Poultry Inspection

The Basis for a Risk-Assessment Approach

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The Basis for a Risk-Assessment Approach

Prepared by the Committee on
Public Health Risk Assessment of
Poultry Inspection Programs

Food and Nutrition Board
Commission on Life Sciences
National Research Council

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PREFACE

In 1985, a committee of the National Research Council's Food and Nutrition Board (FNB) completed a report on the scientific basis of the Department of Agriculture's (USDA) meat and poultry inspection programs. In that study, at the request of the Food Safety and Inspection Service (FSIS) the committee specifically considered whether bird-by-bird inspection as currently done should be modified to a less-than-continuous procedure. The committee concluded that before the traditional postmortem inspection methods are displaced, a comparative risk analysis of traditional and modified inspection procedures is needed. In other words, FSIS should first determine the relative effectiveness of the inspection procedures that would replace the traditional methods. In response to this observation, the FSIS Administrator requested that the National Research Council conduct a follow-up study, specifically regarding poultry production, with the following objectives:

- Development of a risk-assessment model applicable to the poultry production system and an explanation of how it might be used to evaluate poultry inspection procedures.
- A general evaluation of current FSIS poultry inspection programs using the conceptual framework of the model.
- An assessment of the advantages of incorporating statistical sampling into poultry inspection procedures.

In response, a committee was appointed to conduct the study under the auspices of FNB within the Commission on Life Sciences. The multidisciplinary group appointed contained members with expertise in public health, food microbiology, toxicology, risk assessment, risk management, veterinary pathology, poultry inspection technology, biostatistics, and epidemiology. In cooperation with FSIS a formal charge was developed to guide the committee's work.

The information used to prepare this report included data from FSIS, the scientific literature, and other sources. The committee also had the opportunity to visit and inspect two poultry production plants. Opinions regarding the usefulness of poultry inspection were heard from federal veterinarians, poultry producers, and consumer representatives. The committee met five times during the study to review and evaluate this information with the goal of producing a report with conclusions and recommendations that would be useful to FSIS.

A summary of the committee's findings, conclusions, and recommendations appears in Chapter 1, The Executive Summary. Chapter 2 provides a historical background and a description of current poultry procedures. In Chapter 3 the committee describes its risk model. Chapters 4 and 5 apply the model to identify risks associated with

microbiological and chemical contamination of poultry. The current FSIS poultry inspection program is evaluated in Chapter 6. Chapter 7 is a review of the conclusions and recommendations of the committee.

The committee expresses its appreciation to the following USDA staff members who were instrumental in arranging the site visit and providing information about poultry inspection procedures: Douglas Berndt, Robert Cook, William James, Marshall McCoulskey, Judith Segal, and John Prucha.

The committee is grateful for the invaluable assistance of the following people who provided testimony or written material: Diane Heiman, Public Voice for Food and Health Policy; Edward Mennings, National Association of Federal Veterinarians; Carl Telleen, National Joint Council for Food Inspection Locals; and Frank Craig, National Broiler Council. The committee is also grateful to Frederick A. Murphy, Leigh A. Sawyer, and Jeffrey A. Farrar of the Division of Viral Diseases, Center for Infectious Diseases, Centers for Disease Control, who provided information on avian viral diseases.

On behalf of the committee I would also like to thank Zain Abedin, Farid Ahmed, Shakuntala Chaube, and Robert Mathews of the FNB staff for providing the organizational and administrative support needed to complete the report in a timely manner. We wish also to acknowledge the contributions of Sushma Palmer, Director of FNB, and the assistance of Frances Peter, CLS editor; Elizabeth Hamill, FNB research assistant; and Kamar Patel, project secretary.

Of course, the report could not have been completed without the unfailing volunteer efforts of the committee. I am grateful for their commitment to preparing a document of the highest quality.

Joseph Rodricks
Chairman
Committee on Public Health Risk
Assessment of Poultry Inspection
Programs

CONTENTS

CHAPTER 1

EXECUTIVE SUMMARY

The production, slaughter, and distribution of broiler chickens (fryers) has become a major food industry that touches the lives of most Americans. Poultry products are currently consumed at a rate of well over 4 billion birds per year in the United States. Those products that pass through the inspection system required by law are, for the most part, wholesome. But because these products are potentially important vehicles of bacterial and chemical contaminants, the primary government agency charged with the oversight of poultry slaughter, the Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture (USDA), has for the past decade been attempting to improve the effectiveness of poultry inspection by studying, testing, and reviewing several modifications of the existing program. Its goal has been to develop a system that retains the bird-by-bird inspection mandated by law, incorporates new technological advances, and more directly addresses public health concerns.

