International Association for Food Protection

Procedures to Investigate Waterborne Illness

Third Edition

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

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Foreword

Procedures to Investigate Waterborne Illness is designed to guide public health, environmental protection, engineering, and other personnel who investigate reports of illnesses alleged to be waterborne. Prompt action to control an outbreak at its start will help minimize illness. This manual is an update of the 1996 second edition of *Procedures to Investigate Waterborne Illness*. The text has been adjusted where appropriate to reflect more recent understanding of pathogens and their control. A section on the role of environmental water, for instance from irrigation and processing of produce, has been added and the "Collection and Analysis of Data" section has been significantly expanded. The manual is a companion document to the *Procedures to Investigate Foodborne Illness* which was revised and published in 2012. Both the foodborne and waterborne illness manuals are based on epidemiologic principles and investigative techniques that have been found effective to determining causal factors of disease outbreaks. They are designed to improve the quality of investigation of outbreaks and disease surveillance. The reader will note that there is much overlap between the two manuals as the gathering of information during an investigation is very similar as are many of the pathogens that are capable of causing either foodborne or waterborne illness. In fact at the start of the investigation it will often not be clear whether an outbreak is foodborne or waterborne. There are differences in that whereas most waterborne illnesses are contracted through ingestion similar to food, infections can also be generated through skin contact and aerosols.

The *Table of Contents* serves as an outline and a flow diagram shows the interrelationships of the activities and their typical sequence in an investigation. The topics in the manual are presented in the sequence usually followed during investigations, i.e., receiving complaints of an alleged outbreak, interviewing the ill (and sometimes the healthy), developing a case definition, collecting water samples and clinical samples, conducting investigations of the water source and its distribution, interpreting the data, and reporting the outbreak. They are organized so that an investigator can easily find the information needed at any phase of the investigation. The forms at the end offer a convenient and effective way to keep information organized and ready for analysis. And the tables are useful in providing more detailed

information during an investigation, although they are not exhaustive. The tables on the pathogens are organized by symptoms, which will often be known early in an investigation before the pathogen has been confirmed by the laboratory.

Although this manual is intended to aid the investigator when an outbreak happens, the information in part could also be used as a guideline in prevention of an outbreak. Having adequate oversight of a water system and having trained staff are key to preventing outbreaks.

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Procedures to Investigate Waterborne Illness

Introduction

Humanity could not survive without a reliably clean, safe, and steady flow of drinking water. Since the early 1900s when typhoid fever and cholera were frequently causes of waterborne illness in developed countries, drinking water supplies have been protected and treated to ensure water safety, quality, and quantity. Having access to safe drinking water has always been one of the cornerstones of good public health. Safe water is not limited to drinking water, since recreational water and aerosolized water can also be sources for waterborne illness, from treated waters such as in swimming pools, whirlpools, or splash pads and from non-treated surface waters such as lakes, rivers, streams and ponds. Recreational waters may cause illness not only from ingestion of pathogens, but also when in contact with eyes, ears, or skin. Some pathogens in water can be acquired by inhalation of aerosols from water that is agitated or sprayed such as in humidifiers, fountains, or misting of produce. This poses a potential risk to those exposed, particularly if they are immunocompromised.

Often when an outbreak is first suspected, the source is not clear, i.e., food, water, animal contact. Investigation is usually needed to find the common source. In some outbreaks the food may first be identified as the source, such as with produce, but the ultimate source could be contaminated irrigation water. Investigators have to keep an open mind until laboratory and/or epidemiologic evidence links cases to the primary source.

Although we frequently think of waterborne illness originating from a microbiological agent, we should be aware that water may also be contaminated by pesticides, fertilizers, and other chemicals which may enter through industrial discharge, agriculture runoff, or deliberate contamination.

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Waterborne illness acquired from microorganisms may be classified as:

- Toxin-mediated infections caused by bacteria that produce enterotoxins or emetic 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, eyes, ears, or respiratory tract, or contact the skin;
- Intoxications caused by ingestion of water containing poisonous chemicals or toxins produced by other microorganisms

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 microorganism or concentration of poisonous substances ingested, and host susceptibility and reaction.

