Conducting an Outbreak Investigation in 7 Steps (or less)

Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
URL: http://www.idready.org

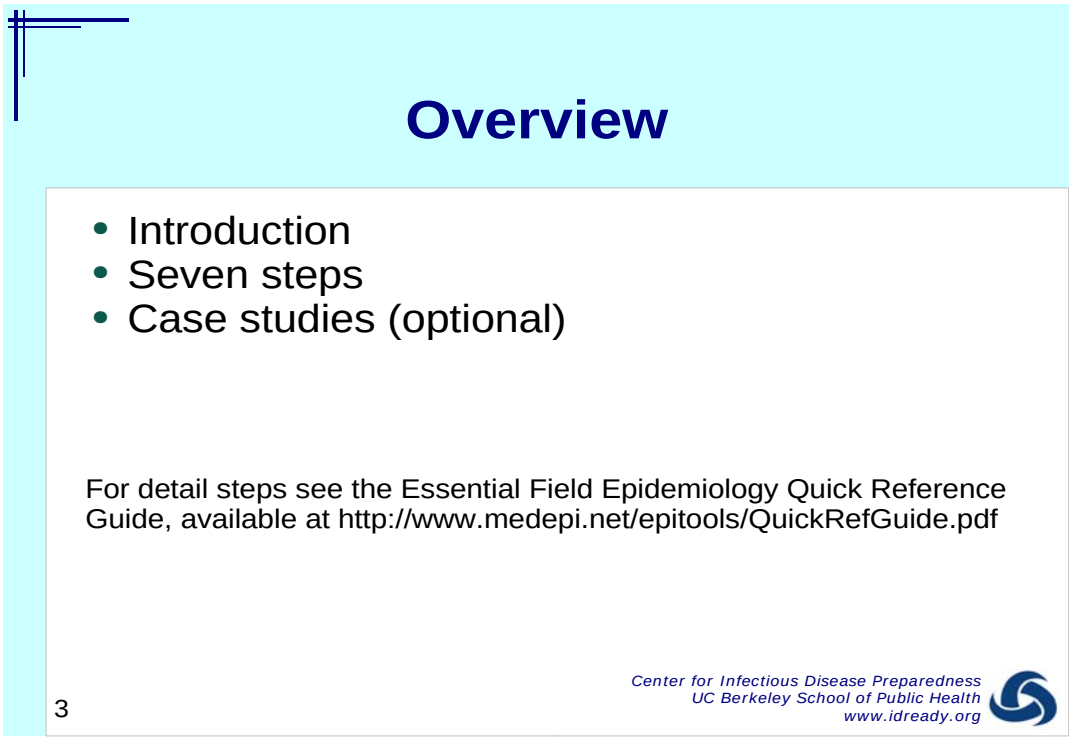
Updated June 2006

Created using freely available, open source software:
http://www.openoffice.org

[INSTRUCTIONS ARE IN CAPITAL LETTERS. Talking points are in normal type.]

Learning objectives: Participants will be able to ...

- Describe at least three ways that outbreaks are recognized;
- Describe at least three reasons for investigating an outbreak;
- Describe at least three constraints to conducting an outbreak investigation;
- Describe the seven step of conducting an outbreak investigation.



Today we are going to review the seven conceptual steps of conducting an outbreak investigation. Most articles that review outbreak investigations present 10 or more steps. Instead, we will focus on the conceptual steps that form the foundation to any epidemiologic investigation or research project.

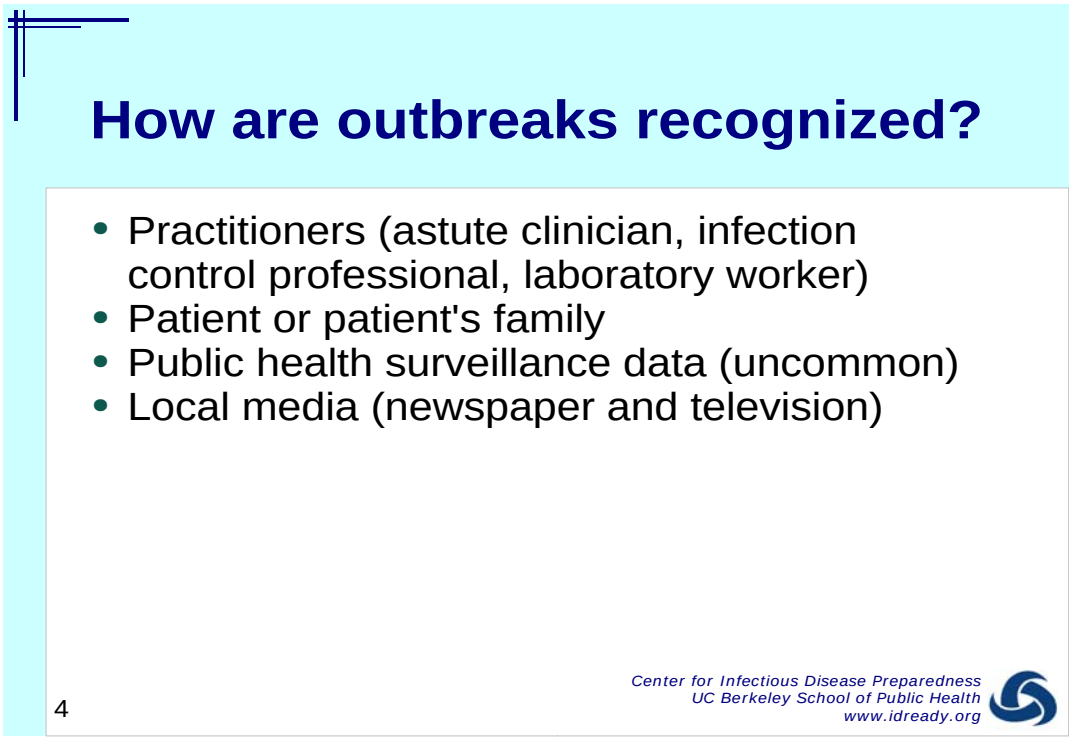
We will cover the 7 conceptual steps, then you will review 2 case studies.

