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Outbreak Investigation

Overview

An outbreak or epidemic is the occurrence in a community or region of an illness(es) similar in nature, clearly in excess of normal expectancy and derived from a common or a propagated source ([19 CSR 20-20.010](#)).

The purpose of this Outbreak Investigation section is to provide general guidelines for local public health agencies (LPHAs) for the process of reporting, investigating, and documenting communicable disease outbreaks. A report of an outbreak may be received in a variety of ways (e.g., active or passive surveillance systems, concerned citizens, healthcare providers, media, law enforcement, etc.). All outbreaks or suspected outbreaks must be reported as soon as possible to the local health authority or the Missouri Department of Health and Senior Services (DHSS).


In Missouri, LPHAs hold the primary responsibility for conducting communicable disease investigations in their jurisdictions. The Bureau of Communicable Disease Control and Prevention (BCDCP) staff provide guidance, recommendations, and support to LPHAs as requested during investigations of communicable diseases. In addition, the BCDCP District Epidemiologists provide epidemiologic support for local investigations if the scope of the investigation exceeds the LPHA’s capacity to respond. When disease investigations span multiple local jurisdictions or states, the District Epidemiologists generally serve in a coordinating role to lead the investigation in coordination with other public health partners including, but not limited to, LPHAs and other state and federal partners. BCDCP support is made available to LPHAs, medical providers, and other public health partners 24 hours per day / 7 days per week, including weekends and holidays, through the DHSS Emergency Response Center by calling 800-392-0272.

Forms

- [Missouri Outbreak Report Form \(MORE\)](#)
- [National Outbreak Reporting System \(NORS\) Form](#)

Notifications

- Contact the [District Epidemiologists](#) or the Missouri Department of Health and Senior Services (DHSS) – Bureau of Communicable Disease Control and Prevention (BCDCP), phone (573) 751-6113, or for afterhours notification contact the DHSS – Emergency Response Center (ERC) at (800) 392-0272 (24/7 if an outbreak is suspected or support is needed).

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Reporting Requirements

- Instances, clusters, or outbreaks of unusual diseases or manifestations of illness and clusters or instances of unexplained deaths which appear to be a result of a terrorist act or the intentional or deliberate release of biological, chemical, radiological, or physical agents, including exposures through food, water or air are a Category 1(B) disease and shall be reported to the local health authority or to DHSS immediately upon first knowledge or suspicion.
- Instances, clusters, or outbreaks of unusual, novel, and/or emerging diseases or findings not otherwise named in 19 CSR 20-20.020, appearing to be naturally occurring, but posing a substantial risk to public health and/or social and economic stability due to their ease of dissemination or transmittal, associated mortality rates, or the need for special public health actions to control are a Category 1(C) disease and shall be reported to the local health authority or to the DHSS immediately upon first knowledge or suspicion.
- Outbreaks (including nosocomial) or epidemics of any illness, disease or condition that may be of public health concern, including illness in a food handler that is potentially transmissible through food, are a Category 2(A) disease and shall be reported to the local health authority or to DHSS within one (1) calendar day of first knowledge or suspicion.


Conducting the Investigation

An outbreak investigation helps identify the mode of transmission of the disease, the etiologic agent, who may be at risk of infection, and ultimately prevent additional cases and reduce the overall morbidity and/or mortality rates. An outbreak investigation may also allow evaluation of the sensitivity and specificity of a surveillance system, evaluation or implementation of intervention strategies (i.e., vaccination, social distancing, or removal of a point source) and contribution to the epidemiology and scientific knowledge of the disease.


A systematic, step-by-step approach to conducting an outbreak investigation is imperative for identifying the source of the outbreak and for controlling and preventing additional cases. Any questions about the outbreak investigation process or need for assistance should be directed to the [District Epidemiologists](#). The steps of an outbreak investigation are not rigid in their order and several often occur simultaneously.

1. Obtain the initial report.

- Collect available information, including:
 - ◆ Contact information for the person making the report
 - ◆ Suspected agent (laboratory findings or provider clinical diagnosis)
 - ◆ Signs and symptoms of illness
 - ◆ Person(s) or groups ill, number ill, number potentially exposed
 - ◆ Summary of demographic information (ages, sex, etc.)
 - ◆ Onset date(s) and duration of illness(es)
 - ◆ Suspected specific exposure or event

