

International Association
for Food Protection

Procedures to Investigate Foodborne Illness

Sixth Edition



Procedures to Investigate Foodborne Illness

Procedures to Investigate Foodborne Illness

Sixth Edition

Prepared by the
Committee on the Control of Foodborne Illness
International Association for Food Protection



International Association for
Food Protection®



Springer

ISBN 978-1-4419-8395-4 e-ISBN 978-1-4419-8396-1

DOI 10.1007/978-1-4419-8396-1

Springer New York Dordrecht Heidelberg London

Library of Congress Control Number: 2011924223

© International Association for Food Protection 2011

All rights reserved. This work may not be translated or copied in whole or in part without the written permission of the publisher (Springer Science+Business Media, LLC, 233 Spring Street, New York, NY 10013, USA), except for brief excerpts in connection with reviews or scholarly analysis. Use in connection with any form of information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed is forbidden.

The use in this publication of trade names, trademarks, service marks, and similar terms, even if they are not identified as such, is not to be taken as an expression of opinion as to whether or not they are subject to proprietary rights.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Procedures to Investigate Foodborne Illness

Sixth Edition

Prepared by the
Committee on the Control of Foodborne Illness International Association
for Food Protection

The following Committee members contributed to this Edition

Ewen C. D. Todd, PhD

Committee Chair

President, Ewen Todd Consulting
Okemos, MI USA

Charles A. Bartleson, M.P.H., R.S.

Washington State Department of Health (retired)
Olympia, WA USA

John J. Guzewich, M.P.H., R.S.

Center for Food Safety and Applied Nutrition
Food and Drug Administration
College Park, MD USA

Agnes Tan, B. Tech (Food) (Hons), M. Hlth. Admin

Microbiological Diagnostic Unit, Public Health Laboratory
Department of Microbiology & Immunology
University of Melbourne
Melbourne
Australia

Marilyn Lee, M.Sc., CPHI(C)

School of Occupational and Public Health
Ryerson University
Toronto, Ontario, Canada

Maria Nazarowec-White, PhD

Associate Director

Bureau of Microbial Hazards

Food Directorate, Health Products and Food Branch

Health Canada

Ottawa, Canada

Foreword

This sixth edition of *Procedures to Investigate Foodborne Illness* is designed to guide public health personnel or teams in any country that investigates reports of alleged foodborne illnesses. It is a companion to another manual published by the IAFP, *Procedures to Investigate Waterborne Illness*. These two manuals are based on epidemiologic principles and investigative techniques that have been found effective in determining causal factors of disease incidence.

This edition describes procedures to:

- Plan, prepare, investigate, and respond to unintentional and intentional contamination of food
- Handle illness alerts and food-related complaints that may be related to illness
- Interview ill persons, those at risk, and controls
- Develop a case definition
- Collect and ship specimens and samples
- Conduct hazard analysis at sites where foods responsible for outbreaks were produced, processed, or prepared
- Trace sources of contamination
- Identify factors responsible for contamination, survival of pathogenic microorganisms or toxic substances, and/or propagation of pathogens
- Collate and interpret collected data
- Report information about the outbreak

These guidelines are presented in the sequence usually followed during investigations. They are organized so that an investigator can easily find the information needed in any phase of an investigation. The instructions, forms, tables, keys, and information on selected etiologic agents, diseases, and food vehicles are comprehensive but not exhaustive.

This manual combines the principles and techniques of epidemiology, statistics, and food preparation review that guide the formation of rational hypotheses and their testing. The *Table of Contents* serves as an outline, and a flow diagram shows interrelationships of the activities and their typical sequence in an investigation. This edition, which includes a section on intentional contamination of food, has a completely revised set of keys in color, and the format of the Manual is larger size for better ease of reading. There will also be a complementary electronic version.

The final foodborne illness summary report form contains detailed categories of places foods where acquired; the sites of contamination, survival, and propagation, which may be at different locations; method of processing or preparation; factors that contributed to the outbreak; and space for a narrative summary. Collection of these sorts of data, over time, can provide focus for preventive and control measures.

Kits including the manual, expanded-size forms, and equipment useful for investigation can be preassembled so that upon notification of an outbreak, investigation can be initiated without delay.