Let's get started:

[NEW THEME] How are outbreaks recognized?

WRITE ON THE BOARD ANSWERS PROVIDED BY THE STUDENTS.

NEXT SLIDE...



Great.

Most outbreaks are recognized by clinicians or concerned individuals that notice something unusual. Examples include the following:

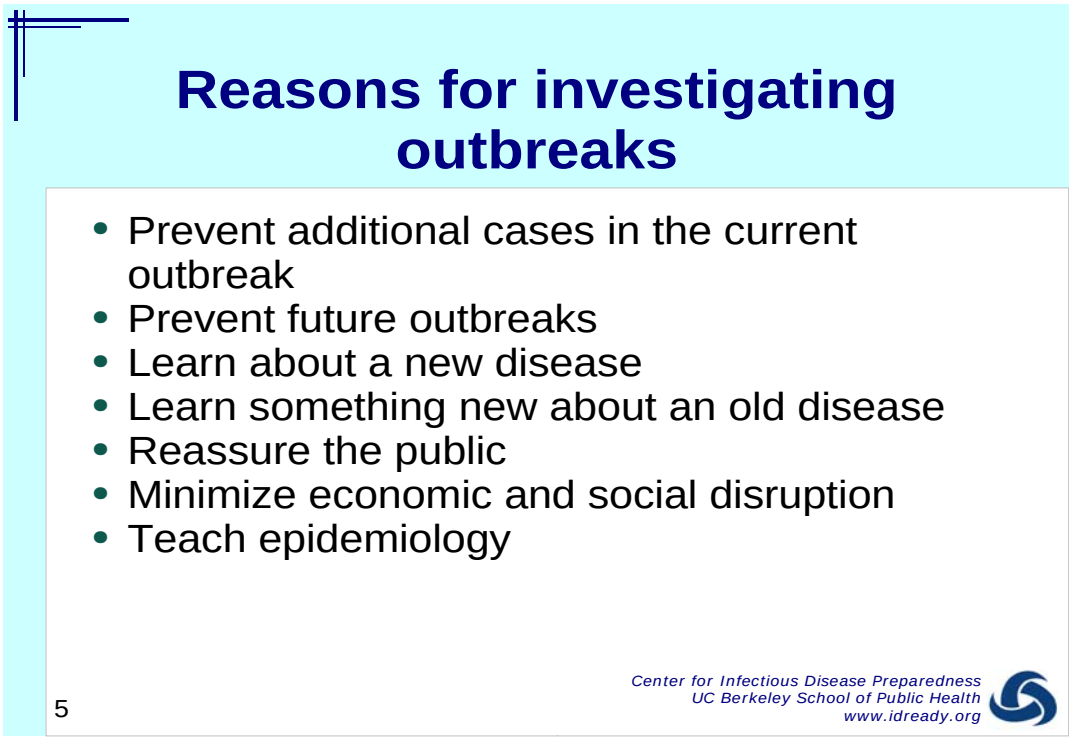
- Outbreak of atypical pneumonias were reported to WHO by Dr. Carlo Unbani. This turned out to be SARS (ref).
- The first case of intentional anthrax in Florida, United States, 2001, was reported by an astute clinician (ref).
- The first cases of Lyme arthritis (get ref)
- First cases of AIDS were reported as 5 cases of pneumocystis carinii (ref)

In general, public health surveillance systems do not detect most outbreak first. Why would this be the case?

[NEW THEME] What are the reasons for investigating outbreak?

WRITE ON THE BOARD ANSWERS PROVIDED BY THE STUDENTS.

NEXT SLIDE...



