank their responses by the likelihood of illness among *vulnerable* consumers.
- The scoring procedures for the first two worksheets set a maximum of 10 instead of open-ended scoring.
- A third worksheet was added to allow experts to attribute foodborne illnesses of five pathogens to the

consumption of foods in 25 processed meat and poultry product categories.

On June 26, 2007, RTI presented the results of the expert elicitation at the Public Meeting on Risk-based Inspection—Expert Elicitation at USDA headquarters in Washington, DC.¹

This report is organized as follows. Section 2 describes the process RTI followed for conducting the expert elicitation. Section 3 presents the results of the expert elicitation for each of the three worksheets.

In Appendix A, we provide copies of the worksheets completed by the experts during the expert elicitation.

¹ The presentation is available at http://www.fsis.usda.gov/PPT/RBI_RTI_062607.ppt.

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Expert Elicitation Methodology

In this section, we describe the methodology of the expert elicitation. We describe the process used to identify and recruit the experts, the development of the elicitation materials, and the procedures for the expert elicitation.

2.1 THE EXPERT PANEL

RTI recruited a total of 17 experts for the panel. The expert panel was composed of

- four experts from the public health community,
- eight industry scientists, and
- five academic participants.

Table 2-1 lists the panelists and their areas of specialization.

As a result of feedback from the previous expert elicitation, FSIS decided that the three areas of expertise—public health, academia, and industry—would be equally represented on the expert panel.

As a result of feedback from the previous expert elicitation, FSIS decided that the three areas of expertise—public health, academia, and industry—would be equally represented on the expert panel. To accomplish this balanced panel, RTI randomly selected four experts from each of the industry and academic areas of expertise for a total of 12 experts.¹ The results presented in Section 3 contain only the responses of the 12 randomly selected experts.

The experts were recruited from a list of 45 potential experts identified by FSIS, the National Advisory Committee on Meat and Poultry Inspection (NACMPI) subcommittee, and RTI. The specific criteria used to select the panelists included

¹ We also provided FSIS with a spreadsheet that contains the responses from all 17 experts who participated.

Table 2-1. Participants in the Expert Elicitation

Panelist	Organization	Expertise Area
Elizabeth Boyle	Kansas State University	Academia
Dean Cliver	University of California, Davis	Public health
Russell Cross	Texas A&M	Industry
James Dickson	Iowa State University	Academia
Warren Dorsa	John Morrell and Company	Industry
Mike Doyle	University of Georgia	Academia
Timothy Freier	Cargill, Inc.	Industry
Dee Griffin	University of Nebraska	Academia
Suzanne Jenkins	Virginia Department of Health	Public health
Cindy Jiang	McDonald's Corporation	Industry
Laurene Mascola	Los Angeles County Department of Health Services	Public health
Edward Mather	Michigan State University	Academia
Joe Meyer	Kraft Foods Global, Inc.	Industry
Dale Morse	New York State Department of Health	Public health
Robert Savage	HAACP Consulting Group, LLC	Industry
Virginia Scott	Food Products Association	Industry
Peter Taormina	The Coca-Cola Company	Industry

- advanced knowledge and professional recognition in a branch of science related to both public health and food safety² and
- an understanding of food science, meat and poultry processing, and foodborne illness.

The recruitment process is described in more detail in Section 2.3.

² "Advanced knowledge" means a postbaccalaureate degree. "Professional recognition" means peer-reviewed publications or presentations at national meetings.

2.2 MATERIALS DEVELOPED FOR THE EXPERT ELICITATION PROCESS

The worksheets developed for the expert elicitation included risk ranking worksheets similar to the 2005 expert elicitation and a new foodborne illness attribution worksheet.

We developed the following documents to use in conducting the expert elicitation:

- A project description, developed by RTI, provided to the panelists prior to agreeing to participate in the expert elicitation process. The document described the reason we were conducting an expert elicitation, and our expectations for the experts.
- FSIS, in collaboration with RTI, developed three elicitation worksheets with instructions and assumptions:
 - Worksheets 1 and 2 rank the public health risks posed by bacterial hazards in each of 25 categories of processed meat and poultry products for healthy adults and for vulnerable consumers, respectively.
 - Worksheet 3 estimates the percentages of U.S. illnesses caused by consuming or handling meat and poultry and attributed to specific meat or poultry product and bacterial pathogen combinations.
- Examples of products, developed by FSIS, for each of the 25 meat and poultry product categories.

Appendix A contains copies of the project description and elicitation worksheets. Section 3 includes the list of example products.

RTI conducted several teleconference calls with FSIS project team members to discuss modifications to the existing materials and procedures used in the previous elicitation. FSIS sent out a preliminary draft of the worksheet for peer review. The peer reviewers were a senior advisor for regulatory support, a veterinary epidemiologist, a deputy director for research, and a senior scientist. They represented four different agencies: Food and Drug Administration, Environmental Protection Agency, USDA's Economic Research Service, and USDA's Animal and Plant Health Inspection Service. RTI worked with FSIS to determine how to modify the worksheets in response to the peer reviewers' comments.

As a result of discussions between RTI and FSIS and the peer reviewers' comments, RTI made the following modifications to the elicitation materials and procedures:

- The product category “Thermally processed, commercially sterile” was added to the list of processed meat and poultry product categories.
- A second worksheet was added to allow experts to rank the public health risks posed by bacterial hazards in each of 25 categories of processed meat and poultry products for *vulnerable* consumers.³
- The scoring procedures for the first two worksheets set a maximum score of 10 instead of open-ended scoring.
- The scoring procedures asked the experts to consider only bacterial hazards and not to consider chemical and physical hazards.
- Experts were asked to rank their confidence in their estimates on a scale of 1 to 3, with 1 indicating “little or no confidence” and 3 indicating “very confident.”
- A third worksheet was added to allow the experts to attribute foodborne illnesses of five pathogens to the consumption of foods in 25 processed meat and poultry product categories.