This manual supersedes previous editions by providing updated information to assist in conducting thorough investigations of foodborne disease outbreaks.

Contents

Procedures to Investigate Foodborne Illness	1
Introduction.....	1
Develop a Foodborne Disease Surveillance System.....	2
Organize the System and Develop Procedures	3
Assign Responsibility	4
Establish an Investigating Team.....	5
Train Staff	5
Assemble Materials.....	5
Investigate Outbreaks.....	6
Act on Notification of Illness.....	6
Prepare for the Investigation	11
Verify Diagnosis.....	11
Develop a Working Case Definition	18
Make Epidemiologic Associations	19
Expand the Investigation.....	21
Seek Sources and Modes of Contamination and Ways by Which the Contaminants Survived and/or Proliferated.....	23
Plan On-Site Investigation	24
Meet Managers.....	25
Draw a Flow Diagram of Operations.....	26
Review Monitoring Records	27
Interview Food Workers.....	28
Conduct Food Processing/Preparation Review.....	29
Identify Contributory Factors of Outbreaks.....	34
Chain of Custody Procedures for Collecting and Analyzing Suspect Foods in Foodborne Illness Investigations.....	41
Recommend or Take Precautionary Control Actions	44
Determine Source of Contamination	45

Analyze Data..... 50

- Plot an Epidemic Curve 50
- Determine Predominant Signs and Symptoms 52
- Determine the Responsible (or Suspect) Meal..... 52
- Calculate Incubation Periods and Their Median..... 54
- Calculate Food-Specific Attack Rates (Retrospective Cohort Analysis) or Case–Control Exposure Percentages..... 55
- Do Stratified Analysis 57
- Calculate Food Preference Attack Rates..... 59
- Make Statistical Calculations..... 60
- Interpret Results and Test Hypotheses 69

Make Recommendations for Control 71

Inform the Public 73

Calculate Economic Impact of Disease Outbreaks 74

Submit Report 75

Use Outbreak Data for Prevention 76

Keys 79

Procedures to Investigate Foodborne Illness

When Intentional Contamination Is Suspected 99

- Foreword 99
- Develop an Intentional Contamination Surveillance 99
- Organize the System and Develop Emergency Response Plans 100
- Establish an Intentional Contamination Investigation Team 100
- Triggers for Recognizing Intentional Contamination of Food..... 102
- Obtain Specific Assistance..... 103
- Find and Interview Additional Cases..... 103
- Seek Sources and Modes of Intentional Contamination and Ways by Which the Contaminants Survived and/or Proliferated 103
- Make Recommendations for Control..... 104
- Specific Advice in Informing the Public about a Suspected or Confirmed Intentional Contamination Event..... 105
- Further Readings 105
- Tables 108
- Acknowledgments..... 137

Forms..... 139

Index..... 165

Procedures to Investigate Foodborne Illness

Introduction

During production, harvesting, processing, packaging, transportation, preparation, storage, and service, any food may be exposed to contamination with poisonous substances or infectious or toxigenic microorganisms. Processing or preparation failure may lead to survival of microorganisms or toxins, and time–temperature abuse can allow proliferation of pathogenic bacteria and molds. In addition, some plants are intrinsically toxic. Animals may acquire toxins from their food or metabolize them, or they become infected with or colonized by pathogenic bacteria, viruses, and parasites. If a product contaminated with sufficient quantities of poisonous substances or pathogenic microorganisms is eaten, susceptible persons may develop foodborne illness. The food supply may be local or global. In fact today, fresh as well as shelf stable food is available from sources all over the world. Foodborne illness outbreaks are routinely being linked to sources of contamination far distant from the point of consumption. Whatever the source, an investigation always begins at one or more local levels and can expand from there. Therefore, foodborne illness surveillance, investigation, and response systems require the close collaboration and coordination of food safety and public health agencies at local, state/provincial, federal/national, and international levels.

Foodborne illnesses comprise the various acute syndromes that result from ingestion of contaminated foods. They are classified as:

- Intoxications caused by ingestion of foods containing either poisonous chemicals or toxins produced by microorganisms
- Toxin-mediated infections caused by bacteria that produce enterotoxins (toxins that affect water, glucose, and electrolyte transfer) during their colonization and growth in the intestinal tract
- Infections caused when microorganisms invade and multiply in the intestinal mucosa or other tissues

Manifestations range from slight discomfort to acute illness to severe reactions that may terminate in death or chronic sequelae, depending on the nature of the causative agent, number of pathogenic microorganisms or concentration of poisonous substances ingested, and host susceptibility and reaction.

