Outbreak investigation checklist: 10 steps to follow, 10 pitfalls to avoid

Version 6 – March 2008

Outbreaks

Outbreaks constitute unique events during which much can be learned about effective methods to prevent diseases. In the specific case of infectious diseases, outbreaks usually reflect a change in the relationship between (1) the host, (2) the agent and (3) the environment. All these mechanisms must be understood to propose adequate control measures. Understanding these mechanisms require a systematic methodological approach.

Field epidemiology methods for outbreak investigations

Confirming, traditional approaches to outbreak investigations

Traditionally, outbreaks have been investigated by disease-specific experts who would count cases, conduct laboratory studies and other studies as needed. Such investigations required subject-matter expertise in the disease of interest. They led to generic prevention measures according to the disease diagnosed or the mode of transmission identified (Table 1).

Creative, field epidemiology methods for outbreak investigation

Field epidemiology methods are primarily based upon epidemiological methods but they usually call for collaboration with other disciplines (e.g., laboratory, environmental specialists, entomologists). They are based upon systematic approach that (1) confirms the outbreak and the diagnosis, (2) generates hypotheses on the basis of descriptive epidemiology and (3) tests these hypotheses using analytical epidemiology methods. They require skills in applied epidemiology and an open-minded attitude. These develop on the basis of field experience. Field epidemiology methods lead to recommendations that are specific to the situation and based upon the conclusions of the investigation. These methods can be applied to any kind of outbreaks, whether the pathogen is known or not and whether the disease is infectious in nature or not.

Table 1: Traditional versus field epidemiology methods for outbreak investigation.

	Conforming, traditional methods	Creative, field epidemiology methods
Approach	▪ Disease-based	▪ Epidemiology centered ▪ Usually multi-disciplinary
Investigation methods	▪ Case count ▪ Laboratory studies ▪ Additional studies (e.g., entomology, parasitology, environmental assessment)	▪ Confirming the outbreak and the diagnosis ▪ Generating hypotheses using descriptive epidemiology ▪ Testing hypotheses using analytical epidemiology ▪ Additional investigations (e.g., vectors, environment)
Background needed	▪ Facts +++, skills ++, attitude+	▪ Fact +, skills++, attitudes++++
Field of application	▪ Known infectious diseases	▪ All outbreaks (known infectious diseases, emerging infectious diseases, injuries, toxic agents)
Control measures	▪ Generic, according to the agent identified and the mode of transmission	▪ Specific, based upon the conclusions of the investigation

10 steps of an outbreak investigation

There are 10 steps to an outbreak investigation, but at each step, common pitfalls should be avoided (Table 2):

1. Determine the existence of the outbreak;
2. Confirm the diagnosis;
3. Define a case;
4. Search for cases;
5. Generate hypotheses using descriptive findings;
6. Test hypotheses with an analytical study ;
7. Draw conclusions;
8. Compare the hypothesis with established facts;
9. Communicate findings
10. Execute prevention measures.

Table 2: Outbreak investigation checklist: Recommended steps and common pitfalls.