Here are some reasons for investigating outbreaks.

[NEW THEME] What are the constraints of conducting a field outbreak investigation?

WRITE ON THE BOARD ANSWERS PROVIDED BY THE STUDENTS.

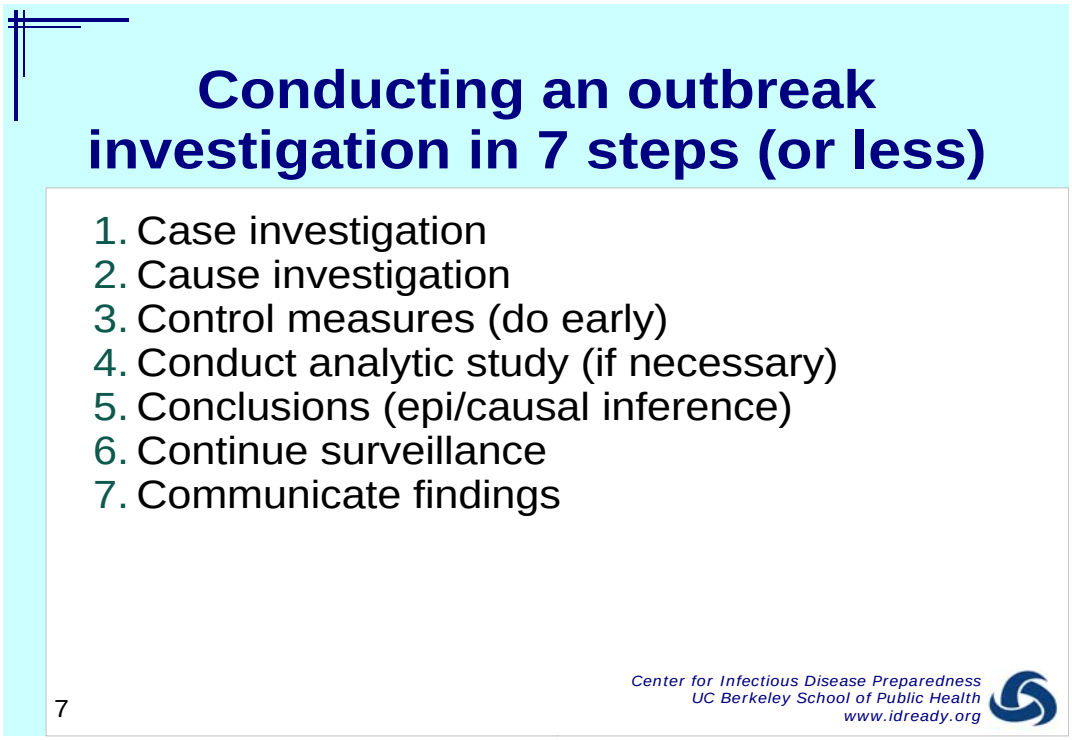
NEXT SLIDE...

Constraints of field outbreak investigation

- Urgency to find source and prevent cases
- Pressure for rapid conclusion
- Statistical power often limited
- Media reports may bias interviewees
- Pressures because of legal liability
- Pressures because of financial liability
- Delays lead to limited human or environmental samples for testing

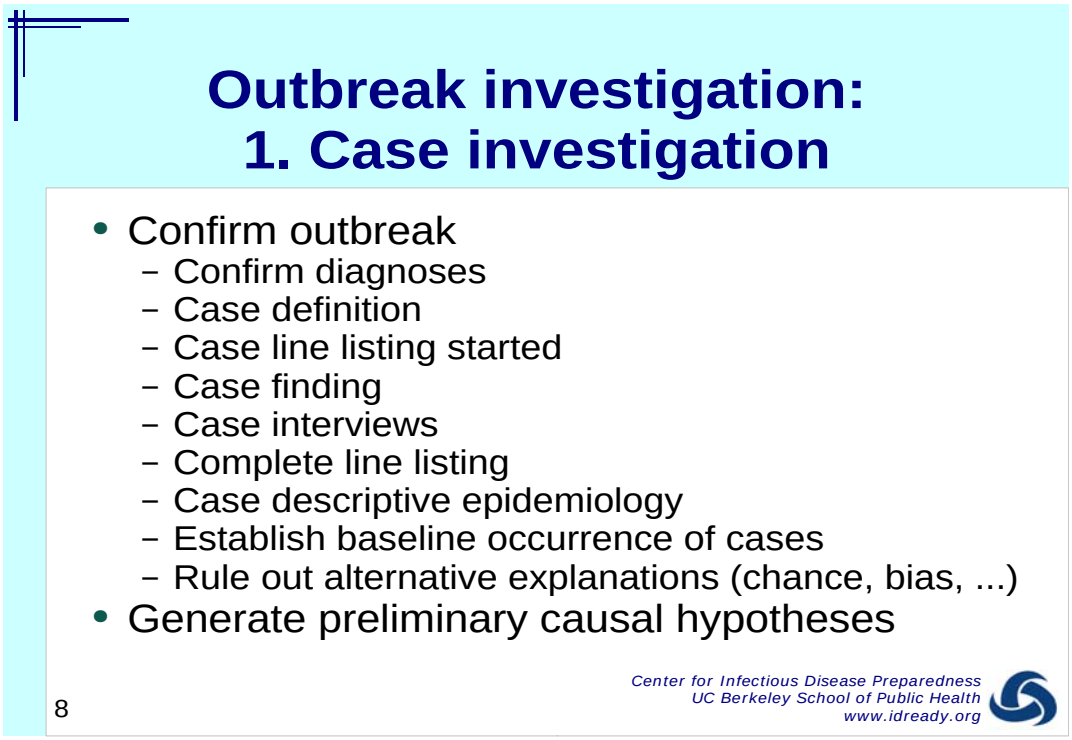
Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
www.idready.org