The public relies on the food industry and health and food regulatory officials for protection from foodborne illness. Such protection depends on rapid detection of outbreaks and a thorough knowledge of the agents and factors responsible for foodborne illness. Current food distribution systems are able to move contaminated products throughout a country or to any place in the world within days of processing. In addition, public health and law enforcement agency officials should always be alert to the rare possibility of an intentional contamination of food by disgruntled employees or terrorists. Rapid reporting of local outbreaks to the national and international levels can, therefore, improve the surveillance and control of foodborne disease and detection of intentional contamination.

The purposes of a foodborne illness investigation are to stop the outbreak or prevent further exposures by:

- Identifying illnesses associated with an incident and verifying that the causative agent is foodborne
- Detecting all cases, the causative agent, the implicated food(s), and the place(s) where food was mishandled or mistreated
- Determining the source and mode of contamination, processes, or practices by which proliferation and/or survival of the etiologic agent occurred
- Gathering information on the epidemiology of foodborne diseases and the etiology of the causative agents that can be used for education, training, and program planning, thereby impacting on the prevention of foodborne illness
- Determining if the outbreak under investigation is a part of a larger outbreak by immediately reporting to state/provincial/national epidemiologists

Once the responsible food has been identified, further cases can often be prevented by halting its distribution and sale; recalling production lots already distributed; and quarantining, reprocessing, or disposing of the contaminated foods to prevent their entry or reentry into food channels.

As epidemiologic data accumulate, information will indicate critical control points in food production, processing, and preparation, as well as appropriate methods for controlling and preventing foodborne disease. This information will guide administrators in making rational decisions and setting program priorities to provide the highest degree of food safety at the lowest cost.

A flow chart, *Sequence of events in investigating a typical outbreak of foodborne illness* (Figure A, page 138) shows the sequential steps, as presented in this manual, in investigating a typical outbreak of foodborne illness and indicates their relationships. A description of each step is presented in this manual.

Develop a Foodborne Disease Surveillance System

An effective surveillance system will:

- Systematically collect data pertaining to the occurrence of foodborne illness and outbreaks

- Guide investigations of diseases, clusters of illness, and outbreaks associated with food consumption
- Determine if the outbreak under investigation is part of a larger multijurisdictional outbreak and coordinate that larger investigation
- Enable analysis and interpretations of surveillance and investigational data
- Disseminate consolidated surveillance information to appropriate agencies and public health partners

Many types of disease-detection and disease-reporting systems may already exist at the local or state/provincial level and can be incorporated into a foodborne disease surveillance program. These include:

- Mandatory (or voluntary) laboratory- or physician-based reporting of specific infectious diseases
- Laboratory-based surveillance systems such as PulseNet in the USA
- Medical records from hospital emergency rooms, urgent-care clinics, and physician offices
- Public complaints made to health agencies
- Follow up of complaints of illnesses arising from the potential intentional contamination of food
- School illness and absentee records
- Absentee records of major employers
- Sentinel studies of selected diseases
- Sales of antidiarrheal drugs
- Syndromic surveillance

An effective disease surveillance system is essential for detection of disease caused by either unintentional or intentional contamination of food.

Organize the System and Develop Procedures

An effective foodborne disease surveillance system requires close cooperation between key personnel in public and private health agencies. When your agency contemplates developing or improving a foodborne disease surveillance program, give top priority to obtaining financial, administrative, political, and strategic support. Then, identify a key person to create, implement, and manage the system. This person takes responsibility to:

- Review existing reporting systems that could be incorporated into the foodborne disease surveillance system
- Identify the types of information that cannot be obtained from existing reporting systems but that need to be collected or addressed by the foodborne disease surveillance system
- Identify ways to merge or integrate the data collected by existing systems with data gathered in the foodborne disease surveillance system

- Identify collaborating agencies and staff
- Train agency staff in surveillance methods
- Collaboration with emergency response and law enforcement agency officials when an intentional contamination of food is suspected
- Assemble materials that will be required during an outbreak investigation
- Evaluate the effectiveness of the system