In addition to the materials provided to the panelists, RTI also developed a moderator’s guide for conducting a kickoff teleconference with all of the experts. The moderator’s guide provided a list of discussion topics for the teleconference moderator to cover before discussing the worksheets in detail. The list of topics included the purpose of the expert elicitation, housekeeping items (deadlines for completion and contractual issues), and background information on the project.

2.3 RECRUITMENT AND DATA COLLECTION PROCESS

The process RTI followed for conducting the expert elicitation included a recruitment phase and a data collection stage. We began recruiting the experts on April 3, 2007, and completed data collection on May 21, 2007. In recruiting the experts, we

- contacted the 45 potential experts (15 public health, 15 academic, and 15 industry) to determine their availability and willingness to participate;

³ Vulnerable consumers were defined as the very young, the elderly, pregnant women and their fetuses, and those with compromised immune systems.

- set up a panel participation (consulting) agreement with each expert who agreed to participate;⁴ and
- developed a timeline for conducting the expert elicitations, including scheduling conference calls and delivering documents by e-mail.

Of the 45 potential experts contacted,

- 17 experts agreed to participate;
- 2 experts initially agreed to participate but had to drop out due to scheduling conflicts;
- 12 experts declined mainly due to scheduling conflicts; and
- 14 experts could not be reached despite repeated attempts by e-mail and telephone calls over 4 weeks.

After RTI contracted with the 17 experts to serve on the panel, we conducted the following activities during the data collection phase:

- scheduled and hosted teleconferences with the experts to discuss the purpose of the data collection, review the worksheets, and respond to questions;
- requested that the experts complete the worksheets using approximately 1 day of consulting time over approximately 7 days; and
- obtained the completed worksheets and lists of cited references from the consultants.

Once we obtained the completed worksheets, we entered data from all the experts into a spreadsheet. Because FSIS wanted equal numbers of experts for all three areas of expertise, we randomly selected four experts in each area (with the exception of public health specialists because only four participated) to include in the aggregated responses presented in this report. The aggregated responses are described in Section 3.

⁴ Some panel participants (i.e., government employees) were not able to accept an honorarium; thus, the panel participation agreement was not necessary.

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Results

In this section, we present the detailed results of the expert elicitation process for the three worksheets. FSIS will use the data collected from the expert elicitation as one factor in determining how to allocate inspection resources.

3.1 INTRODUCTION

To ensure consistency of product definitions, FSIS provided a list of example products for each of the 25 processed meat and poultry product categories. The product categories along with their examples are presented in Table 3-1. These examples are the same as for the 2005 expert elicitation except that thermally processed, commercially sterile products were added.

The assumptions for the risk ranking are the same as for the 2005 expert elicitation except that experts were asked to consider only bacterial hazards.

Before completing the elicitation worksheets, the expert panel was first asked to take into account the product examples provided by FSIS and the following scoring assumptions for Worksheets 1 and 2:

- Consider only bacterial hazards. Do not consider illness caused by viruses, chemical hazards, or physical hazards.
- Each of the 25 finished products will reach the consumer without further processing at another establishment or at retail. Examples of each of the finished product types are provided in the attached table titled "Finished Product Type Examples."
- Each product is produced in a USDA-regulated processing plant that operates under sanitation standard operating procedures (SSOPs) and a Hazard Analysis Critical Control Point (HACCP) system.
- The incoming source material (raw meat or poultry and other ingredients) for the processed product comes from

Table 3-1. Finished Product Type Examples

Finished Product Type	Product Examples
Raw intact beef	Steaks, roasts
Raw intact pork	Chops, roasts, ribs, loins
Raw intact meat—other (sheep, goat)	Chops, roasts
Raw intact chicken	Whole bird not stuffed and stuffed, parts (including necks/feet and giblets), boneless/skinless parts
Raw intact turkey	Whole bird not stuffed and stuffed, parts (including necks/feet and giblets), boneless/skinless parts
Raw intact poultry—other (ducks, geese, squab)	Whole bird not stuffed and stuffed, carcass parts
Raw ground, comminuted, or otherwise nonintact beef	Ground, restructured, tenderized/injected/marinated, AMR ^a
Raw ground, comminuted, or otherwise nonintact pork	Ground, restructured, tenderized/injected/marinated, AMR ^a , MS ^b pork
Raw ground, comminuted, or otherwise nonintact meat—other (sheep, goat)	Ground, restructured, tenderized/injected/marinated
Raw ground, comminuted, or otherwise nonintact chicken	Ground, restructured, tenderized/injected/marinated, MS ^b chicken
Raw ground, comminuted, or otherwise nonintact turkey	Ground, restructured, tenderized/injected/marinated, MS ^b turkey
Raw ground, comminuted, or otherwise nonintact poultry—other (ducks, geese, squab)	Ground, restructured, tenderized/injected/marinated, MS ^b poultry
Raw otherwise processed meat	Batter set nuggets and tenders, char marked patties
Raw otherwise processed poultry	Batter set nuggets and breaded parts, partially cooked rolls and loaves
RTE acidified/fermented meat (without cooking)	Genoa salami, hard salami, pepperoni
RTE acidified/fermented poultry (without cooking)	Turkey pepperoni
RTE dried meat	Dried beef, jerky, landjager, meat sticks, some chorizo
RTE dried poultry	Jerky (basically turkey)
RTE salt-cured meat	Country ham, prosciutto, coppa, capocollo, basturma, bresaola
RTE salt-cured poultry	Ducks, geese
RTE fully cooked meat	Hot dogs, deli meats, roasts
RTE fully cooked poultry	Whole birds, parts, hot dogs, deli items, roasts
RTE meat fully cooked without subsequent exposure to the environment	Cooked in package (canned ham (not shelf stable), cook-in-bag), hot packed (chili, sauces, soups)
RTE poultry fully cooked without subsequent exposure to the environment	Cooked in package (cook-in-bag), hot packed (soups)
Thermally processed, commercially sterile	Canned meat or poultry products (canned ham, canned chicken, chili, sauces, soups)

^aAMR = Advanced Meat Recovery.