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- ◆ Location of ill persons (single county, multi-county, multi-state, etc.)
 - ◆ Suspected mode of transmission (food, water, animal, person-to-person, healthcare-associated)
 - ◆ Actions taken to date (control measures, environmental assessments/inspections, etc.)
 - Notify the District Epidemiologists of any suspected or known outbreaks via email or phone call.
2. **Establish the existence of an outbreak.**
 - Determine if there are other associated cases and if the number of cases exceeds the expected baseline by reviewing recent surveillance data (i.e., disease registries, syndromic data).
 3. **Verify the diagnosis.**
 - Collect additional clinical samples, if needed.
 - Request confirmatory testing at a reference laboratory, if needed.
 4. **Notify public health partners.**
 - Ensure that key partners from public health laboratory, environmental health, regulatory agencies, and other partners are identified and aware of the outbreak.
 5. **Create an outbreak case definition.**
 - Combine clinical characteristics, laboratory test results, and epidemiological information into criteria for the categorization of cases to determine who is included in the outbreak. The outbreak case definition is almost always restricted by **person** (i.e., daycare attendees or staff), **place** (i.e., patients in a specific wing of a hospital, attendees of a wedding), and **time** (i.e., persons with illness onset between certain days). The initial case definition is often quite broad, to capture all possible cases; however, as the investigation proceeds it generally becomes more refined and divided into subcategories, such as suspect (i.e., fever only), probable (i.e., fever with cough and epidemiologically linked to a confirmed case), and confirmed (i.e., fever and cough with laboratory confirmation of influenza).
 6. **Find cases systematically and record information.**
 - Create a line list with case information, including variables such as onset date, patient demographics, clinical data, laboratory data, and risk factor or epidemiologic data.
 - If appropriate, develop a focused questionnaire based on information from initial surveillance efforts (person, place, and time variables) and the hypothesized agent, source, and mode of transmission.
 - If applicable, select an appropriate study design (e.g., cohort or case-control) based on the circumstances to test the hypothesis. The design should specify how a comparison group of non-ill persons will be selected and what statistical analyses will be performed.
 - If appropriate, work with public health partners to conduct an environmental

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assessment and collect specimens. Work with the District Epidemiologists to coordinate analysis of clinical and environmental specimens with the Missouri State Public Health Laboratory.

7. Perform descriptive and analytical epidemiology.


- Characterize the data by person, place, and time.
- If appropriate, obtain denominator data to calculate attack rates and identify potential associations and risk factors.
- Create an epidemic curve that reflects case illness onsets over time. The epidemic curve can give clues about the mode of transmission (e.g., person-to-person transmission or point/common source exposure), size of the outbreak, and incubation period.
- Select the categories to be analyzed for risk factors and/or associations using Epi Info or other suitable statistical software such as SAS, SPSS, or R.
- Analyze the data to identify differences in exposure frequencies between the ill and well groups (if case/control study), or differences in illness rates between exposed and non-exposed (if cohort study), to confirm or refute the hypothesis.
- If appropriate, the data can also be displayed in map form, revealing potential information such as common source exposure or clustering of cases.

8. Develop and test hypotheses.

- Use the information from the statistical analysis, along with laboratory data, environmental findings, and any other relevant information, to evaluate the hypothesis and formulate conclusions. If the hypothesis does not appear to be confirmed, it may be necessary to modify the direction of the investigation or to formulate a new hypothesis.

9. Implement control and prevention measures.

- Implement control measures that are indicated by the statistical, environmental, laboratory, and other findings to prevent further spread of the agent. Examples include:
 - ◆ isolation and quarantine
 - ◆ providing vaccine or immune globulin to exposed contacts
 - ◆ recalling, embargoing, or destroying food
 - ◆ correcting a contaminated water source or supply system
 - ◆ making a public announcement of the outbreak
 - ◆ improving sanitation, food handling or infection control practices
 - ◆ closing a restaurant until corrections can be made
 - ◆ recommending antibiotic treatment and/or exclusion (from work, child care etc.)
 - ◆ using barrier precautions such as masks and gloves


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- Evaluate the control measures for efficacy. Consider control measures successful if additional cases are prevented. Outbreaks are generally considered over after two incubation periods have passed since the last onset date occurred. If more than two incubation periods have passed and new cases are still occurring, then the outbreak is not under control. New cases may represent continuing exposure from a common source, a new common source, or person-to-person transmission from old cases.
 - Continue to identify problem(s), develop new solution(s), implement control and prevention measures, and evaluate.
- 10. Continue or enhance surveillance.**
- Continue or enhance surveillance to assure cases are not missed and that implemented control measures have been effective.
- 11. Communicate findings.**
- The results of the investigation should be shared with stakeholders (i.e., hospital staff, local health authorities, scientific community) so that others can learn from the investigation and recommendations. Reliable, complete information about outbreaks contributes to understanding the trends and causal factors in disease incidence, and to detecting and evaluating new diseases and risks. An outbreak report may be used to justify resources that were expended and/or to identify a need for additional resources for future incidents. An outbreak report can be requested under Missouri’s Sunshine Law and may serve as evidence in legal proceedings. Please see the next section regarding outbreak documentation.

Outbreak Documentation

Outbreaks are generally considered over after two incubation periods have passed since the last onset date occurred. Once the outbreak is over, a final outbreak report should be completed to summarize the outbreak investigation. The type of final documentation depends on whether the outbreak was more routine or expanded.

