Objectives for This Guide

Introduction to Investigating an Outbreak

After studying this guide and answering the questions in the exercises, you will be able to

- list the reasons that health agencies investigate reported outbreaks
- list the steps in an outbreak investigation
- define the terms "cluster," "outbreak," and "epidemic"
- describe how to determine whether an epidemic actually exists
- define a "line listing" and describe what it is used for
- execute the initial steps of an investigation and develop biologically plausible hypotheses
- draw a traditional epidemic curve

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A Challenge for the Disease Detective

One of the most exciting and challenging tasks facing an epidemiologist—or "disease detective"—working in a public health department is investigating an outbreak. Frequently, the cause and source of the outbreak are unknown. Sometimes large numbers of people are affected. Often, residents are concerned because they fear more people, including themselves, may become ill unless the cause is found quickly. There may be hostility and defensiveness if an individual, product, or company has been accused of being the source of the outbreak. Into this pressure-packed setting comes the epidemiologist from the health department, who must remain calm, professional, and scientifically objective. Fortunately, epidemiology provides the scientific basis, the systematic approach, and the focus on prevention and the population at large that are needed.

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What is an Outbreak?

An **outbreak** or an **epidemic** exists when there are *more cases of a particular disease than expected in a given area, or among a specific group of people, over a particular period of time*. An aggregation of cases in a given area over a particular period, regardless of whether

the number of cases is more than expected, is a **cluster**. In an outbreak or epidemic, we usually presume that the cases are related to one another or that they have a common cause.

Many epidemiologists use the terms "outbreak" and "epidemic" interchangeably; however, some restrict the use of "epidemic" to situations involving large numbers of people over a wide geographic area. The public is more likely to think that "epidemic" implies a crisis situation.

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Uncovering Outbreaks

Health departments learn about most outbreaks in one of two ways. The first and probably most common way is through calls from a doctor, some other health care provider, or a citizen who knows of "several cases." In one such instance in 1989, a nationwide epidemic of a severe illness, eosinophilia-myalgia syndrome (EMS), was first detected when a physician in New Mexico called a consultant in Minnesota and realized that, together, they had seen three patients with highly unusual symptoms. All three patients said they had used the dietary supplement L-tryptophan. The local physician promptly called the New Mexico state health department, setting into motion a chain of actions leading to the discovery of a large nationwide epidemic and the recall of L-tryptophan.

The second means of identifying outbreaks is the routine analysis of public health surveillance data. Through **public health surveillance**, data on health are systematically collected, analyzed, interpreted, and disseminated on an ongoing basis. This information, which is based on reports sent in by doctors, laboratories, and other sources, allows investigators to track patterns of disease in a community and to determine how to control and prevent it. When, during routine analysis, the data show an increase over the normal background level of reported cases of a particular disease, an outbreak may be indicated.

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Why Investigate Outbreaks?

Health departments investigate suspected outbreaks for a variety of reasons. These include the need to institute control and prevention measures, the severity of the problem and its risk to others, the opportunity for research and training, program considerations, and public relations, political concerns, and legal obligations.

Control and prevention. A primary reason for a public health investigation is to control the outbreak at hand and prevent future outbreaks. In any investigation, you have to strike a balance between these two goals, depending on where the outbreak is in its natural course: Are cases occurring in increasing numbers or is the outbreak just about over?

If cases are continuing to occur, your first priority will more than likely be controlling the outbreak, so you want will to assess its extent and the characteristics of the population at risk so you can design measures to prevent additional cases. On the other hand, if

an outbreak appears almost over, you may want to focus on investigating further to identify its source and using that information to develop measures that will prevent future outbreaks.

The balance between instituting control measures and conducting further investigation depends on how much you know about the agent causing the illness, the source of the agent, and its mode of transmission, since you cannot design control measures without this information.

Severity and risk to others. Decisions regarding whether and how extensively to investigate an outbreak are also influenced by the severity of the problem and its risk to others. It is particularly urgent to investigate an outbreak when the disease is severe and could affect more people unless prompt control measures are taken. For example, in the United States, every case of plague and botulism is investigated immediately to identify and eradicate the source. Cases of syphilis, tuberculosis, and measles are investigated promptly to identify contacts and interrupt transmission.

Research opportunities. Another important objective of outbreak investigations is simply to gain additional knowledge. Each outbreak offers a unique opportunity to study the natural history of the disease in question—including the agent, mode of transmission, and incubation period. For a newly recognized disease, there is the opportunity to study the clinical spectrum of the illness. Investigators also attempt to characterize the populations at greatest risk and to identify specific risk factors.

Even with familiar diseases, investigators can learn more about the impact of control measures and the usefulness of new epidemiological and laboratory techniques. For example, an outbreak of measles in a highly immunized community provides a setting for investigators to study the effectiveness of vaccine, the effect of age at vaccination, and the duration of protection afforded by the vaccine (1).

Training opportunities. Investigating an outbreak requires a combination of diplomacy, logical thinking, problem solving, quantitative skills, epidemiological know-how, and judgment. These skills improve with practice and experience. For this reason, many investigative teams pair a seasoned epidemiologist with an epidemiologist-in-training, who gains valuable on-the-job training and experience while assisting in the investigation and control of the outbreak.

Program considerations. Health departments routinely use a variety of programs to control and prevent illnesses such as tuberculosis, vaccine-preventable diseases, and sexually transmitted diseases. By investigating an outbreak of a disease targeted by one of these programs, health departments may discover populations at risk that have been overlooked, failures in the program's intervention strategy, changes in the agent causing the disease, or events beyond the scope of the program. This information can then be used to improve control and prevention efforts.

Public, political, or legal concerns. Public, political, or legal concerns sometimes override scientific concerns in the decision to conduct an investigation. Increasingly, the public has taken an interest in disease clusters and potential environmental exposures and has called upon health departments to investigate. Such investigations almost never identify a link between the disease and

the suspected source (2,3). Nevertheless, many health departments have learned that it is essential to be "responsibly responsive" to public concerns, even if the concern has little scientific basis (4,5,6). They also see these instances as opportunities to educate the public. In some instances (e.g., a request by three or more workers to investigate workplace health and safety), investigations are required by law.

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