^bMS = Mechanically separated.

a slaughter plant, trim producer, grinder, or other firm with average or typical food safety controls.

- The processing plant's food safety controls are average or typical; do not think of extreme or unusual processing situations.
- The products receive typical handling by all parties from the time the products leave the processing plant through the time they are consumed (so you may account for safe handling or mishandling if you believe either to be typical).
- Raw products are cooked before consumption.
- None of the products are irradiated.
- In regard to the ready-to-eat (RTE) products:
 - Unless specifically stated in the product description on the worksheet, all are exposed to the environment during handling after lethality treatment(s);
 - None contain an additive to inhibit growth of *L. monocytogenes*; and
 - None receive any postlethality treatment to destroy *L. monocytogenes*.

In the sections that follow, we present the expert panel results related to the likelihood of illness among *healthy adult* consumers and *vulnerable* consumers due to consuming or handling each of the 25 finished product types and the burden of illness that is caused by specific pathogens and meat and poultry product combinations. The results presented here aggregate experts' rankings across all three areas of confidence. The individual rankings were provided to FSIS in three Excel spreadsheets.¹ The worksheets also contain brief comments provided by the experts on their individual estimates.

3.2 THE LIKELIHOOD OF ILLNESS DUE TO CONSUMING OR HANDLING PROCESSED MEAT AND POULTRY PRODUCTS

The purpose of the expert elicitation was to rank the public health risks posed by bacterial hazards in each of 25 categories of processed meat and poultry products.

¹ As noted previously, RTI also provided FSIS with a spreadsheet that contains the rankings from all 17 experts who participated.

Using a scale of 1 to 10, the panel was asked to rank the likelihood of illness from consuming or handling each of the 25 finished product types among *healthy adult* consumers (Worksheet 1) and then among *vulnerable* consumers (Worksheet 2). Vulnerable consumers were defined as the very young, the elderly, pregnant women and their fetuses, and those with compromised immune systems.

In this scale, a value of 1 represented the least likelihood of illness and a value of 10 represented the greatest likelihood of illness. The panelists could assign the same score to two or more products if they believed that the likelihood was the same for multiple products. The experts were required to assign at least one product category with a value of 1 and at least one product category with a value of 10. The panelists could also use fractions between the numbers 1 and 10.

Table 3-2 presents the median, minimum, and maximum scores for each product category for *healthy adult* consumers based on the completed worksheets from all 12 experts. Table 3-3 presents the corresponding information for *vulnerable* consumers.

In both tables, **thermally processed, commercially sterile** products were ranked as having the lowest risk, and **raw ground, comminuted, or otherwise nonintact chicken** products were ranked as having the highest risk. In general, results are similar between the two worksheets. In particular,

- raw products were generally assigned higher rankings, and RTE products were generally assigned lower rankings, and
- poultry products generally were ranked higher than red meat products.

However, the opinions of the experts varied substantially with the full range of scores used for many of the product categories.

The panel was also asked to indicate their level of confidence in their rankings for each of the finished product categories: 1 indicates a low level, 2 indicates a medium level, and 3 indicates a high level of confidence. For the *healthy adult* population, the panel had at least a medium level of confidence in 16 of the 25 product categories. For *vulnerable consumers*,

Table 3-2. Ranking of Product Categories by the Likelihood of Illness Among *Healthy Adults* as a Result of Consuming or Handling Each of 25 Finished Product Types

Finished Product Type	Median Score	Minimum Score	Maximum Score	Level of Confidence
Raw intact beef	5.5	1.0	8.0	2.6
Raw intact pork	5.0	1.0	8.0	2.5
Raw intact meat—other than beef or pork	5.5	1.0	8.0	1.7
Raw intact chicken	8.0	2.0	10.0	2.6
Raw intact turkey	8.0	2.0	10.0	2.5
Raw intact poultry—other than chicken or turkey	8.0	1.0	9.0	1.9
Raw ground, comminuted, or otherwise nonintact beef	8.0	3.0	10.0	2.5
Raw ground, comminuted, or otherwise nonintact pork	6.0	2.0	10.0	2.3
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	7.0	1.0	10.0	1.7
Raw ground, comminuted, or otherwise nonintact chicken	10.0	4.0	10.0	2.6
Raw ground, comminuted, or otherwise nonintact turkey	9.0	4.0	10.0	2.3
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	8.5	1.0	10.0	1.8
Raw otherwise processed meat	7.0	1.0	8.0	1.9
Raw otherwise processed poultry	7.0	2.0	10.0	2.0
RTE acidified/fermented meat (without cooking)	3.5	1.0	7.0	1.9
RTE acidified/fermented poultry (without cooking)	4.0	1.0	6.0	1.9
RTE dried meat	3.0	1.0	5.0	2.0
RTE dried poultry	3.0	1.0	5.0	2.0
RTE salt-cured meat	3.0	1.0	6.0	1.9
RTE salt-cured poultry	3.0	1.0	8.0	1.8
RTE fully cooked meat	2.5	1.0	8.0	2.6
RTE fully cooked poultry	3.0	1.0	8.0	2.6
RTE meat fully cooked without subsequent exposure to the environment	1.6	1.0	4.0	2.4
RTE poultry fully cooked without subsequent exposure to the environment	1.6	1.0	4.0	2.5
Thermally processed, commercially sterile	1.0	1.0	1.0	2.5

Table 3-3. Ranking of Product Categories by the Likelihood of Illness Among *Vulnerable Consumers* as a Result of Consuming or Handling Each of 25 Finished Product Types

