

**Version**

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**As of: May 2015**

OFFICE OF PUBLIC HEALTH INFORMATICS AND  
EPIDEMIOLOGY (OPHIE)

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Training Course Materials



# Handbook for the '*Legionella*' Training Course

OPHIE TRAINING COURSE MATERIALS

# Handbook for the *'Legionella'* Training Course

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## Welcome to the Online Training Course for 'Legionella'

*This online accessible training course is intended to be done at the employee's own pace. The intent of this course is to create a common foundation of knowledge to build off of during future outbreak prevention, investigation, and treatment of legionella.*

**I**n this ongoing grant climate of 'do more with less', we here at the Nevada Division of Public and Behavioral Health's (DPBH) are working on ways to continue bringing you training opportunities, but with little to no travel expenses associated with those trainings.

One of the strategies we have come up with is to provide training opportunities through an online format using an internet-accessible system called **Prezi**. For those of you who have never heard of Prezi, it is basically a more dynamic version of the old standby: *Microsoft (MS) Power Point*. Rather than transitioning from slide-to-slide like we have in the past on MS Power Point; with Prezi you 'fly' through the transitions seamlessly. You'll see what I mean in a few moments.

Today's online training course should take about **1 hour and 15 minutes** to complete.

### System Requirements to Run Today's Training Course

**Basic Computers Will Work Fine:** The technical support team at Prezi has posted the following on their Prezi Basics web page:

*The Prezi editor runs well on most contemporary computers, even netbooks. You can easily determine if your computer meets system requirements to watch prezis by:*

1. *Checking out any prezzi from [www.Prezzi.com/explore](http://www.Prezzi.com/explore) to see if it plays back smoothly on your computer.*
2. *Checking if you can play back YouTube videos while in full screen mode when in any prezzi.*

*High End Usage: If you would like to play a very large prezzi (with many videos, animations, high resolution images, etc.), Prezzi uses Adobe Flash technology to render prezzi in real time, therefore you can create very high resolution presentations, but your playback performance will rely on the hardware. Here are some hardware recommendations:*

1. *Fast processors and lots of memory will help more than a strong graphics card.*
2. *It can help to play a prezzi through once, it will play more smoothly the second time (do not restart the prezzi).*

*Website: The [www.Prezzi.com](http://www.Prezzi.com) website supports all major modern browsers (Internet Explorer 9 and above, Mozilla Firefox 3 and above, Google Chrome, Safari) but for the best experience we recommend using the most standard compliant browsers available (Firefox 3.6+, Chrome 4+, Safari 4+). Flash version 11.1 is required.*

*Prezzi for Windows /Mac: For users who would like to access Prezzi through Microsoft Windows:*

- *2.33GHz or faster x86-compatible processor, or Intel Atom™ 1.6GHz or faster processor for netbook class devices*
- *Microsoft® Windows® XP, Windows Server 2003, Windows Server 2008, Windows Vista® Home Premium, Business, Ultimate, or Enterprise (including 64 bit editions) with Service Pack 2, Windows 7, or Windows 8 Classic*
- *512MB of RAM (1GB recommended)*

*For users who would like to access Prezzi through a Mac Operating System (OS):*

- *Intel® Core™ Duo 1.83GHz or faster processor*
- *Mac OS X v10.6, v10.7, or v10.8*
- *512 MB of RAM (1GB recommended)*

**High-Speed Internet Connection:** In order to access today's training course, you will need access to a computer with a high-speed internet connection. We realize that for many of you in our rural counties, such a connection may be an issue. So in an effort to ensure that you can at least read along with what the audio recordings for each transition, we have provided a complete transcript of what those audio recordings cover.

**Software Requirements:** In addition to this internet connection requirement, we ask that your computer also have *Windows Player* installed. This will allow your personal computer (PC) to run the audio portions of the Prezi presentation.

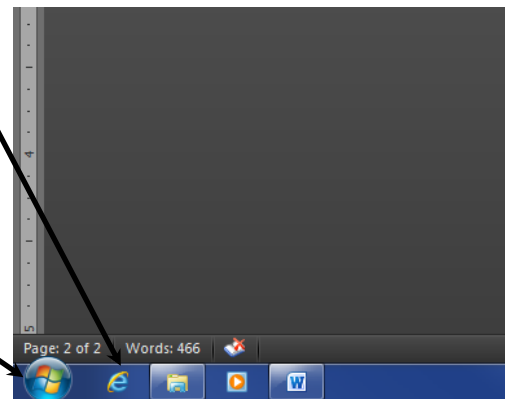
**Sound Speaker(s):** In order to listen to the presenter's recordings for each transition in today's course, please ensure that your PC has a speaker (or speakers) that are working, and as basic as this sounds: make sure the volume is turned on and up. If your system does not have a speaker, then you can follow along in this course handbook and read through each recording's content.