In 1983, recognizing the need to evaluate these proposed changes in inspection procedures, the Administrator of FSIS requested that the Food and Nutrition Board (FNB) of the National Research Council (NRC) examine the scientific basis of USDA's meat and poultry inspection program. The committee appointed to perform that task, the Committee on the Scientific Basis of the Nation's Meat and Poultry Inspection Programs, thoroughly evaluated current FSIS inspection programs. During the course of its study of those programs the committee observed that it could not find a comprehensive statement of criteria justifying inspection procedures, a systematic data base on contaminants, or a technically complete analysis of the benefits to human health resulting from the inspection process. That is, in general it found that it is not possible to determine from existing data whether current inspection programs actually fulfill their goal of protecting the public health. That committee considered whether to recommend a move to one of the newly proposed, less-than-continuous postmortem inspection systems but concluded that no such changes should be recommended until justified by a detailed risk analysis of the public health risks involved. It recommended that FSIS establish a risk-assessment program and apply formal risk-assessment procedures to assist in planning and evaluating all phases of poultry production in which hazards to public health might occur.

In response to that committee's assessment, which was published in 1985,[1] FSIS requested that FNB conduct another study to develop a risk-assessment model for comparing the effects on public health that might result from different postmortem inspection goals and strategies, to evaluate the public health risks associated with broiler chickens, and to review the advantages of a sampling program as part of an overall quality assurance program for poultry slaughter.

This report describes the findings of the Committee on Public Health Risk Assessment of USDA Poultry Inspection Programs, which was appointed to conduct the second study. The committee began its task by reviewing the ways in which traditional and new inspection procedures are related to public health. It soon decided that to evaluate poultry-related public health risks properly, it would be necessary to consider in addition to postmortem inspection various aspects of the poultry processing system outside the purview of FSIS, for example, growing conditions, preparation and handling, and cooking. Viewing the poultry processing system as a whole, the committee developed a conceptual risk-assessment model that could serve as a prototype for assessing public health risks associated with the entire spectrum of activities involved in poultry production, slaughter, processing, preparation, and consumption (referred to in this summary as the poultry system). It then evaluated the two most important health hazards associated with poultry--microbial and chemical contaminants--within the context of the model.

The conclusions and recommendations described in the following paragraphs derive from the committee's qualitative application of the model to the available information on poultry health hazards. Since the current data base is essentially the same as that used in the 1985 report, the present committee did not conduct another comprehensive evaluation of the FSIS poultry inspection program but, rather, focused on developing the risk-assessment model and delineating how it might be used to evaluate FSIS programs. As requested by FSIS, emphasis in this report has been placed on the use of risk assessment as a tool for evaluation. Some aspects of risk management that may lead to solutions of risk problems by FSIS are briefly described in Chapters 3, 4, and 5.

GENERAL CONCLUSIONS

The committee concluded that a risk-assessment approach is needed to evaluate health hazards associated with poultry. Accordingly, it developed a risk model, which is divided into submodels representing five different phases of the poultry system. These submodels are

[1]The committee's report, Meat and Poultry Inspection: The Scientific Basis of the Nation's Program, was published by the National Academy Press.

further broken down into various components. The model can be used to identify sources of health hazards, to suggest means of controlling their introduction, and to assess uncertainties in the ability to link public health consequences with specific hazards. Because the structure of any model reflects the particular perspective and knowledge of its designers, the conclusions and recommendations of the committee based on its model reflect its perception of how the poultry industry is most logically and usefully subdivided.

As stated in Chapter 3, the committee concluded that the present system of continuous inspection provides little opportunity to detect or control the most significant health risks associated with broiler chickens. Although information is not sufficient for the committee to conclude that the FSIS inspection program has no public health benefits, the weight of the evidence does suggest that the current program can not provide effective protection against the risks presented by microbial agents that are pathogenic to humans.

The committee concluded that risk assessment is one of the most valuable tools available to serve regulatory agencies such as FSIS because it facilitates a structured approach to the evaluation of information as well as an explicit, consistent, and logical treatment of data. Furthermore, it heightens awareness of uncertainties in the data and entails consideration of current scientific knowledge. If risk assessment were to be used by FSIS to identify health hazards associated with poultry, the most likely outcome would be to reduce public exposure to those hazards. This outcome would be dependent on implementing procedures that assign priorities based on the potential for reducing the magnitude of risk associated with a given hazard and on the prevention of risks instead of coping with them after they are present.