The public relies on public health regulators to investigate and mitigate waterborne illness. Mitigation depends upon rapid detection of outbreaks and a thorough knowledge of the agents and factors responsible for waterborne illness. Public health and law enforcement agency officials should always be alert to the rare possibility of an intentional contamination of water supplies by disgruntled employees or terrorists.

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

- Identifying illness associated with an exposure and verifying that the causative agent is waterborne
- Detecting all cases, the causative agent, and the place of exposure
- Determining the water source, mode of contamination, processes, or practices by which proliferation and/or survival of the etiological agent occurred
- Implementing emergency measures to control the spread of the outbreak
- Gathering information on the epidemiology of waterborne diseases and the etiology of the causative agents that can be used for education, training, and program planning, thereby impacting on the prevention of waterborne illness
- Determining if the outbreak under investigation is part of a larger outbreak by immediately reporting to state/provincial/national epidemiologists

In the instance of a bottled water outbreak, halting of distribution and sale of product and recall of product, some of which may already be in consumers' homes, are necessary to prevent further illness.

As epidemiologic data accumulate, information will indicate the source of the problem, whether a municipal water treatment plant, bottled water manufacturing plant, or recreational water exposure, and suggest methods for controlling and preventing waterborne illness. This information will guide administrators in making informed decisions to provide the highest degree of waterborne safety.

A flowchart, *Sequence of events in investigating a typical outbreak of waterborne illness* (Fig. 1) shows the sequential steps, as presented in this manual, in investigating a typical outbreak of waterborne illness and illustrates their relationships. A description of each step is presented in this manual.