Finished Product Type	Median	Minimum	Maximum	Level of Confidence
Raw intact beef	5.5	1.0	9.0	2.6
Raw intact pork	5.5	1.0	8.0	2.6
Raw intact meat—other than beef or pork	6.5	1.0	8.0	2.0
Raw intact chicken	8.5	4.0	10.0	2.6
Raw intact turkey	8.0	4.0	10.0	2.6
Raw intact poultry—other than chicken or turkey	8.0	2.0	9.0	2.1
Raw ground, comminuted, or otherwise nonintact beef	9.5	4.0	10.0	2.5
Raw ground, comminuted, or otherwise nonintact pork	7.0	2.0	10.0	2.5
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	7.5	1.0	10.0	1.8
Raw ground, comminuted, or otherwise nonintact chicken	10.0	4.0	10.0	2.6
Raw ground, comminuted, or otherwise nonintact turkey	9.0	4.0	10.0	2.5
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	9.0	2.0	10.0	2.0
Raw otherwise processed meat	7.5	3.0	9.0	2.1
Raw otherwise processed poultry	7.5	2.0	10.0	2.1
RTE acidified/fermented meat (without cooking)	5.0	1.0	7.0	2.0
RTE acidified/fermented poultry (without cooking)	5.0	1.0	8.0	2.0
RTE dried meat	4.0	1.0	6.0	2.1
RTE dried poultry	4.0	1.0	6.0	2.1
RTE salt-cured meat	3.3	1.0	7.0	2.0
RTE salt-cured poultry	3.3	1.0	9.0	2.0
RTE fully cooked meat	5.5	1.0	10.0	2.7
RTE fully cooked poultry	5.0	1.0	10.0	2.7
RTE meat fully cooked without subsequent exposure to the environment	2.0	1.0	5.0	2.5
RTE poultry fully cooked without subsequent exposure to the environment	2.0	1.0	5.0	2.4
Thermally processed, commercially sterile	1.0	1.0	1.0	2.5

the panel had at least a medium level of confidence in 24 of the 25 product categories.

3.3 ATTRIBUTION OF FOODBORNE ILLNESSES TO SPECIFIC PATHOGENS AS A RESULT OF CONSUMING OR HANDLING PROCESSED MEAT AND POULTRY PRODUCTS

The experts were also asked to attribute foodborne illnesses of five pathogens to handling and consuming foods in 25 processed meat and poultry product categories. Tables 3-4 through 3-8 provide the aggregated results of attribution by product category for each of the five pathogens. The percentages provide an estimate of illnesses resulting from handling and consuming each category of processed meat and poultry products. The products with the highest attribution percentages for each of the pathogens were as follows:

- *Salmonella* (non-typhi): raw intact chicken (22%); raw intact turkey (14%); and raw ground, comminuted, or otherwise nonintact chicken (9%).
- *Salmonella* (multidrug resistant): raw ground, comminuted, or otherwise nonintact beef (20%); raw intact chicken (19%); and raw ground, comminuted, or otherwise nonintact chicken (8%).
- *E. coli* O157:H7: raw ground, comminuted, or otherwise nonintact beef (57%); raw ground, comminuted, or otherwise nonintact meat—other than beef or pork (14%); and raw intact beef (8%).
- *Listeria monocytogenes*: RTE fully cooked meat (30%); RTE fully cooked poultry (25%), and RTE acidified/fermented meat (without cooking) (6%).
- *Campylobacter jejuni/coli*: raw intact chicken (36%); raw intact turkey (13%); and raw ground, comminuted, or otherwise nonintact chicken (12%).

Thermally processed, commercially sterile products had the lowest mean attribution (0.1% or less) across all pathogens.

The products with the highest attribution percentages for each of the pathogens were also the products with the widest range of attribution percentages. The wider ranges indicate less agreement among the experts.

Table 3-4. Attribution of Foodborne Illnesses of *Salmonella* (Non-Typhi) to Consuming or Handling Foods in 25 Processed Meat and Poultry Product Categories

Finished Product Type	Mean	Minimum	Maximum
Raw intact beef	4.6%	0.0%	15.0%
Raw intact pork	2.8%	0.0%	9.0%
Raw intact meat—other than beef or pork	2.7%	0.5%	10.0%
Raw intact chicken	22.0%	10.0%	50.0%
Raw intact turkey	14.1%	3.0%	40.0%
Raw intact poultry—other than chicken or turkey	3.7%	0.5%	10.0%
Raw ground, comminuted, or otherwise nonintact beef	8.4%	2.0%	22.0%
Raw ground, comminuted, or otherwise nonintact pork	4.3%	0.0%	10.0%
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	2.2%	0.0%	5.0%
Raw ground, comminuted, or otherwise nonintact chicken	8.9%	1.0%	20.0%
Raw ground, comminuted, or otherwise nonintact turkey	6.8%	1.0%	15.0%
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	2.8%	0.0%	10.0%
Raw otherwise processed meat	3.5%	0.0%	10.0%
Raw otherwise processed poultry	5.6%	0.0%	15.0%
RTE acidified/fermented meat (without cooking)	1.0%	0.0%	3.0%
RTE acidified/fermented poultry (without cooking)	1.6%	0.0%	3.0%
RTE dried meat	0.9%	0.0%	4.0%
RTE dried poultry	1.0%	0.0%	4.0%
RTE salt-cured meat	0.5%	0.0%	1.0%
RTE salt-cured poultry	0.6%	0.0%	2.0%
RTE fully cooked meat	0.5%	0.0%	1.0%
RTE fully cooked poultry	1.0%	0.0%	5.0%
RTE meat fully cooked without subsequent exposure to the environment	0.3%	0.0%	2.0%
RTE poultry fully cooked without subsequent exposure to the environment	0.3%	0.0%	2.0%
Thermally processed, commercially sterile	0.0%	0.0%	0.0%
Total	100%		
Mean Level of Confidence	2.2		

Table 3-5. Attribution of Foodborne Illnesses of *Salmonella* (Multidrug Resistant) to Consuming or Handling Foods in 25 Processed Meat and Poultry Product Categories