**How to Access, Open and Watch the Prezi Presentation:** Open the internet browser for your PC by double clicking on that browser's icon in the bottom-left corner of your screen like this:

If your computer is setup with a shortcut to your browser, like this, then click here:

If your computer does not have that shortcut, then click here:

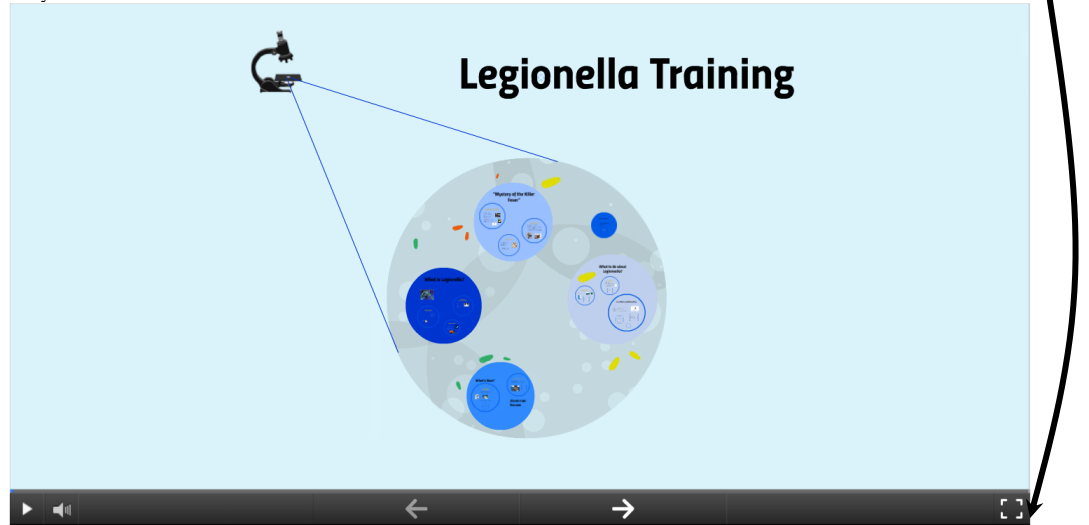
When that opens, look for the Internet browser and double click on that.



Once your internet browser opens, you will need to copy/paste this web address into your browser. I realize that this is a long address to type out, but please enter each letter/digit/symbol carefully; otherwise the presentation will not open for you.

[http://prezi.com/tspvitbansgr/?utm\\_campaign=share&utm\\_medium=copy&rc=ex0share](http://prezi.com/tspvitbansgr/?utm_campaign=share&utm_medium=copy&rc=ex0share)

Depending on your internet connection, this presentation may take a few seconds, to a few minutes, to load; so please be patient. Once the presentation does load, you can watch the course as it displays, on a portion of your PC's screen; or, you can expand it to fill your computer's entire screen by clicking on this symbol in the bottom-right corner of your screen:



You can play this training course like a video by clicking that “Play” button in the bottom-left corner of the window, or you can advance the presentation at your own pace, by clicking this right-facing arrow at the bottom of the screen.

Note: If you opt to watch the course in the full-screen mode, the software will pop-up a question about “*Allow full screen with keyboard controls?*” Just click on the **Allow** button.

From that point on, you will watch and listen at your own pace. If you need to go back and redo a previous slide (or as Prezi calls them: Path), then simply click that left-facing arrow at the bottom of your screen. Adjust your PC's volume and enjoy the course.

# Full Transcript of the 'Legionella' Training Course

Path 1: Before we get going, please adjust your computer's volume control so you can hear the audio component of this training course. You can advance the presentation at your own pace, by clicking the right-facing arrow at the bottom of your screen. For those of you taking this course for CEU credits, please complete your Pre-test before beginning this online presentation. For those of you who are not completing this course for credits, it would be great if you took the pre-test. It helps me evaluate the effectiveness of the course.

Path 2: Hello, and thank you for viewing this Legionella training course. The purpose of this course is to give you a foundation of knowledge on Legionella and its related diseases

Path 3: Instead of rushing straight into the technicalities of legionella and legionellosis outbreaks, I thought I would give you a little bit of history about the disease. As a side note, we will cover the definition of the term legionellosis later in this training course.

Path 4: The first appearance of legionellosis was not in 1976, but that is when researchers began to recognize it for what it was. Before that, it had simply been a mystery disease that had never been identified.