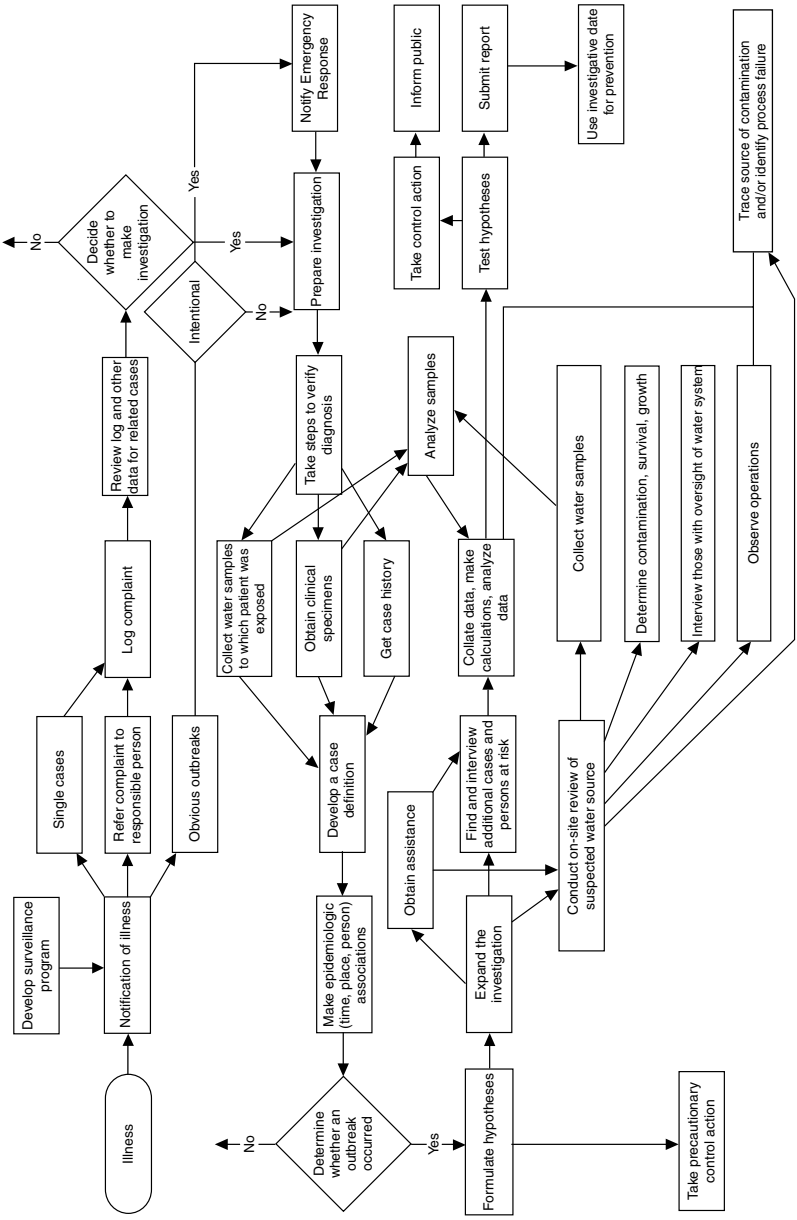

Fig. 1 Sequence of events in investigating a typical outbreak of waterborne illness. An intentional water contamination event may or may not be obvious. It can be recognized at any point during the outbreak investigation. If intentional contamination is suspected follow your notification scheme in emergency response plans (this could include law enforcement, emergency management and other government agencies)

Develop a Waterborne Disease Surveillance and Emergency Operations Program

The primary purpose of a waterborne disease surveillance system is to systematically gather accurate information on the occurrence of water-related illnesses in a community, thus allowing development of a rational approach for the detection, control and prevention of waterborne illness. Other purposes are to (a) determine trends in the incidence of waterborne diseases, (b) characterize the epidemiology of waterborne diseases, (c) gather and disseminate information on waterborne diseases, and (d) develop a basis for evaluating control efforts. It may be useful to coordinate this system with, or integrate it into a foodborne disease surveillance system. However, while the procedures are quite similar from an epidemiologic viewpoint, they may differ with respect to personnel or agencies involved. An effective disease surveillance system is essential for detection of disease caused by either unintentional or intentional contamination of food.

An effective waterborne disease surveillance system consists of:

- Early reports of enteric and other illnesses that may be related to water exposure or consumption
- Coordinated effort between local and state public health partners, water utility and water recreation staff
- Systematic organization and interpretation of data
- Timely investigation of identified outbreaks or clusters of illness
- Dissemination of outbreak reports and surveillance summaries to all appropriate stakeholders

Many types of reporting systems may already exist at the local or state/provincial level, and these should be incorporated into a waterborne disease surveillance program. These include (a) mandatory (or voluntary) laboratory- or physician-based reporting of specific infectious diseases, (b) national-based surveillance systems such as CaliciNet (CDC 2009) or NORS (CDC 2009) in the US, (c) physician office, hospital emergency, and urgent-care clinic medical records, (d) public complaints made to health agencies and/or local water utilities, (e) school illness and absentee records, (f) absentee records of major employers, (g) water treatment records kept by water utilities (e.g., turbidity, disinfection levels, occurrence of coliforms), (h) increased sales of antidiarrheal drugs and anti-nausea medications, and (i) source water quality data kept by environmental agencies (e.g., departments of natural resources and geological survey agencies). Another type of surveillance mechanism that may supplement or enhance existing reporting systems is a daily log of illness and water quality complaints.

Organize the System and Develop Procedures

An effective waterborne illness surveillance system requires close cooperation between key personnel in public and private health agencies, laboratories, water utilities and water recreation staff, and environmental health agencies. When your

agency contemplates initiation or development of a waterborne illness surveillance program, give top priority to identification of appropriate financial, political, strategic, and administrative support. Then, identify a key person to create, implement, and manage the system.