Develop procedures to seek and record complaints about foodborne diseases. For example, list the telephone number of the foodborne disease (food poisoning) unit prominently under the appropriate health agency in the phone book or on the front inside cover. To be most effective, have this number monitored 24 h a day, 7 days a week either by an answering service or a telephone emergency services system. Identify medical care facilities and practitioners, and seek their participation. Direct education activities, such as newsletters and talks at meetings, to stimulate participation in the program. Encourage food and tourist industries to report complaints of suspected foodborne illness. Some jurisdictions are exploring the use of social media to inform the public to communicate relevant information regarding public health, including food recalls and foodborne disease outbreaks. Consider developing such a strategy in your agency. Also, encourage private and hospital laboratories to report isolations of bacteria (e.g., *Escherichia coli* O157:H7, *Salmonella*, *Shigella*, *Vibrio cholerae*), viruses (e.g., norovirus and hepatitis A virus), parasitic agents (e.g., *Trichinella spiralis*, *Cyclospora cayetanensis*, *Giardia lamblia*), and other agents that may be foodborne. Develop regulations to require clinical laboratories to submit cultures of *Salmonella*, *Shigella*, *E. coli* O157:H7, and *Listeria* to state public health laboratories for further characterization. Develop a protocol for notification and coordination with agencies that might cooperate in investigation activities, including 24-h, 7-day-a-week contacts. Notify and coordinate with state/provincial, district, and national agencies that have surveillance and food regulatory responsibilities, and other national and international health agencies, as appropriate.

Collaborate with the public health laboratories and receive pulsed-field gel electrophoresis (PFGE) data on a regular basis. Such information may be useful in identifying clusters and potential foodborne outbreaks.

Assign Responsibility

Delegate responsibility to a professionally trained person who is familiar with epidemiologic methods and food safety to direct the surveillance program, report to appropriate agencies and public health partners as needed, take charge when foodborne and enteric disease outbreaks are suspected, and handle publicity during outbreaks. Delegate responsibility to others who will carry out specific epidemiologic, laboratory, and on-site investigations. If an intentional contamination of food event is suspected, law enforcement agencies may become the lead agency responsible for the investigation. Ensure that this person has methods of communicating regularly with other local state and national foodborne investigators and receiving notices about foodborne illnesses and outbreaks, e.g., national foodborne listservs.

Establish an Investigating Team

Establish a team of epidemiologists, sanitarians, public health inspectors, microbiologists, nurses, physicians, public information specialists, and others (e.g., toxicologists) as needed. Free flow of information and coordination are essential among those participating in foodborne and enteric disease surveillance and investigation, particularly when several different agencies are involved. Food-related complaints are usually directed to health departments or food regulatory agencies, but perhaps to different jurisdictions. When a food is suspected of being intentionally contaminated leading to illnesses, contact emergency response and/or law enforcement officials for their involvement. Therefore, it is essential that these complaints be recorded by the agency receiving the alerts. Whenever possible, share the information with participating parties or nearby jurisdictions by rapid means such as electronic mail or fax. Give top priority to illness and outbreak investigations.

Train Staff

Select staff members to participate in the foodborne disease surveillance program based on their interest, education, and ability. Inform them of the objectives and protocol of the program. Emphasize the value of disease surveillance in a food safety program. Assign them to investigations and encourage the use of epidemiologic information and approaches in their routine disease surveillance and prevention activities. Develop their skills so that they can carry out their role effectively during an investigation and teach them procedures to interpret data collected during investigations. Conduct seminars routinely, and during or after investigations, to update staff and keep agency personnel informed. Train office workers who receive calls concerning foodborne illnesses to give appropriate instructions. Those who participate in the investigation will learn from the experience and often are in a position to implement improvements after the investigation is completed.

Assemble Materials

Assemble and have readily available kits with forms and equipment as specified in Table A. Restock and maintain kits on a schedule recommended by laboratory staff to ensure their stability and sterility. Verify expiration dates, and use kits before this date or discard. Assemble a reference library, including e-mail and internet addresses, on foodborne and enteric illnesses and control measures; make it available to the staff. Update this library with information on foodborne pathogens and investigation techniques from articles in scientific journals, new books, manuals, and internet searches. (See Further Readings for suggestions.)