Finished Product Type	Mean	Minimum	Maximum
Raw intact beef	5.3%	0.0%	14.0%
Raw intact pork	2.6%	0.0%	8.0%
Raw intact meat—other than beef or pork	2.3%	0.0%	10.0%
Raw intact chicken	19.3%	1.0%	60.0%
Raw intact turkey	8.1%	0.0%	25.0%
Raw intact poultry—other than chicken or turkey	2.5%	0.0%	10.0%
Raw ground, comminuted, or otherwise nonintact beef	20.0%	1.0%	74.0%
Raw ground, comminuted, or otherwise nonintact pork	6.2%	0.0%	12.0%
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	2.4%	0.0%	15.0%
Raw ground, comminuted, or otherwise nonintact chicken	8.2%	0.0%	16.0%
Raw ground, comminuted, or otherwise nonintact turkey	6.7%	0.0%	16.0%
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	2.2%	0.0%	5.0%
Raw otherwise processed meat	3.1%	0.0%	10.0%
Raw otherwise processed poultry	4.3%	0.0%	16.0%
RTE acidified/fermented meat (without cooking)	0.9%	0.0%	3.0%
RTE acidified/fermented poultry (without cooking)	1.5%	0.0%	5.0%
RTE dried meat	0.4%	0.0%	1.0%
RTE dried poultry	0.6%	0.0%	2.0%
RTE salt-cured meat	0.3%	0.0%	1.0%
RTE salt-cured poultry	0.8%	0.0%	2.0%
RTE fully cooked meat	0.5%	0.0%	2.0%
RTE fully cooked poultry	0.9%	0.0%	7.0%
RTE meat fully cooked without subsequent exposure to the environment	0.5%	0.0%	5.0%
RTE poultry fully cooked without subsequent exposure to the environment	0.6%	0.0%	5.0%
Thermally processed, commercially sterile	0.0%	0.0%	0.0%
Total	100%		
Mean Level of Confidence	1.7		

Table 3-6. Attribution of Foodborne Illnesses of *E. coli* O157:H7 to Consuming or Handling Foods in 25 Processed Meat and Poultry Product Categories

Finished Product Type	Mean	Minimum	Maximum
Raw intact beef	8.4%	0.0%	20.0%
Raw intact pork	1.3%	0.0%	7.0%
Raw intact meat—other than beef or pork	2.6%	0.0%	20.0%
Raw intact chicken	1.1%	0.0%	12.0%
Raw intact turkey	0.3%	0.0%	3.0%
Raw intact poultry—other than chicken or turkey	0.7%	0.0%	6.0%
Raw ground, comminuted, or otherwise nonintact beef	57.0%	0.0%	92.0%
Raw ground, comminuted, or otherwise nonintact pork	1.4%	0.0%	5.0%
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	13.8%	0.0%	75.0%
Raw ground, comminuted, or otherwise nonintact chicken	0.4%	0.0%	3.0%
Raw ground, comminuted, or otherwise nonintact turkey	0.3%	0.0%	2.0%
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	0.4%	0.0%	3.0%
Raw otherwise processed meat	2.9%	0.0%	7.0%
Raw otherwise processed poultry	0.6%	0.0%	4.0%
RTE acidified/fermented meat (without cooking)	4.2%	0.0%	15.0%
RTE acidified/fermented poultry (without cooking)	0.3%	0.0%	3.0%
RTE dried meat	1.3%	0.0%	5.0%
RTE dried poultry	0.2%	0.0%	1.0%
RTE salt-cured meat	0.8%	0.0%	5.0%
RTE salt-cured poultry	0.2%	0.0%	1.0%
RTE fully cooked meat	1.1%	0.0%	8.0%
RTE fully cooked poultry	0.2%	0.0%	1.0%
RTE meat fully cooked without subsequent exposure to the environment	0.3%	0.0%	2.0%
RTE poultry fully cooked without subsequent exposure to the environment	0.3%	0.0%	2.0%
Thermally processed, commercially sterile	0.0%	0.0%	0.0%
Total	100%		
Mean Level of Confidence	2.3		

Table 3-7. Attribution of Foodborne Illnesses of *Listeria Monocytogenes* to Consuming or Handling Foods in 25 Processed Meat and Poultry Product Categories

Finished Product Type	Mean	Minimum	Maximum
Raw intact beef	1.4%	0.0%	10.0%
Raw intact pork	0.6%	0.0%	5.0%
Raw intact meat—other than beef or pork	0.4%	0.0%	3.0%
Raw intact chicken	1.3%	0.0%	10.0%
Raw intact turkey	0.8%	0.0%	5.0%
Raw intact poultry—other than chicken or turkey	1.4%	0.0%	7.0%
Raw ground, comminuted, or otherwise nonintact beef	1.9%	0.0%	15.0%
Raw ground, comminuted, or otherwise nonintact pork	0.9%	0.0%	5.0%
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	0.8%	0.0%	4.0%
Raw ground, comminuted, or otherwise nonintact chicken	1.3%	0.0%	5.0%
Raw ground, comminuted, or otherwise nonintact turkey	1.2%	0.0%	5.0%
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	0.9%	0.0%	5.0%
Raw otherwise processed meat	1.5%	0.0%	8.0%
Raw otherwise processed poultry	1.4%	0.0%	7.0%
RTE acidified/fermented meat (without cooking)	6.4%	0.0%	40.0%
RTE acidified/fermented poultry (without cooking)	4.4%	0.0%	20.0%
RTE dried meat	3.2%	0.0%	20.0%
RTE dried poultry	3.2%	0.0%	20.0%
RTE salt-cured meat	3.6%	0.0%	20.0%
RTE salt-cured poultry	4.0%	0.0%	20.0%
RTE fully cooked meat	30.2%	0.0%	95.0%
RTE fully cooked poultry	25.0%	0.0%	58.0%
RTE meat fully cooked without subsequent exposure to the environment	2.1%	0.0%	10.0%
RTE poultry fully cooked without subsequent exposure to the environment	2.0%	0.0%	12.0%
Thermally processed, commercially sterile	0.1%	0.0%	1.0%
Total	100%		
Mean Level of Confidence	2.4		