This person takes responsibility for:

- Reviewing the types of reporting systems that already exist in your agency or in other agencies that could be incorporated into a waterborne illness surveillance system
- Identifying the types of information that cannot be obtained from existing reporting systems but that need to be collected or addressed by the waterborne illness surveillance system
- Identifying ways to merge or integrate the data collected by existing systems with data gathered in the waterborne illness surveillance system
- Identifying collaborating agencies and staff
- Develop a mechanism to communicate and update all stakeholders (may be by blast e-mail or periodic conference calls)
- Providing training in surveillance methods for agency staff and other partners to enhance cooperation
- Assembling materials that will be required during an outbreak investigation
- Evaluating the effectiveness of the system.

Develop procedures to seek and record complaints about waterborne illnesses, water supplies, and water recreational sites. For example, list the telephone number of the waterborne illness investigation unit prominently on local and state public health and water utility websites. To be most effective, have this number monitored 24/7 by staff or an answering service. If possible, the utilization of social media such as Facebook or Twitter should be considered and monitored as many large municipalities (including drinking water utilities) and recreational facilities have an Internet presence. If your agency has social media accounts, consider using this vehicle to further disseminate information regarding waterborne illness clusters or outbreaks. Identify medical care facilities and practitioners and seek their participation. Direct educational activities, such as newsletters and talks at meetings, to stimulate participation in the program. Encourage water treatment utilities and operators of recreational water sites to report suspected complaints of waterborne illness to the appropriate local agencies. Also, encourage private and hospital laboratories to report isolations of parasitic agents (e.g., *Giardia*, *Cryptosporidium*), viruses (e.g., norovirus and hepatitis A virus), bacteria (e.g., *E. coli* (pathogenic), *Salmonella*, *Shigella*, *Vibrio cholerae*), and other agents that may be waterborne. Develop a protocol for notification and coordination with agencies that might cooperate in investigational activities, including 24-h-a-day, 7-days-a-week contacts. A comprehensive contact list should be constructed and updated at least twice a year as individuals may change. Notify and coordinate with state/provincial or district agencies, national agencies that have surveillance and water regulatory responsibilities, and other national and international health agencies, as appropriate. For example, it may be useful to find out the level of participation within a certain jurisdiction in national-level outbreak surveillance programs such as NORS (CDC, 2015) or other national surveillance system.

Assign Responsibility

Delegate responsibility to a professionally trained person who is familiar with epidemiologic methods and with the principles of water treatment and recreational water protection. This person will (a) direct the surveillance program, (b) take charge if waterborne and enteric outbreaks are suspected, and (c) handle publicity during outbreaks. Delegate responsibility to others who will carry out specific epidemiologic, laboratory and on-site investigations. If an intentional contamination event is suspected, local and national law enforcement agencies will likely become the lead agency responsible for the investigation. With this in mind, it is critical to identify appropriate individuals and include them in communication and any practice drills that may occur. If a relationship has been established prior to any event, the investigation may run more smoothly.

Establish an Investigation Team

Enlist help from a team of epidemiologists, microbiologists, sanitarians/environmental health officers/public health inspectors, engineers, chemists, nurses, physicians, public information specialists, and other (e.g., toxicologists) as needed. Free flow of information and coordination among those participating in waterborne disease surveillance and investigation are essential, particularly when several different agencies are involved. Water-related complaints are equally likely to be directed at health departments or water utilities but also perhaps to different jurisdictions. Therefore, it is essential that these complaints be registered by an agency and that the information is rapidly shared within and perhaps outside of a particular jurisdiction as part of an integrated surveillance system. Whenever possible, share the information with participating parties by rapid means such as e-mail and by calling 24/7 contact phone numbers. If an intentional contamination event is suspected, contact emergency response and law enforcement for their early involvement.

Train Staff

Select staff members who will participate in the waterborne disease surveillance program on the basis of interest and ability. Inform them of the objectives and protocol of the program. Emphasize not only the value of disease surveillance, but also the value of monitoring water quality and treatment performance. If possible, provide printed learning material that can be referenced later. Encourage the use of epidemiologic information and approaches in routine disease surveillance and prevention activities. Develop their skills so that they can carry out their role effectively during an investigation, and teach them how to interpret data collected during investigations. Conduct seminars routinely and during or after investigations to