Here are the constraints and challenges of conducting a field outbreak investigation.



Here are the 7 conceptual steps:

1. The purpose of the case investigation is to collect sufficient information about the cases to determine: Is this an outbreak? And, what might be causing the outbreak? (generate hypotheses)
2. The purpose of the cause investigation is to review systematically the known causes (using epidemiologic concepts of transmission mechanisms and dynamics).
3. Design, implement, and evaluate control measures using information from the case and cause investigations. Most outbreaks investigated by health departments do not go beyond this step.
4. Conduct an analytic study if control measures are not working or to test a causal hypotheses (if necessary).
5. Understand the process drawing conclusions (making epidemiologic and causal inferences).
6. Continue surveillance (detection, monitoring, evaluation).
7. Prepare report and communicate findings.

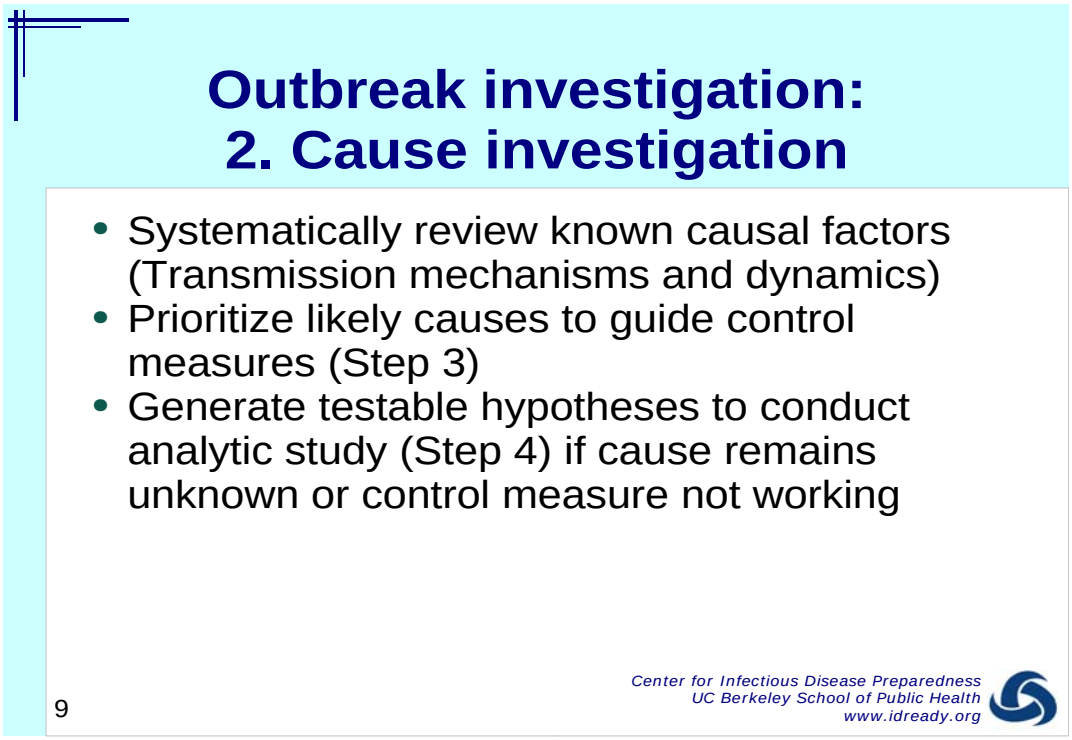


Again, the primary purpose of the case investigation is to confirm an outbreak and to generate preliminary causal hypotheses.