An effective risk-management program will consist of several monitoring activities, some of which are outside FSIS authority. Therefore, a comprehensive effort to protect the public from poultry-associated hazards will require an active and consistent liaison between FSIS and other government agencies. Attempts to control these public health risks could be significantly compromised without such interagency cooperation.

The committee confirmed that the current data base can serve as the basis for a comprehensive, quantitative risk assessment only for certain well-characterized chemical residues. For many purposes, however, including initial planning and evaluation of inspection strategies, it is sufficient and useful to perform qualitative assessments, such as that done by the committee in this report.

GENERAL RECOMMENDATIONS

- FSIS should adopt the well-established precepts of risk assessment as an integral part of its strategy to identify and manage

public health risks associated with poultry. The committee's risk model can serve as a prototype that FSIS can refine by applying its extensive knowledge of the poultry system.

- FSIS should evaluate the current inspection system by using the risk-assessment model proposed by the committee and on the basis of its findings, modify the system so that it more directly addresses public health concerns.
- Rather than focusing on one procedure, such as bird-by-bird inspection, as the primary component of an inspection process, FSIS should direct its efforts toward the establishment of a comprehensive quality assurance program. Such a program would consist of several components, one of which might be organoleptic inspection.
- Emphasis should be shifted from detection to prevention of problems at the earliest feasible stage in production to increase the effectiveness of poultry risk-management activities.

A RISK-ASSESSMENT MODEL FOR POULTRY-ASSOCIATED HAZARDS

The process of risk assessment requires first a conceptual framework and second a risk model. For its conceptual framework, the committee adopted the well-accepted view of the role and nature of risk assessment developed in 1983 by the National Research Council's Committee on the Institutional Means for Assessment of Risks to Public Health, which proposed that risk assessment proceed in four steps: hazard identification, dose-response assessment, exposure assessment, and risk characterization. The use of these four steps helps to ensure the inclusion of all factors that determine risk. Successful execution of the final step, risk characterization, is dependent on the development and application of a model such as that proposed by the committee in Chapter 3.

In developing its model, the committee reviewed the major risk agents (pathogenic microorganisms or their toxins, and chemical residues) associated with the five major divisions (or submodels) of the poultry system: production (grow-out); slaughter; packing and processing; distribution and preparation; and consumption. The model includes all phases of processing in which hazards might be present, the sources from which risk agents are generated or released, routes of human exposure, and mechanisms by which the exposure can result in adverse health effects. The model provides one possible approach to the evaluation of current FSIS inspection programs. It can serve as a guide in the development of future programs and assist in determining the level of public health protection afforded by current inspection procedures.

Conclusions

- The committee concluded that by conducting a qualitative examination of each component of the risk model it is possible to identify potential sources of health hazards and to suggest means of preventing their introduction.

- The committee's assessment suggests that to minimize public health risks, the traditional focus on slaughter should be expanded to include other potential sources of poultry-related hazards, such as production, preparation and handling, and cooking.
- Although qualitative risk assessments, such as those undertaken by the committee, are often sufficient to identify hazards and their probable sources, quantitative assessments are required to establish the validity and mechanisms of cause-and-effect relationships and to identify the magnitude of public health problems.
- As FSIS evaluates the poultry processing system with the objective of increasing public health protection, its managerial personnel will have to identify those circumstances in which quantitative assessments are justified on the basis of additional insights or improved clarity that they could lend to the decision-making process.

Recommendations

- The committee's risk model should be regarded as a prototype that FSIS can modify and refine to suit its own special needs and goals.
- FSIS should attempt to ensure that all aspects of the poultry system are included in any risk model used, even if certain areas fall within the purview of other agencies.
- Qualitative risk assessments should form the initial bases for planning and selecting inspection and quality assurance programs. Quantitative assessments should be used when qualitative assessments prove inadequate and when sufficient data are available.

MICROBIOLOGICAL HAZARDS AND POULTRY

Salmonella species and Campylobacter jejuni from all sources (i.e., not from chickens alone) are each responsible for up to 2,000 cases of gastroenteric disease per 100,000 people per year in the United States. Illnesses caused by these microorganisms tend to be most severe among the very young, the very old, or patients with immunosuppressive diseases. The rate of infection tends to increase with increasing size of the inoculum (dose), although a relatively low inoculum is sometimes capable of causing disease in humans. The potential for introduction of Salmonella and Campylobacter, the most commonly encountered human pathogens on chicken, is highly variable and may occur at multiple points during production, slaughter, and processing. After reviewing data related to the occurrence, potential for causing infection, and pathogenicity for humans of several microbial species known to be present on chicken, the committee drew the following conclusions, which are described in greater detail in Chapter 4.

