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Section III: How to determine if a workplace is experiencing an outbreak

A Legionnaires' outbreak (that is, two or more confirmed cases) is both an occupational and a public-health concern. The investigation will include local public health departments and possibly the Centers for Disease Control and Prevention (CDC). To minimize employee risk and maximize the effectiveness of the effort, close coordination among OSHA, other public agencies, and the employer is necessary. It is important to remember that Legionnaires' disease in workers may have its origin in the community and may not be related to the work environment.



Investigation Protocols:

OSHA has developed two investigation protocols available for differing levels of suspected exposure to Legionnaires' disease bacteria (LDB). Both investigations follow the same general pattern and include a preliminary opening conference and walk-through of the facility to conduct a physical assessment of the water systems. A more detailed examination of the systems involves a review of maintenance records, assessment of findings, and a closing conference to present control actions based on findings. The degree of certainty that the site is the source of illness determines the course of action taken during an investigation.

- Conduct a [level one investigation](#) when LDB contamination is suspected or no more than one case of probable or confirmed Legionnaires' disease is recognized.
- Initiate a [level two investigation](#) when more than one probable case of Legionnaires' disease has been reported.



Keep in mind: Individual circumstances may require changes in the investigation. These procedures are provided only to assist in the investigation of potential Legionnaires' disease cases. All cases require sound professional judgment in deciding the appropriate course of action.

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Section III:A. Investigation Protocols: Level One

Conduct a level one investigation when there is a probable basis for suspecting that workplace water sources have been contaminated with Legionnaires' disease bacteria (LDB), or when there is information that no more than one case of Legionnaires' disease has been reported.

OSHA personnel are encouraged to inform local health authorities of the investigation. Local health authorities may be helpful in the collection and analysis of water samples after the resolution of any issues related to sample confidentiality, including medical privilege of information, rights of the employer, and authority of local health departments.



Use the following procedure when Legionnaires' disease may be related to the work environment:

1. [Obtain an overview of all water systems](#)
2. [Conduct a walk-through inspection](#)
3. [Assess the results](#)
4. [Recommend control actions](#)

Step 1: Obtain an overview of all water systems

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A facilities engineer or experienced member of the building maintenance staff with a working knowledge of the system's design and current operation is needed to assist in the walk through inspection. An overview of the water systems includes plumbing systems, heating-ventilating-air-conditioning (HVAC) systems, and other water reservoirs.

A review of the plumbing system includes:

- Hot and cold domestic water systems
- Water heaters
- Distribution pipes
- Water coolers
- Water treatment equipment
- Connections to process water systems
- Storage tanks

The HVAC system review includes:

- Cooling towers
- Evaporative condensers
- Fluid coolers
- Humidifiers



Fig. 1: Investigate storage tanks as part of the plumbing system review

- Direct and indirect evaporative air-cooling equipment
- Air washers for filtration
- Note the location of the fresh-air intakes of the building's air-handling units relative to water sources such as the cooling towers

Investigate other potential sources of employee exposure including:

- Decorative fountains
- Whirlpools and spas
- Plant misters and grocery produce misters
- Humidifiers
- Water for cooling industrial processes
- Tepid-water
- Eye-washes and safety showers

Review maintenance records on water systems including water heaters and cooling towers.

- Review records of temperature checks of domestic water supplies, visual and physical inspections of cooling towers, and reports of cooling-tower water-quality assessment and chemical treatment.

Identify the locations where other problems may exist:

- Inspect locations of the system where water is allowed to stagnate such as storage tanks, unused plumbing pipe sections ("dead legs"), or infrequently used faucets.
- Check for cross-connections between domestic and process water systems, and note the condition and type of back-flow prevention devices in use.
- Investigate recent major maintenance or changes in the system's operation.
- Determine if there were recent or frequent losses of water pressure from the incoming water supply due to line breakage or street repairs. The failure of a back-flow prevention device under loss of pressure can contaminate the system.