Table 3-8. Attribution of Foodborne Illnesses of *Campylobacter jejuni/coli* to Consuming or Handling Foods in 25 Processed Meat and Poultry Product Categories

Finished Product Type	Mean ^a	Minimum ^a	Maximum ^a
Raw intact beef	2.2%	0.0%	8.0%
Raw intact pork	2.5%	0.0%	10.0%
Raw intact meat—other than beef or pork	1.4%	0.0%	5.0%
Raw intact chicken	36.1%	5.0%	90.0%
Raw intact turkey	12.6%	2.0%	39.6%
Raw intact poultry—other than chicken or turkey	4.3%	0.0%	10.0%
Raw ground, comminuted, or otherwise nonintact beef	2.4%	0.0%	8.0%
Raw ground, comminuted, or otherwise nonintact pork	2.9%	0.0%	15.0%
Raw ground, comminuted, or otherwise nonintact meat—other than beef or pork	1.1%	0.0%	6.0%
Raw ground, comminuted, or otherwise nonintact chicken	12.4%	0.0%	25.0%
Raw ground, comminuted, or otherwise nonintact turkey	7.7%	0.0%	20.0%
Raw ground, comminuted, or otherwise nonintact poultry—other than chicken or turkey	2.3%	0.0%	10.0%
Raw otherwise processed meat	1.8%	0.0%	10.0%
Raw otherwise processed poultry	6.6%	0.0%	20.0%
RTE acidified/fermented meat (without cooking)	0.3%	0.0%	2.0%
RTE acidified/fermented poultry (without cooking)	1.2%	0.0%	5.0%
RTE dried meat	0.2%	0.0%	1.0%
RTE dried poultry	0.4%	0.0%	2.0%
RTE salt-cured meat	0.1%	0.0%	1.0%
RTE salt-cured poultry	0.3%	0.0%	2.0%
RTE fully cooked meat	0.2%	0.0%	1.0%
RTE fully cooked poultry	0.7%	0.0%	5.0%
RTE meat fully cooked without subsequent exposure to the environment	0.1%	0.0%	1.0%
RTE poultry fully cooked without subsequent exposure to the environment	0.3%	0.0%	2.0%
Thermally processed, commercially sterile	0.0%	0.0%	0.0%
Total	100%		
Mean Level of Confidence	2.0		

^aOne respondent entered values that did not sum to 100. The responses were normalized to 100% using the initial response distribution. The normalized responses were included in the analysis.

On average, the experts rated their level of confidence as medium for each of the pathogens included in the worksheets. The experts had the lowest confidence for *Salmonella* (multidrug resistant) with a mean score of 1.7 and the highest confidence for *Listeria monocytogenes* with a mean score of 2.4.

4

Reference

Karns, S., M. Muth, and M. Cogliati. September 2005.
Memorandum prepared for USDA, FSIS. "Relative Risks
of Meat and Poultry Products: An Expert Elicitation."
[http://www.fsis.usda.gov/PDF/Elicitation_Memo_092205
.pdf](http://www.fsis.usda.gov/PDF/Elicitation_Memo_092205.pdf).

Appendix A: Elicitation Materials

PROJECT DESCRIPTION
THE LIKELIHOOD AND ATTRIBUTION OF FOODBORNE ILLNESSES DUE TO
CONSUMING OR HANDLING PROCESSED MEAT AND POULTRY PRODUCTS: AN
EXPERT ELICITATION

RTI Project No. 0208893.027

Description

The U.S. Department of Agriculture, Food Safety and Inspection Service (USDA, FSIS) has contracted with RTI International (RTI) to assist in conducting an expert elicitation. The purposes of this expert elicitation are to:

- (1) rank the public health risks posed by bacterial hazards in each of 25 categories of processed meat and poultry products for healthy adults and for vulnerable consumers and
- (2) estimate the percentages of U.S. illnesses caused by consuming or handling meat and poultry and attributed to specific meat or poultry product and bacterial pathogen combinations.

We are asking for your assistance as a participant in the expert elicitation process to complete three worksheets. Worksheets 1 and 2 concern the likelihood of illness among healthy adult consumers and vulnerable consumers. Worksheet 3 concerns the burden of illness that is caused by specific meat or poultry product and bacterial pathogen combinations. While scoring the categories, we will ask that you consider only biological hazards, i.e., pathogens. The results of the expert elicitation will be used by FSIS in the development of its risk-based inspection initiatives.

What We Would Need from You

If you agree to participate in the expert elicitation process, you will need to do the following:

- complete the accompanying Interest Form;
- review the three worksheets you will be completing for the expert elicitation;
- participate in a 45-minute teleconference to discuss the worksheets and ask questions about the process;
- using resources at your disposal, complete the worksheets providing your best estimates of the needed information within one week of the initial teleconference; and
- deliver your responses to the worksheets and a list of citations to RTI by Federal Express or e-mail.

To compensate you for your time, we will pay you an honorarium of \$250 for completing the worksheets. If you are not able to accept the honorarium, we would still like to encourage your participation.

For additional information on this project, you can contact:

Shawn Karns
Food and Agricultural Policy Research Program
RTI International
Research Triangle Park, NC 27709-2194
E-mail: karns@rti.org
Phone: 919-541-6380

RTI is an independent, nonprofit organization that serves clients in government, industry, academia, and public service throughout the United States and abroad. Our headquarters are located on a 180-acre campus in Research Triangle Park, NC, and we employ a worldwide staff of more than 2,000 people. The Food and Agriculture Policy Program at RTI has been conducting analyses of the economic effects of food safety and nutrition regulations for USDA and FDA for more than 15 years.