Unless you are experienced conducting outbreak investigations, it's difficult to remember all the steps involved. Its a good idea to keep our Essential Field Epidemiology Quick Reference Guide readily available for consultation. The Guide is available at http://www.medepi.net/epitools/QuickRefGuide.pdf

Better yet, convene an interdisciplinary team (public health nurse, medical epidemiologist, epidemiologist, environment health specialist, etc) and discuss what information needs to be collected to confirm an outbreak and to generate preliminary hypotheses. In general, you will develop a plan that addresses all these steps, even without a Guide. If you are inexperienced, it's generally a mistake to do this by yourself.

The Quick Reference Guide covers the case investigation in much more detail. Just remember that this is the first step and to convene an interdisciplinary team if possible.



From the case investigation you have confirmed an outbreak and have generated preliminary causal hypotheses. Based on your experience, you may have sufficient data to implement effective control measures. However, not uncommonly, the cause of the outbreak remains uncertain and/or you do not know enough to implement effective control measures. In this case, you may need to identify and prioritize causal hypotheses to implement control measures and/or to test these hypotheses and identify the most likely cause(s).

To save time and resources, you need a systematic and comprehensive approach: Use the components of transmission mechanisms and dynamics to guide your review of the literature, guidelines, and experts. You aim to accomplish the following:

- Prioritize likely causes to guide control measures,
- Generate and prioritize testable hypotheses to conduct an analytic study if the cause remains unknown or control measures are not working.

The cause investigation extends and complements the case investigation; it guides control measures and analytic studies.

How is cause investigation usually organized?

- Epidemiologic/clinical investigation
- Environmental investigation
- Laboratory investigation
- Veterinary or vectorborne investigation
- Forensics/Law enforcement investigation

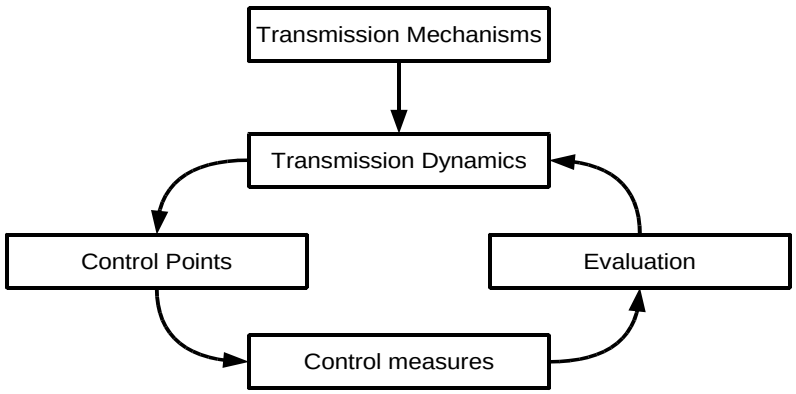
Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
www.idready.org

So far, our approach addresses primarily an epidemiologic investigation. In order to conduct a thorough investigation we will need consultation with other specialists including environmental investigators, laboratorians, veterinarians, law enforcement, etc. They may need to conduct their own complete investigation. There may or may not be overlap in the investigations. If there is overlap, we need to coordinate investigative activities to minimize duplication of efforts. Additionally, we need to realize that communications can be hampered by discipline-specific jargon, or terminology that has different meanings to each discipline.

For example, how do the these terms' meanings differ for public health and law enforcement:

- Surveillance
- Evidence
- Case

Outbreak investigation: 3. Control measures (do early)



Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
www.idready.org

This slide is to remind us that

- Transmission mechanisms drive transmission dynamics,
- Transmission dynamics have critical control points,
- The 5 critical control points lead to six control strategies,
- Six control strategies guide selection of control measures

GO TO NEXT SLIDE...