Step 2: Conduct a walk-through inspection

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Equipment List for walk-through inspections:

- Respirator
- Thermometer for measuring water temperatures
- Flashlight
- Film or video camera to record observations

General conditions:

- If an operating cooling tower is suspected of being contaminated, turn it off before entering and wear appropriate respiratory protection in the form of a half-face respirator equipped with a HEPA or similar type of filter capable of effectively collecting one-micrometer particles during the examination of the system. For more information on outbreak response, see [Section IV: Control Actions](#).

- Record the general condition of the cooling tower.



Fig. 2: Thermometer on a storage tank

- Determine the presence and condition of drift eliminators, which are designed to limit the vapor release from the units, along with the basin temperature of the water in the cooling tower if it is currently being operated.
- Record the location of the tower relative to outdoor-air intakes, kitchen exhausts, plant material, or other sources of organic material that might contribute to the growth of LDB.
- Note the location and evaluate the condition of the sumps for the cooling towers, evaporative condensers, and fluid coolers. These sumps are sometimes located indoors to protect them from freezing.
- The lack of a regular maintenance schedule or water-treatment program for a cooling tower or evaporative condenser system suggests a potential for LDB contamination.

Water Temperature:

- Measure and record the temperature of water drawn from each storage-type water heater in the facility. This temperature may be significantly below the water heater's gauge temperature because of heat stratification.
- Record the maximum temperature of water at faucets connected to each water heater in the system.
 - Record temperatures at locations near, intermediate, and distant from the heaters.
 - It may be necessary to run the water for several minutes before it reaches a maximum temperature.
- Examine the water temperature and the potential for stagnation of cold-water storage tanks used for reserve capacity or to maintain hydrostatic pressure.
 - Storage tanks should be protected from temperature extremes and covered to prevent contamination.
 - Record the temperature of the domestic cold-water lines at various locations throughout the facility.
 - Note both the initial temperature and the final equilibrium temperature on the cold-water line and record the time required to reach equilibrium; this can be an indicator of the amount of stagnation in the system.

Bio-film and Scale Buildup:

- Evaluate cooling towers, evaporative condensers, and fluid coolers for bio-film growth, scale buildup, and turbidity.
- Note the presence of rust and scale in the water, which may indicate infrequent use, corrosion, or bio-film formation.

Cross Contamination:

- Record the locations of any cross-connections between the cooling tower water system and any domestic water system. These may supply a back-up source of cool water to refrigeration condenser units or serve to supply auxiliary cooling units.

Step 3: Assess the results

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Use the walkthrough inspection to determine a course of action.

- Recommend corrective actions if the system is poorly maintained

and operating temperatures for water heaters are below the recommended minimum or cold-water systems are above the recommended maximums.

- No further action is necessary if:
 - Operating temperatures measured at water heaters are 140°F (60°C) or above.
 - The delivery temperature at distant faucets is 122°F (50°C) or higher.
 - Cold-water temperature is below 20°C (68°F).



Fig. 3: Determine a course of action based on investigation findings

Step 4: Recommend control actions

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Water Sampling: For a level one investigation, the absence of proper operating conditions alone is sufficient evidence that LDB may be present in the system, that the water system poses an unnecessary risk to employees, and that corrective measures are needed.

- The employer may want to obtain samples before beginning these control actions to assess the extent of the problem.
- The employer should take necessary control actions even if the results of pre-treatment tests are negative.
 - Water sampling can produce false-negative results, a contaminated portion of the system may have been missed, and the absence of LDB organisms at the time of sampling does not ensure that the system will remain negative.
- If the employer sampled before undertaking corrective measures, water samples also should be collected after the completion of the control actions to determine if the corrective measures were successful.

Control actions may include:

- Disinfection of the domestic water system via heat treatment.
 - Control actions limited to raising the water heater temperature without evaluating the system for points of stagnation, heat loss and gain, cross-contamination, and other factors that contribute to growth are generally not sufficient.
- Biocide treatment such as chlorine.
- A process for cleaning heat rejection systems that follows sound practices to minimize potential for LDB growth.
- If, after control actions, the LDB levels in a water source exceed the suggested recommendations in [Section II:E. Water Sampling Guidelines](#), re-examine the water system to determine if potential contamination points within the system were overlooked and reassess control procedures to determine if they were performed properly.
 - Repeat the procedures as needed until contamination levels meet the guidelines.

