Essential Field Epidemiology: Outbreak Investigations

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Overview

Day 1

9:00 am – 12:00 pm

[2h] Epidemiologic Concepts for the Prevention and Control of Infectious Diseases

[1h] The Epidemiologic Approach: Steps to Evidence-based Action

1:30 pm – 4:30 pm

[2h] The Epidemiologic Approach: Steps to Evidence-based Action (continued)

[1h] Conducting an Outbreak Investigation in 7 Steps

Day 2

9:00 am – 12:00 pm

[1h] Steps 1 & 2: Case & Cause Investigation (descriptive epidemiology – generating hypotheses)

[2h] Step 4: Conducting an Analytic Study (analytic epidemiology – testing hypotheses)

1:30 pm – 4:30 pm

[1h] Step 5: Making Statistical, Epidemiological, and Causal Inferences

[1h] Step 6: Designing and Implementing Surveillance Systems

[1h] Step 7: Communicating Findings

Day 3

9:00 am – 12:00 pm

[1h] Epidemiologic Computing: Concepts and Solutions

[2h] Directed Outbreak Exercise

1:30 pm – 4:30 pm

[2h] Self-directed Outbreak Exercise

[1h] Review Outbreak Exercise

Curriculum Overview

Epidemiologic Concepts for the Prevention and Control of Infectious Diseases

In this session we will cover infectious disease transmission mechanisms (chain model of infectious diseases, natural history of infection and infectiousness, and convergence model of microbial threats), transmission dynamics (epidemic curves, basic and control reproductive number, and infection rates), and transmission containment (control points, control strategies, and control measures).

The Epidemiologic Approach: Steps to Evidence-based Action

Epidemiology is a foundational science of public health investigations, including outbreak investigations. In this session we will review the epidemiologic approach, including infectious disease surveillance, descriptive and analytic epidemiology, measurement and epidemiologic measures, study design and implementation, inferences in epidemiology, communication of findings, and evidence-based public health action.

Conducting an Outbreak Investigation in 7 Steps (Lecture & Discussion)

In this session we will conduct an interactive case study to introduce the 7 conceptual steps to conducting an outbreak investigation: (1) case investigation, (2) cause investigation, (3) control measures, (4) conducting an analytic study, (5) making statistical, epidemiological, and causal inferences, (6) designing and implementing surveillance systems, and (7) communicating findings from an outbreak investigation in report form or media communications.

Step 1: Case Investigation

The goals of the case investigation are to confirm an outbreak and to establish preliminary causal hypotheses. To confirm an outbreak, we will utilize the following steps: confirm diagnoses; develop a case definition; construct a line listing, design and implement cases finding; collect biologic specimens; conduct a descriptive study (epidemic curves, spatial spread); and rule out alternative explanations.

Step 2: Cause Investigation

The goals of the cause investigation are to systematically review known causal factors, prioritize likely causes to guide control measures (needed for Step 3), and generate testable hypotheses to conduct analytic study (needed for Step 4) if a cause remains unknown or control measure not working. The cause investigation may be organized by epidemiologists and clinical investigators, environmental investigators, laboratory investigators, veterinarian or vector specialists, infection control professionals, or forensics/law enforcement.

Step 3: Control measures

Majors goals of conducting an outbreak investigation are to control a current outbreak and to

prevent future outbreaks. For person-to-person communicable diseases, we implement transmission containment measures. These measures are designed based on our understanding of control points and control strategies which are derived from our understanding of transmission mechanisms and transmission dynamics. Steps 1 and 2 inform designing control measures.

Step 4: Conducting an Analytic Study

Analytic studies – using case-control or cohort designs – are conducted to test hypotheses in order to understand the causes of an outbreak. The hallmark of an analytic study is the recruitment of a comparison group to test causal hypotheses. Analytic studies are staff, time, and resource intensive and are conducted when: (1) the cause of the outbreak remains unknown, (2) control measures are not working, (3) to answer important research questions, or (4) to train investigators. In this session we cover study design, survey design, data analysis, and controlling for confounding.

Step 5: Making Statistical, Epidemiological, and Causal Inferences

A major goal of outbreak investigations is to draw valid conclusions about the nature and causes of an outbreak (causal inference). Understanding causality depends on our understanding of causal pathways and models of causation. Additionally, threats to making valid inferences can occur at the design and implementation phase of an investigation and include random error (chance), systematic error (bias), and confounding.

Step 6: Designing and Implementing Surveillance Systems

In this session we will review the goals of infectious disease surveillance systems, steps in establishing surveillance system, and elements of good surveillance systems. We will emphasize understanding the operating characteristics (sensitivity, specificity, and predictive value) of case definitions and outbreak detection systems.

Step 7: Communicating Findings

Findings of an outbreak investigation need to be communicated early and clearly. Written forms of communication include letters, memos, interim reports, final reports, and peer-reviewed scientific publications. Verbal forms of communication include media press conferences; interviews with newspaper, television, or radio reporters; and pre-recorded radio or television spots. In this session we will review written communication, crisis risk communication, and media interviewing.

Field Outbreak Investigation Emergency Management Principles

Large or deadly outbreaks can quickly overwhelm the capacity and capability of local outbreak investigators. Infectious disease preparedness goals include early detection and warning, rapid investigation, and rapid and appropriate response. Investigative systems will need to scale up rapidly to meet the demands of a complex or large outbreak. Different agencies – that normally do not work together – will need to communicate, collaborate, and coordinate. The Incident

Command System (ICS) was developed and tested in California for multiple agencies to mount an effective and coordinated disaster response. ICS emergency management will be adapted for conducting outbreak investigations. These concepts and principles will be incorporated in the course presentations.

Epidemiologic Computing: Concepts and Solutions

An overview of epidemiologic computing for hospital-based outbreak investigations will be reviewed. In an outbreak investigation, there are many issues that arise related to linking multiple data sources, organizing data, analyzing data in real time, reporting, and communicating results. Information management for epidemiologists entails proficiency and efficiency with epidemiologic and statistical computing so that one can rapidly detect, investigate, and respond to hospital outbreaks.

Directed and Self-directed Exercises

The course is designed to be interactive and participatory to reinforce learning. However, to assure core competencies in the application of concepts to conducting an outbreak investigation, we will take participants through a directed outbreak exercise. Then participants will break into teams and conduct a self-directed outbreak investigation based on an evolving tabletop exercise.