Transmission dynamics and control points

Effective reproductive number

$$R(t) = c\ p\ d\ x(t)$$

Conditional infection rate

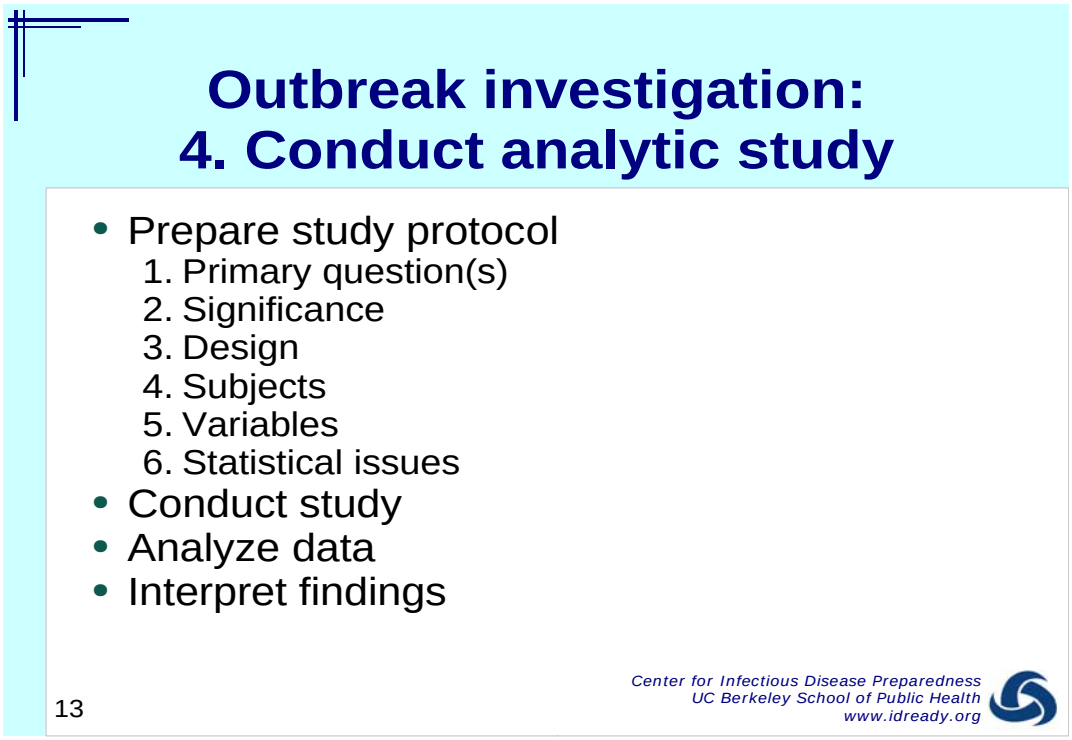
$$I(t) = c\ p\ P(t)$$

Control points	Prevention and control strategies
Contact rate (c)	1. Reduce contact rate
Prob. source infectious (P)	2. Reduce proportion infectious sources
Transmission prob. (p)	3. Reduce infectiousness 4. Reduce susceptibility 5. Interrupt transmission
Duration infectiousness (d)	(see #3)
Fraction susceptible (x)	6. Increase herd immunity

Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
www.idready.org

Here are the five critical control points and the six control strategies:

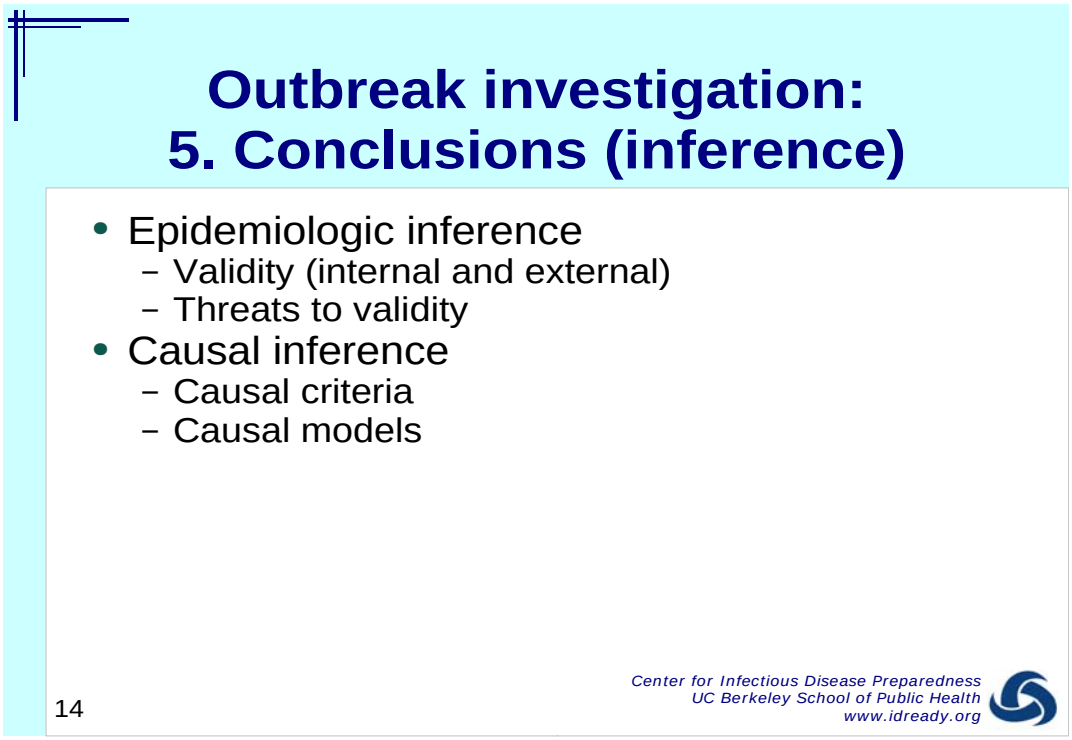
1. How can we reduce the contact between susceptible hosts and infectious sources?
2. How can we reduce magnitude and duration of infectiousness in the source?
3. How can we reduce host susceptibility?
4. How can we reduce the proportion of infectious sources? (e.g., contaminated units of blood)
5. How can we increase herd immunity?