Additional actions may include:

- Eliminate dead legs in the plumbing system.
- Insulate plumbing lines and install heat tracing to maintain proper temperatures in the system.

- Eliminate rubber gaskets.
- Remove or frequently clean fixtures such as aerators and shower heads.

[Additional information](#) (App II:A-1) on biocides is also available.

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Section III:B. Investigation Protocols: Level Two

Initiate a level two investigation when more than one possible cases of Legionnaires' disease has been reported at a facility. A level two investigation is similar to a level one investigation with the addition of the following procedures. Local Health Authorities, Centers for Disease Control and Prevention (CDC) investigators, or OSHA representatives will:

- Inform and educate employees about the disease to minimize employee concerns and aid in early recognition of new cases.
- Conduct medical surveillance of all employees currently on sick leave to identify any new cases.
- Assess past sick-leave absences for undetected cases of the disease.
- Collect water samples during the walkthrough inspection.



Local, state, or federal authorities will take the following steps when more than one probable case of Legionnaires' disease has been reported:

1. [Obtain an overview of all water systems \(Section II:A. Level One\)](#)
2. [Conduct a walkthrough inspection and collect water samples](#)
3. [Initiate an employee awareness program](#)
4. [Review worker absences to detect other cases](#)
5. [Recommend control actions \(Section II:A. Level One\)](#)

Step 2: Walkthrough inspection with sample collection

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Conduct a walk through survey of the facility and collect water samples.

- Estimate the size of the building and the number of water services during an initial walkthrough.
- Prearrange supply and shipping of the required number of sterile sample containers with the appropriate laboratory.
- See [Section II:E. Water Sampling Guidelines](#) for sampling procedures.



Fig. 1: Collect water samples during the walk through.

The purpose of an employee awareness program is to inform the workers of the potential outbreak and to educate them about Legionnaires' disease.

- This program is of medical importance to aid in early recognition of the disease.
- It is important to help alleviate employee concerns about the disease.
- It is imperative not to alarm but to educate the workers.
- It is equally important to stress the importance of the need to know the health status of all employees on sick leave.
- This program should supplement the [case identification program](#) to discover previously undetected cases of the illness at the worksite.
- An employee awareness program includes a sample letter and supplemental information about the diseases that the employer can use for informing employees of a potential or actual outbreak.
 - [Appendix III: B-1. Sample Letter From Employer to Employees](#)
 - [Appendix III: B-2. Sample Information to be Obtained by Interview with Employees Calling in on Sick Leave](#)



Fig. 2: Employee Surveys

Implement the following elements of this program immediately upon recognition of more than one probable or confirmed case of disease in the workplace.

- An initial employee training session that provides basic information about the disease and actions being taken to investigate the problem.
- An ongoing general information service to provide updates and answer questions that may arise among employees.
- Medical and psychological counseling services when an outbreak has occurred.
- A medical monitoring program must be instituted to track all workers currently on sick leave.

Case Identification Program: The purpose of this phase of an investigation is to identify cases of Legionnaires' disease among the workers. The investigation includes identification of all employees who took three or more consecutive days of sick leave from six weeks before the index Legionnaires' case was identified to the present. Request that all employees who have been identified as having had pneumonia, or potentially having had pneumonia, during this period undergo voluntary medical testing to detect evidence of Legionnaires' disease. A physician's diagnosis of pneumonia or pneumonia-like symptoms that includes a fever (38°C, 101°F) and cough indicate a need for further evaluation. A sample program is described below.

1. Conduct an Interview: Examine sick leave records to identify all employees who used three or more consecutive days of sick leave from six weeks before the earliest known case to the present.