**WORKSHEETS ON THE LIKELIHOOD AND ATTRIBUTION OF FOODBORNE
ILLNESSES DUE TO CONSUMING OR HANDLING PROCESSED MEAT AND
POULTRY PRODUCTS: AN EXPERT ELICITATION**

The purpose of this expert elicitation is to rank the public health risks posed by bacterial hazards in each of 25 categories of processed meat and poultry products. Along with the risks posed by meat and poultry products to healthy adults, we will be eliciting your opinion about risks to the vulnerable population, who are the most susceptible to severe foodborne illnesses. FSIS will use the data from this elicitation as one factor in determining how to allocate inspection resources. You will complete 3 worksheets. We are asking you to:

- 1) Rank product categories by the likelihood of illness among *healthy adults* due to consuming or handling various types of processed meat and poultry products;
- 2) Rank product categories by the likelihood of illness among *vulnerable* consumers due to consuming or handling various types of processed meat and poultry products; and
- 3) Estimate the percentages of U.S. illnesses caused by consuming or handling meat and poultry and attributed to specific meat or poultry product and bacterial pathogen combinations.

If you have questions, please contact Shawn Karns at 919-541-6380 or karns@rti.org.

Please return the completed worksheet by email, fax, or FedEx:

Email: coglaiti@rti.org

Fax: 919-541-6683, Attn: Michaela Cimini Coglaiti

FedEx: Michaela Cimini Coglaiti
RTI International
REPR, Hobbs 123
3040 Cornwallis Rd.
Research Triangle Park, NC 27709-2194
(919) 990-8498

Assumptions - Worksheets 1 and 2

Consider only bacterial hazards. Do not consider illness caused by viruses, chemical hazards or physical hazards. Take into account all that you know about meat and poultry science, food processing, food transport, consumer handling, and foodborne illness, but assume the following when scoring:

- Each of the 25 finished products will reach the consumer without further processing at another establishment or at retail. Examples of each of the finished product types are provided in the attached table titled "Finished Product Type Examples."
- Each product is produced in a USDA-regulated processing plant that operates under sanitation standard operating procedures (SSOP) and a Hazard Analysis Critical Control Point (HACCP) system.
- The incoming source material (raw meat or poultry and other ingredients) for the processed product comes from a slaughter plant, trim producer, grinder, or other firm with average or typical food safety controls.
- The processing plant's food safety controls are average or typical; do not think of extreme or unusual processing situations.
- The products receive typical handling by all parties from the time the products leave the processing plant through the time they are consumed (so you may account for safe handling or mishandling if you believe either to be typical).
- Raw products are cooked before consumption.
- None of the products are irradiated.
- In regard to the ready-to-eat (RTE) products:
 - Unless specifically stated in the product description on the worksheet, all are exposed to the environment during handling after lethality treatment(s);
 - None contain an additive to inhibit growth of *L. monocytogenes*;
 - None receive any post-lethality treatment to destroy *L. monocytogenes*.

Scoring Instructions - Worksheets 1 and 2

The finished product types are listed in the first column. Example products of each type are given in the attached table.

In the second column, using a scale of 1 through 10, rank the likelihood of illness from consuming or handling each of the 25 finished product types among **healthy adult** consumers (Worksheet 1) and then among **vulnerable consumers** (Worksheet 2). Vulnerable consumers are the very young, the elderly, pregnant women and their fetuses, and those with compromised immune systems. Remember to consider only illnesses caused by bacteria.

In this scale, "1" represents the least likelihood of illness and "10" represents the greatest likelihood of illness. You may use fractions. You also may score two or more product types the same if you believe the likelihood is the same, including your highest and lowest rankings. You must rank at least one product type as a "1" and another as a "10."

When you enter your ranking for each type of processed product, imagine that the product is on a consumer's kitchen counter. The product has been produced, handled and shipped according to the assumptions for Worksheets 1 and 2. The consumer will handle and prepare the product "typically," i.e. in the manner most consumers would handle and prepare the product, which could be properly or improperly. Possible illness will result either from consuming or handling the product.

After you have ranked each of the 25 products indicating the likelihood of illness, then tell us how confident you are about each estimate in the next column. If you are very confident given your knowledge and experience, place a "3" in the cell corresponding to the estimate. If you are moderately confident, enter a "2." If you have little confidence in your estimate for a particular estimate, perhaps because you have little or no knowledge of or experience with illness from a product type, enter a "1" in the cell.

Finally, enter any comments you have about each ranking in the cells in the final column. If you attribute your estimate to a particular pathogen or pathogens, please say so. If your estimate is based upon specific knowledge about industrial processing, shipping and handling, or consumer preparation of a specific product category, please say so.

Please complete your scores for all worksheets independently without discussing them with the other experts. If you have questions, please contact Shawn Karns at 919-541-6380 or karns@rti.org.

Worksheet 1. How do you rank the likelihood of illness among *healthy adults* due to consuming or handling each of 25 finished product types?

1 (You may use fractions) 10
 Least Likely to cause illness Most likely to cause illness

Finished product type	Likelihood of illness among healthy adults (1 to 10)	Confidence Level 1=low 2=medium 3=high	Brief explanation of your score: specify bacterial pathogen(s) or assumptions made
Raw intact beef			
Raw intact pork			
Raw intact meat – other than beef or pork			
Raw intact chicken			
Raw intact turkey			
Raw intact poultry – other than chicken or turkey			
Raw ground, comminuted, or otherwise non-intact beef			
Raw ground, comminuted, or otherwise non-intact pork			
Raw ground, comminuted, or otherwise non-intact meat – other than beef or pork			
Raw ground, comminuted, or otherwise non-intact chicken			
Raw ground, comminuted, or otherwise non-intact turkey			
Raw ground, comminuted, or otherwise non-intact poultry – other than chicken or turkey			
Raw otherwise processed meat			
Raw otherwise processed poultry			
RTE acidified/fermented meat (without cooking)			
RTE acidified/fermented poultry (without cooking)			
RTE dried meat			
RTE dried poultry			
RTE salt - cured meat			
RTE salt - cured poultry			
RTE fully - cooked meat			
RTE fully - cooked poultry			
RTE meat fully-cooked without subsequent exposure to the environment			
RTE poultry fully-cooked without subsequent exposure to the environment			
Thermally processed, commercially sterile			

Scoring Instructions – Worksheet 3

This instrument elicits your expert opinion regarding the burden of illness that is caused by specific pathogens and that can be attributed to the specific categories of meat and poultry products. The estimates you provide through this exercise will be used with other existing epidemiological and clinical data to estimate a burden of illness for processed meat and poultry products.