Investigate Outbreaks

Investigating an outbreak involves:

- Receiving notification of illnesses that might be foodborne
- Interviewing ill persons and persons at risk who remained well
- Making epidemiologic associations from initial information
- Forming hypotheses

Further investigation to confirm or refute the hypotheses includes:

- Collecting clinical specimens and food samples
- Conducting an on-site investigation to determine the source and mode of contamination, survival, and/or proliferation of the etiologic agent
- Characterize further the etiologic agent by various typing schemes, e.g., serology
- Perform DNA profiling of isolates from clinical specimens and food samples to determine the extent of the outbreak, e.g., by PFGE.

Act on Notification of Illness

Prompt handling and referral of food-related complaints, rapid recognition of the problem, and prevention of further illnesses are the foundations of a successful investigation. This first contact with the public is a vital aspect of an investigation. As indicated earlier, any action respecting a potential deliberate contamination of food will generate a specific approach to further action.

Receive Complaints or Alerts

Upon receiving a complaint or an alert about a food or illness potentially attributed to food, record the information on Form A. An alert or complaint relating to food may involve foodborne illness, food spoilage, adulteration of a product, mislabeling, or an unsanitary establishment. Alerts also can be initiated by reports from physicians, by reports of foodborne pathogens isolated by laboratories, by calls to poison control centers, and by reports of treatment given in either hospital or private emergency rooms, or by emergency squads. Alerts may also include an increase in a particular PFGE pattern from clinical isolates. An investigation may be initiated to determine if there is a common food exposure among patients with the PFGE pattern. The pattern may be compared with similar PFGE patterns in the PulseNet databases to determine if there are similar occurrences of the pattern in food and clinical isolates nationwide or internationally. The form provides information upon which to decide whether an incident should be investigated. It is not difficult to fill out and can be completed by a public health professional or trained office worker.

Assign a sequential number to each complaint. If additional space is needed to record information, use the reverse side or attach additional sheets. Always ask the complainant to provide names of other persons at the event under suspicion, whether or not ill, and names of any other persons who are known to be ill with the same syndrome. Follow up by contacting these additional persons.

It is of paramount importance to collect clinical specimens and a sample of the suspect food or water as soon as possible. See section *Obtain Clinical Specimens*, (page 15) and *Collect Samples of Suspect Foods* (page 42) for detailed procedures. Tell the complainant to collect stool or vomitus specimens from ill persons using a clean utensil in a clean jar or plastic bag and to seal tightly and label clearly with name of ill person and date. Samples should be collected in containers and in accordance with the specific laboratory procedures where they will be submitted. Then, put all specimen containers into either a paper or plastic bag, label, and store in a refrigerator (but do not freeze). Emphasize the need to retain a sample of all suspect foods in their original container or package, if practical. Otherwise, instruct this person to put a half pint (250 g/mL), if that much is available, or otherwise all of the remaining food, into a clean container that has been boiled or into an unused plastic bag. Also, put this jar or bag into either a paper or plastic bag, label with name of facility, food, and date, and refrigerate but do not freeze. Instruct the ill person to hold all clinical specimens and food samples until the health agency evaluates the epidemiological evidence and arranges, if necessary, to collect them. If it is determined that the specimen or sample is not necessary, notify the complainant and advise on proper disposal of the material. Collect clinical specimens and food samples as soon as practicable and according to the recommendations given in this text.

If there is a cluster of cases, monitor reports from physicians, complaints about food, or records of laboratory isolation of enteric pathogens that may suggest outbreaks of disease or contributory situations.

Log Alert and Complaint Data

Extract key information (see * and † entries) from Form **A** and enter it onto Form **B**.

Record time of onset of the first symptom or sign of illness, number of persons who became ill, predominant symptoms and signs, and name of the food alleged to have caused the illness, if stated. Also, enter names of places or common gatherings at which the stricken person ate during the 72 h before onset of illness and other pertinent information. Under “history of exposures” column, use appropriate abbreviations to indicate the reported information. Under “comment,” enter notations of type of agent isolated, results of specimen tests, places where food or water was consumed during travel, names and locations of restaurants or other foodservice facilities, and other pertinent information including hospitalization, occupation, or place of employment. At this phase of the investigation, it probably will not be