- Interview these employees. If it appears that an employee experienced a pneumonia-like illness, complete a health surveillance questionnaire. [Appendix III: B-3. Health Surveillance Questionnaire](#)
- Also interview employees who feel that they might have had symptoms of Legionnaires' disease but did not use three or more consecutive days of sick leave.
- Administer an epidemiological questionnaire. [Appendix III: B-4 Epidemiological Questionnaire](#)

2. Medical Release: Request employees who experienced a pneumonia-like illness and saw a physician to sign a medical release form to allow the company or OSHA to obtain additional information from the attending physician.

- Interview the physicians of all employees who have sought medical care and signed a medical release form using a physician survey questionnaire. [Appendix III:B-5. Physician Survey Questionnaire - Legionellosis](#)

- Inform employees participating in surveys of their Privacy Act rights as well as their right to protect their own medical information.

- Physician-patient confidentiality must not be violated.
- Necessary medical information may be communicated only with the patient's written permission.
- When seeking employees' permission, clearly inform them that the purpose of obtaining a proper diagnosis and sharing this information is to protect them and their fellow workers against the potential threat of legionellosis.

- Handle all medical records in accordance with [29 CFR 1913.10](#).

- It may be necessary to obtain medical releases from the employees interviewed to obtain supplemental information from a company health unit or from the employee's physician.
- Seek similar arrangements for permanent contract employees controlled by separate organizations in the building such as janitors, cafeteria workers, and security personnel.

3. Clinical Testing: Consider a clinical test for potential cases to confirm additional cases. Recommend a serological or other diagnostic test for possible Legionnaires' disease cases identified from interviews, the review of work absences, and discussions with the patients' physicians.

- Serological tests determine the antibody level of an individual.
- A single antibody titer of 1:256 with a physician's diagnosis of pneumonia should be interpreted as a probable case of Legionnaires' disease.
- If an antibody titer for Legionnaires' disease Bacteria (LDB) was obtained at the time of illness or if serum was collected from the patient at the early phase of the illness (acute phase), then the acute antibody titer level should be compared with the convalescent titer. A four-fold increase in titer is sufficient to confirm a case of Legionnaires' disease.
- [Additional information](#) (App I:B) on diagnostic methods, including culture, direct fluorescent antibody (DFA) staining, and serology is also available.

4. Other diagnostic tests may also be appropriate:

- If the potential case occurred recently, a urine antigen test may detect *L. pneumophila* serogroup-1 antigen.
 - A positive urine antigen test for a diagnosed pneumonia case is also accepted as evidence of a confirmed case. However, this test is available only for *L. pneumophila* serogroup-1 infections.
- Collect sputum, lung tissue, or lung aspirates from currently symptomatic individuals for LDB culture.
 - A positive culture confirms the diagnosis of Legionnaires' disease.

5. Disease Confirmation: If this process confirms more than one case of disease, then the facility should be considered to have experienced an outbreak. See [Section IV. Outbreak Response](#). **Note: The immediacy of the action will depend on whether the outbreak is ongoing or occurred 30 days or**



Fig. 3: Employees with symptoms should fill out proper recordkeeping forms.

more in the past.

- Take prompt action to control exposure at the site if there is evidence that an outbreak is on-going.
- Initiate control procedures, continue medical surveillance of the workforce to detect new cases of disease, and identify the water source responsible for the outbreak.

6. Assess the Results: Use the walkthrough inspection, medical surveillance, and water test results to determine a course of action.

- If the evidence indicates that two or more cases of Legionnaires' disease have occurred at a site and at least one of the cases was within the last 30 days, assume that an outbreak is in progress.
- Take prompt actions as required in [Section IV](#) to protect building occupants.
- If the water system is poorly maintained or operating temperatures for water heaters are below 60°C (140°F), or cold water above 20°C (68°F), recommend corrective actions.

No action is necessary if the results of the investigation are negative. Under the following circumstances, assume that the site is not the origin of the identified cases:

- All water and HVAC systems are well maintained and in good operating condition.
- All water sample results are negative or acceptably low.
 - See [Section II: E. Water Sampling Guidelines](#)
- No new cases of the disease have been identified at the work site.

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