Routine outbreak investigations are common outbreak investigations where the agent is known (or inferred based on epidemiological data) that often results in minimal public health intervention. In addition, these routine investigations rarely require the use of epidemiologic studies for hypothesis testing. Examples of routine outbreak investigations may include norovirus, influenza, or COVID-19 in long-term care facilities or school settings, scabies outbreaks in any type of institution, or hand, foot and mouth disease outbreaks in child care settings. There may be situations where these examples may require formal documentation such as any novel findings, a new strain of the agent, or other factors or findings that may further the body of knowledge about the agent. Final documentation for routine outbreaks should include a [Missouri Outbreak Report Form \(MORE\)](#) and an epidemic curve. The outbreak report should be

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completed and submitted to the District Epidemiologists within two weeks of the conclusion of the outbreak. Please contact the District Epidemiologists for assistance in the event circumstances arise that prevent completion of the report within the two-week timeframe.

Expanded outbreak investigations are outbreaks that require a more in-depth and multi-faceted investigation, and therefore necessitate a more thorough manner of documentation. Examples of expanded outbreaks include outbreaks where the primary mode of transmission may be through food or water, or when there is prolonged person-to-person spread. It is critical to document aspects of these outbreaks such as study design, statistical findings, environmental findings, laboratory results, and control measures. Final documentation for expanded outbreaks should include a [MORF](#) and a formal written report of the investigation with an epidemic curve.


Waterborne outbreaks require extensive data collection and, as such, the MORF cannot be substituted. For waterborne outbreaks the final documentation should include a [NORS Form](#) and a formal written report of the investigation with an epidemic curve. The outbreak report should be completed within 90 days after the conclusion of the outbreak. Please contact the District Epidemiologists for assistance in the event circumstances arise that prevent completion of the report within the 90-day timeframe.

A formal outbreak report should contain the following components:

- **Name of Investigation** - Provide a name that is unique to the investigation. The investigation name should start with the Outbreak ID Number followed by any combination referencing the location (city, county, state, multi-state), group affected (venue, vicinity, etc.), time frame of outbreak (month, season, year, etc.), the name of the agent, or other variables applicable to the outbreak.
 - 22-CD-##: Salmonellosis Outbreak Among Campers in Wayne County, Summer 2022
 - 23-CD-##: Outbreak of Acute Gastroenteritis of Unknown Etiology Among Elementary Students in St. Louis County, April, 2023
 - 23-CD-##: Multi-County Outbreak of E. coli O157:H7 Outbreak Among Attendees of a Wedding, November, 2023.
- **Lead Investigator(s)** - Provide the name and affiliation of the individual leading/coordinating the investigation. Provide the names and/or affiliations of other co-investigators.
- **Date** - Provide the date of the final report; This will be the date the LPHA submits the report to the District Epidemiologists for review.
- **Prepared By** – List the name(s) and affiliation(s) of the author(s) of the report; this is the person(s) that should be addressed if questions about the report arise.
- **Introduction** - Provide descriptive information regarding who identified the outbreak and/or how it was reported; date of the initial report; and summarize the situation (initial number ill, initial symptoms, etc.).

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- **Background** - Provide general background information regarding the location where the outbreak occurred; the epidemiologic description of the pathogen (if known), such as the reported incubation period, duration of illness, disease severity; any laboratory details and or surveillance data.
- **Methods** - Provide information on case finding, study design, how information was collected and applicable case definitions for the outbreak. Include methods on sample collection (both human and environmental), site visits, etc. State any software packages used to analyze data. Methods are the recipe for how the investigation was conducted and will allow for interpretation of the results and conclusions.
- **Results** - Provide a summary of the (who, what, when, where) of cases; case statuses (confirmed, probable, suspect); demographics (age, sex, race, ethnicity); jurisdiction(s); clinical descriptions (symptoms, duration of symptoms, onset dates, hospitalizations, and deaths); date(s) of specimen(s) collected and all laboratory findings (what was tested, where testing occurred, type of test, test results). Include descriptive and analytical statistics. Also include findings from environmental investigations, onsite visits, or other pertinent information.
- **Discussion** - Discuss the information included in the results and background to help explain the results of the investigation and the possible associations between the illnesses and possible risk factors. How do the epidemiological, laboratory, and environmental findings mesh with the known epidemiology of the disease? Do the findings support the hypothesis? Provide alternative hypotheses if known. Further describe other interesting or key features of the outbreak and list any limitations for the study.
- **Control Measures** - Describe any control measures that were recommended or implemented, including restaurant or child care inspections, isolation of cases, etc.
- **Conclusion** - Make your final statement that the findings of the investigation confirmed (or did not confirm) the existence of an outbreak; what is the suspected cause and source of the outbreak (if able to be determined); and describe how the control measures implemented likely impacted the number of cases seen. Also use this section to describe why the findings of the investigation are significant and how they can be applied to future outbreaks.
- **Appendix** - Include in this section any tables for summary data or statistical findings which are labeled accordingly and referenced throughout the document, including the epidemic curve. The appendix may also include additional supporting documentation such as inspection reports, notification letters, press releases, etc.
- **References** - Include in this section any articles cited in the outbreak report using the American Medical Association (AMA) format or American Psychological Association (APA) format.

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The approved final report should be distributed to all agencies that contributed to the investigation effort. The report should also be maintained in accordance with record retention laws.

Resources

1. Bennett JE, Dolin R, Blaser MJ. Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. 2020;2(9):161-162.