On occasion, you will need to conduct an analytic study. This is necessary when need/want to test some causal hypotheses because you have not identified the cause, and/or control measures are not working.

Testing a causal hypothesis requires a carefully designed analytic study. To design a study you need to prepare a study protocol. This is true whether you are designing a study for an outbreak investigation or a NIH research study. The study protocol can be brief, but you need to articulate (1) What are the primary questions you proposed to answer? ["Asking the right question is half the right answer."] (2) What are these questions the most important? (3) What is the study design? (case-control vs retrospective cohort), (4) Who are the subjects and how will they be selected and recruited into the study? (5) What the measurements you will collect? (outcome, exposures, etc.), and (6) How many subjects do you need (sample size) and how will you analyze the data?

These steps need to be planned (and hopefully pilot tested) before you embark on a resource-intensive study.

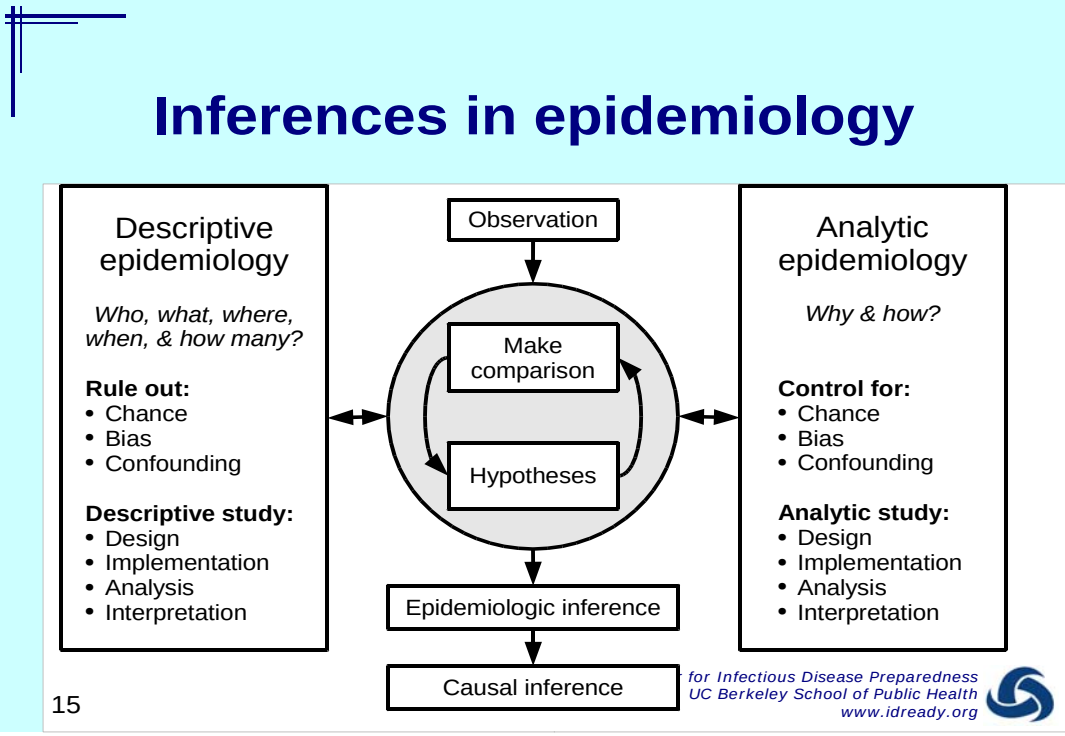


Drawing conclusions from epidemiologic data is called epidemiologic inference. How accurate your inferences are with respect to your study population is called internal validity. How accurate your inferences are with respect to external, but similar, populations is called external validity (or generalizability). You cannot have external validity until you first have internal validity.

To make valid epidemiologic inferences, you need to address threats to validity: namely, chance (random error), bias (systematic error), and confounding (alternative causes acting).

Drawing conclusions about causality (that an exposure caused or is causing an outcome) is called causal inference. Making causal inferences requires synthesizing information from your investigation (epidemiologic, environmental, laboratory), the biomedical and public health literature (documentation of similar outbreaks), and common sense.

Consequently, using a conceptual causal model and some guiding causal criteria will facilitate this process.



This slide is to remind us of how epidemiologic inference works. We are reminded that chance, bias, and confounding threaten valid epidemiologic inferences in descriptive and analytic studies.

It's also important to remember that many non-epidemiologists make observations, notice differences, generate hypotheses to explain the observed differences, and jump to conclusions, In contrast, epidemiologists first *rule out* threats to validity before drawing conclusions from descriptive studies, and only then entertain new hypotheses. Epidemiologists then *control for* threats to validity in designing studies to test those new hypotheses. Making valid epidemiologic inferences requires this type of epidemiologic thinking. Fortunately, you don't have to be an epidemiologists to think like an epidemiologist.