Conclusions

- Current inspection programs are not designed to detect the most important human pathogens found on poultry. This is evident from the reviews of FSIS inspection programs conducted by the present committee and the earlier Committee on the Scientific Basis of the Nation's Meat and Poultry Inspection Program.
- Minimizing microbial contaminants on poultry is a worthwhile objective, but it is premature to establish formal microbiological criteria for classifying raw products as microbiologically acceptable or unacceptable. The committee concluded that the data required to justify such formal regulatory standards do not exist..
- There is conclusive evidence that microorganisms pathogenic to humans (such as Salmonella and Campylobacter) are present on poultry at the time of slaughter and at retail.
- There is evidence linking disease in humans to the presence of pathogens on chickens. For example, epidemiological studies indicate that approximately 48% of Campylobacter infections are attributable to chicken. Data also suggest that chicken is probably an important source of salmonellosis in the United States.
- It is not known with certainty whether bacteria, viruses, and parasites that are common causes of disease in poultry can serve as food-borne pathogens for humans. Most of these organisms do not appear to be pathogenic in humans, but some may be. Thus, more data on the pathogenicity of these organisms are needed.

Recommendations

The association between microorganisms in and on poultry at slaughter and the occurrence of disease in humans is complex. Several potential sources of contamination exist throughout the poultry system. The committee recognizes, therefore, that attempts to resolve this problem will be correspondingly difficult and may require collaboration with other agencies. On the basis of its review of the literature and established principles of microbiology, however, the committee recommends that certain actions such as the following be taken to reduce the potential for disease to be caused by poultry-borne microorganisms.

- The ongoing search for data on microbial risks should continue and be complemented by new research. Emphasis should be placed on the prevention of human disease rather than on simple control of microbial counts during slaughter and processing.
- Potentially pathogenic microorganisms on poultry should be identified, the potential for exposure to an infectious dose of each pathogen should be determined, and the potential impact on public health that would result from the failure to control exposures should be evaluated.
- The critical control points at which known pathogenic microorganisms such as Salmonella and Campylobacter may be introduced into the poultry system should be identified and monitored, preferably

as a part of an HACCP (Hazard Analysis Critical Control Point) program.

- A population-based surveillance program should be established so that disease occurrence can be correlated with inspection strategies. This will require measuring the level of pathogenic microorganisms on market-ready poultry as well as establishing a system for surveillence of disease within a well-defined population.
- A range of educational programs for people who raise poultry and for those who handle raw broilers in slaughterhouses, at retail, and during food preparation in the home and commercial establishments should be developed or intensified. As part of this effort, poultry products should be labeled at retail to inform consumers how to handle the poultry to prevent diseases originating from microbial contaminants.

CHEMICAL HAZARDS AND POULTRY

The 1985 report Meat and Poultry Inspection contained a description and evaluation of the National Residue Program (NRP), which is the only formal program for monitoring chemical contaminants in poultry. In that report the committee concluded that the fundamental design of NRP needs to be improved to ensure protection from chemical hazards. In particular, it questioned the adequacy of sampling sizes and procedures, the basis for and the utility of tolerance levels as currently set, and the basis for setting priorities for testing. In light of these conclusions, the present committee approached its analysis of chemical risks by reviewing the current status of toxicological testing used in chemical risk assessments, by describing where information and data are needed to appropriately characterize various classes of chemicals, and by delineating eight necessary components of a program for controlling chemical contaminants (see Chapter 5). After examining data on the identification, toxicological properties, and occurrence of chemical hazards in poultry, and considering this information in the context of its model, the committee reached the conclusions listed below.

Conclusions

- Adequate methods exist for identifying chemical hazards in poultry and estimating their toxicity. Toxicological risks associated with a wide variety of chemicals, including herbicides, pesticides, food additives, and food and drinking water contaminants, have for several years been assessed on the basis of data obtained from experiments in animals. These methods of risk assessment can be used for chemical contaminants in poultry, although to date they have been applied primarily to other routes of exposure.
- The entry of chemical residues into poultry can be controlled with approaches adopted by the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA). These agencies have well-established procedures for systematically determining permissible levels of exposure to toxic chemicals and managing the points of entry