For each of the foodborne pathogens listed below, estimate the percentage of human illnesses attributable to consumer handling and consumption of each processed meat and poultry product type relative to the total number of illnesses caused by the handling and consumption of all processed meat and poultry products in the U.S.

For example, of all the foodborne illness attributable only to meat and poultry products and caused by *Salmonella* spp. (Non-Typhi), tell us what percentage you estimate is attributable to raw intact beef. Each column should add up to 100%. You may attribute 0% of illnesses to product types.

At the bottom of each column, please tell us how confident you are about your estimates for that pathogen. If you are very confident given your knowledge and experience, place a "3" in the cell corresponding to the estimates. If you are moderately confident, enter a "2." If you have little confidence in your estimates, perhaps because you have little or no knowledge of or experience with the bacterial pathogen in meat and poultry products, enter a "1" in the cell.

On the page provided after the worksheet, please give any details necessary to explain your estimates. If you have research results in mind, please cite them.

If you have questions, please contact Shawn Karns at 919-541-6380 or karns@rti.org.

Worksheet 3. Among the illnesses caused by each pathogen and attributable only to the consumption or handling of contaminated processed meat and poultry products, what percentage of those is attributable to each specific product type below?

Finished product type	<i>Salmonella</i> (Non-Typhi) %	<i>Salmonella</i> (Multi-drug Resistant) %	<i>E. coli</i> O157:H7 %	<i>Listeria</i> <i>Monocytogenes</i> %	<i>Campylobacter</i> <i>jejuni/coli</i> %
Raw intact beef					
Raw intact pork					
Raw intact meat – other than beef or pork					
Raw intact chicken					
Raw intact turkey					
Raw intact poultry – other than chicken or turkey					
Raw ground, comminuted, or otherwise non-intact beef					
Raw ground, comminuted, or otherwise non-intact pork					
Raw ground, comminuted, or otherwise non-intact meat – other than beef or pork					
Raw ground, comminuted, or otherwise non-intact chicken					
Raw ground, comminuted, or otherwise non-intact turkey					
Raw ground, comminuted, or otherwise non-intact poultry – other than chicken or turkey					
Raw otherwise processed meat					
Raw otherwise processed poultry					
RTE acidified/fermented meat (without cooking)					
RTE acidified/fermented poultry (without cooking)					
RTE dried meat					
RTE dried poultry					
RTE salt - cured meat					
RTE salt - cured poultry					
RTE fully - cooked meat					
RTE fully - cooked poultry					
RTE meat fully-cooked without subsequent exposure to the environment					
RTE poultry fully-cooked without subsequent exposure to the environment					
Thermally processed, commercially sterile					
Total	100%	100%	100%	100%	100%
Your confidence level in your estimates 1=low; 2=medium; 3=high					

Comments/Citations for Worksheet 3

Thank you for completing the worksheets!

Finished Product Type Examples

Finished Product Type	Product Examples
Raw intact beef	Steaks, roasts
Raw intact pork	Chops, roasts, ribs, loins
Raw intact meat – other (sheep, goat)	Chops, roasts
Raw intact chicken	Whole bird not stuffed and stuffed, parts (including necks/feet and giblets), boneless/skinless parts
Raw intact turkey	Whole bird not stuffed and stuffed, parts (including necks/feet and giblets), boneless/skinless parts
Raw intact poultry – other (ducks, geese, squab)	Whole bird not stuffed and stuffed, carcass parts
Raw ground, comminuted, or otherwise non-intact beef	Ground, restructured, tenderized/injected/marinated, AMR
Raw ground, comminuted, or otherwise non-intact pork	Ground, restructured, tenderized/injected/marinated, AMR, MS pork
Raw ground, comminuted, or otherwise non-intact meat – other (sheep, goat)	Ground, restructured, tenderized/injected/marinated
Raw ground, comminuted, or otherwise non-intact chicken	Ground, restructured, tenderized/injected/marinated, MS chicken
Raw ground, comminuted, or otherwise non-intact turkey	Ground, restructured, tenderized/injected/marinated, MS turkey
Raw ground, comminuted, or otherwise non-intact poultry – other (ducks, geese, squab)	Ground, restructured, tenderized/injected/marinated, MS Poultry
Raw otherwise processed meat	Batter set nuggets and tenders, char marked patties
Raw otherwise processed poultry	Batter set nuggets and breaded parts, partially cooked rolls and loaves
RTE acidified/fermented meat (without cooking)	Genoa salami, hard salami, pepperoni
RTE acidified/fermented poultry (without cooking)	Turkey pepperoni
RTE dried meat	Dried beef, jerky, landjager, meat sticks, some chorizo
RTE dried poultry	Jerky (basically turkey)
RTE salt-cured meat	Country ham, prosciutto, coppa, capocollo, basturma, bresaola
RTE salt-cured poultry	Ducks, geese
RTE fully-cooked meat	Hot dogs, deli meats, roasts
RTE fully-cooked poultry	Whole birds, parts, hot dogs, deli items, roasts
RTE meat fully-cooked without subsequent exposure to the environment	Cooked in package (canned ham (not shelf stable), cook-in-bag), hot packed (chili, sauces, soups)
RTE poultry fully-cooked without subsequent exposure to the environment	Cooked in package (cook-in-bag), hot packed (soups)
Thermally processed, commercially sterile	Canned meat or poultry products (canned ham, canned chicken, chili, sauces, soups)

AMR = Advanced Meat Recovery.

MS = Mechanically separated.