Steps	Specific recommendations	Pitfalls to avoid
1. Determine the existence of an outbreak	✓ Determine whether there is a clustering of cases, a cluster of cases of an outbreak-prone disease or a single case of a disease of international importance. ✓ Review incidence in the past in the area of the outbreak. ✓ Check for recent changes in the surveillance system (numerator). ✓ Check for recent changes in the population size (denominator).	× **Taking all reported clusters at face value** Reported clusters may be pseudo-outbreaks. Check all reports for background rates, changes in surveillance practices (e.g., increased awareness) and change in the denominator (e.g., population movements).
2. Confirm the diagnosis	✓ Make clinical description of a few cases to raise hypotheses in terms of diagnosis. ✓ Collect the right biological specimens the right way to confirm the suspected diagnoses. ✓ Send the biological samples safely and appropriately packaged to the right laboratory.	× **Failing to obtain a laboratory diagnosis** Every efforts must be made to obtain a diagnosis as early as possible during the outbreak. This includes obtaining a careful clinical description of the cases and obtaining laboratory confirmation. Ask for assistance with respect to collecting and transporting specimens and identifying the correct laboratory for analysis, if needed.
3. Define a case	✓ Formulate a time, place and person case definition, using generic case definition if applicable (e.g., WHO, CDC, MoH). Multiple levels are possible, including sensitive case definitions (adapted to the descriptive stage) and a specific one (more adapted to the analytical stage).	× **Defining cases poorly** Cases must be defined with some attention and precision; otherwise, the case count may too large, too small, or inaccurately defined. A good case definition is essential to hypothesis generation. Have precise criteria, and use time, place and person elements. Seek help if needed.
4. Search for cases	✓ Search for cases within the time and space limits of the case definition. ✓ Compile and update a line listing of cases (e.g., on a spreadsheet) For each case, document at least the date of onset, age, sex, the zone of residence and the outcome.	× **Conducting a door-to-door case search or a survey upfront** Case search does not need to be done through a door-to-door survey all the time. In most cases, you can keep these undertakings for the second part of the investigation (hypothesis testing). For the descriptive initial part, you can (1) search for cases through surveillance and (2) obtain denominator separately. The case search strategy does not need to be 100% exhaustive: it needs to be uniform.
5. Generate hypotheses using descriptive findings	✓ Describe the outbreak over time through an epidemic curve. ✓ Draw a spot map, and if possible, a map with incidence / 1000 population by area of residence. ✓ Calculate population-based incidence by age and sex groups. ✓ Conduct hypothesis-generating interviews with case-patients to try to find out what is common to all case-patients.	× **Merging the hypothesis generating and the hypothesis-testing stages** The descriptive stage generates information (1) through epidemiological information organized by (a) time, (b) place and (c) person and (2) through hypothesis generating interviews. Surveys conducted in the absence of a hypothesis clearly defined on the basis of this type of information blur the distinction between the two stages of the investigation and may seriously impair the capacity to formulate a conclusion.

Steps	Specific recommendations	Pitfalls to avoid
6. Test hypotheses with an analytical study	✓ Write a mini-protocol to spell out the hypotheses to test and the study design to use. ✓ Conduct an analytical study (case control or cohort).	× **Believing that a questionnaire constitutes a study protocol** The analytical step is a careful epidemiological study. It requires a design and an analytical plan before it is initiated. A case control study is not always the answer. Do not rush to the questionnaire but rather follow each of the 10 steps. If you do a study, write a one-page mini-protocol in bullet format.
7. Draw conclusions	✓ Analyze the analytical epidemiological study. ✓ Formulate conclusions that explain the facts observed.	× **Having excessive confidence in the conclusions** The final conclusions of an investigation is not reached as soon as a p value happens to be under 0.05. Formulating conclusions requires review of causality criteria, examination of the proportion of cases exposed to the suspected source, discussion of other possible explanations and a double check to see whether the source identified or the hypothesis considered explains all the descriptive findings.
8. Compare the hypothesis with established facts	✓ Conduct an environmental assessment guided by the results of the analytical study. ✓ Review literature. ✓ Discuss conclusions with colleagues, peers and supervisors.	× **Rushing to conduct an environmental assessment** In most cases, your environmental assessment will be guided and focused by the analytical epidemiology findings to further confirm a hypothesis. It is not a fishing expedition conducted at the early stages of the investigation where all kinds of samples are tested in the absence of any hypotheses to try to find an answer.
9. Communicate findings	✓ Write a one-page draft summary report to leave in the field before departure. ✓ Communicate findings with supervisors, the laboratory and local public health authorities.	× **Failing to communicate the results to decision-makers** An investigation is not complete until the results have been communicated to those who need the information to act. A number of target audiences will need to receive the information in an adapted medium to engage in what they should do. Sending the report to a supervisor is not sufficient.
10. Execute prevention measures	✓ Formulate clear, specific feasible recommendations on the basis of your findings (Who? What? When? How?). ✓ Ensure implementation of the recommendations. ✓ Evaluate the relevance and effectiveness of the recommendations.	× **Formulating general recommendations that are not based upon findings** Recommendations need to focus on those interventions that would have prevented the outbreak or that will control it. They should be guided by the results of the investigation, based upon evidence, focused and feasible. Do not re-formulate all the recommendations of hygiene but focus on the specific ones that are the key issue in the outbreak.