Finally, conclusions from data or a study are integrated with other information to decide whether you believe an exposure is causing the outbreak (causal inference). Implementing control measures is predicated on inferring causality with sufficient certainty.

Outbreak investigation: 6. Continue surveillance

- Detect outbreaks
- Detect public health threats
- Detect infectious cases (case finding)
- Monitor trends in a target population
- Monitor exposed individuals for symptoms
- Monitor treated individuals for complications
- Direct public health interventions
- Evaluate public health interventions
- Generate hypotheses for further evaluation

Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
www.idready.org

If you don't have a surveillance system in place before an outbreak, you need to implement one during or after an outbreak. If you don't, how else will you know that the problem has been resolved or is recurring?

FOR EACH CATEGORY, HAVE 1 OR 2 STUDENTS GIVE AN EXAMPLE FROM THEIR KNOWLEDGE OR EXPERIENCE.

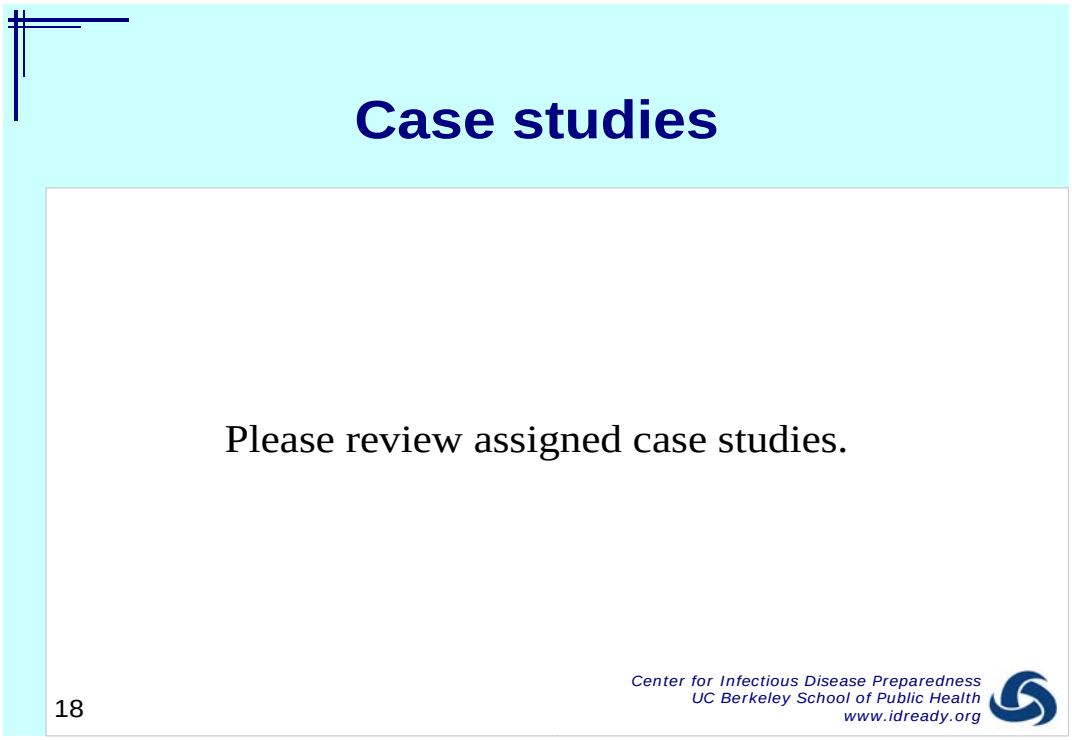
Outbreak investigation: 7. Communicate findings

- Communicate preliminary assessments and recommendations (letter, memo)
- Prepare interim/final reports
- Prepare manuscript (optional)
- Risk communication strategy (what to say)
- Media communication strategy (how to say it)

Center for Infectious Disease Preparedness
UC Berkeley School of Public Health
www.idready.org

Finally, you need promptly regularly communicate with stakeholders.

We will cover this material in detail in a separate lecture.



IT WOULD BE INSTRUCTIVE TO REVIEW ONE OR TWO SHORT JOURNAL ARTICLES OR LOCAL REPORTS THAT ILLUSTRATE SOME OF THESE STEPS. MOST INVESTIGATIONS DO NOT GO BEYOND STEP 3, SO MAKE SURE TO INCLUDE ONE OF THESE.

FOR EACH ARTICLE/REPORT ASK THE FOLLOWING:

1. DESCRIBE THE CASE INVESTIGATION (STEP 1)?

2. WHAT DID THEY DO WELL?

3. WHAT COULD THEY HAVE DONE BETTER?

REPEAT THESE QUESTIONS FOR EACH STEP.

NOTE: IT'S IMPORTANT TO SELECT READINGS THAT ARE INTERESTING AND RELEVANT TO YOUR TRAINEES, AND THAT ARE NOT TO LONG OR COMPLEX.