Path 5: In July, 1976, the Pennsylvania American Legion was gathering at the Bellevue-Stratford Hotel to celebrate the United States bicentennial. Roughly 2,000 people had gathered in this single location. Three days after the end of the convention, Ray Brennan, a 61 year old with a history of heart disease had a heart attack and died. Ten more legionnaires died within the next week. All of them had complained about tiredness, chest pains, lung congestion, and fever since they had returned from the convention. By the time the outbreak was recognized 130 people had been hospitalized, and 25 had died. All together 182 cases were identified, with 29 deaths. The media caught a hold of the story and the investigation was on.

Path 6: This is an image of the Bellevue-Stratford Hotel. Nearly 2,000 people crammed into this hotel for the convention alone, not to mention the residents who were not taking part in the convention. The Bellevue-Stratford Hotel had been built in 1904 and had never undergone a restoration.

Path 7: I wanted to include this picture to show what the convention would have looked like. Nearly all of the attendees were men and a large majority were elderly.

Path 8: You can see from this Time magazine cover that this outbreak captured the attention of the media. Why? What about this disease was special? During the winter of 1975 -1976, scientists feared that they had identified a recurrence of the 1918 influenza virus that had devastated so much of the world. Fast forward to



Philadelphia, where a mysterious illness had killed 16% of the people who had gotten sick, and you have a recipe for fear and sensation.

Path 9: As soon as it became clear that there was an outbreak occurring, the CDC sent 20 investigators to attempt to find out what disease was killing people at such a high rate. It became clear, very quickly, that this disease had a common-source and that location of that source was the Bellevue-Stratford Hotel. After six months of investigation what wasn't becoming clear was what was causing the outbreak.

Path 10: This is the epi curve for the 1976 outbreak. It is a fairly classic representation of a common source outbreak.

Path 11: So, how did researchers identify this disease?

Path 12: As time passed, the media and the public increased the pressure on the investigators. Public health officials were struggling to communicate with the public and the public was becoming very frustrated. Dr. Joseph McDade was one of the most criticized investigators and also the man who realized that humanity had seen this disease before. It was a bacteria that had been isolated before in 1947. At that time it had been thought to only affect animals. The bacteria was named after the American Legion, it was called *legionella*.

Path 13: This is a picture of two CDC investigators examining the culture isolates of *legionella pneumophila* from the 1976, Philly outbreak. On the left is George Gorman and on the right is Jim Feeley.

Path 14: This is a cartoon of some of the investigators from the CDC who travelled to Philadelphia. It was given to David Fraser upon his leaving the CDC. This outbreak greatly influenced the careers of nearly all of the investigators involved.

Path 15: Beyond the identification of Legionella, the 1976 Philadelphia outbreak had a lasting effect on public health in the United States.

Path 16: Researchers were able to use the data and information gathered in 1976 to identify outbreaks caused by legionella as far back as 1959. One of the most important was the realization that Legionella was responsible for an outbreak in Pontiac, Michigan. Although it was legionella that caused this outbreak, it was determined that it was a different disease, which public health officials called "Pontiac fever"

Path 17: If we're being honest, the public relations side of the investigation was something of a trainwreck. The public needed to be able to contact public health officials 24/7. However, if someone attempted to do so after working hours, they were simply unable to. As a result, public relations was reexamined for public health and was very much improved.

Path 18: This is a map of Michigan. You can see Pontiac to the west of Detroit.

Path 19: So, let's get down to brass tax and take a look at what it means to say someone has legionellosis, or was exposed to Legionella bacteria.

Path 20: This is a simple, computerized image of legionella looks like.

Path 21: So, what do I mean when I refer to the Legionella family of bacteria?

Path 22: There are dozens of species of legionella bacteria, but the one that we are going to pay attention to is Legionella Pneumophila. It is the causative agent for Legionnaires' Disease and Pontiac Fever.

Path 23: All right, at this point I'm going to rush over a few of the more technical aspects of Legionella bacteria. Legionella pneumophila is a gram-negative bacteria, which is non-capsulated, aerobic, is not pigmented, and has 35 different serotypes. The serotype that is most commonly seen in cases of Legionnaires' Disease is serotype 1. Legionella pneumophila invades macrophages and creates a membrane bound vacuole to surround it and protect it from degradation by lysosomes. There, the bacteria is able to multiply. That's the most technical that I am going to get, so I hope it didn't bore you too much.

Path 24: Here we have a picture of Legionella under UV illumination

Path 25: When referring to sickness caused by legionella, we use the term legionellosis and that is the term that I will be using for the rest of the presentation, unless the distinction between Pontiac fever and Legionnaires' disease is important to the information being conveyed.

Path 26: Here is another picture of legionella, this time, under infrared light.

Path 27: So, how did those American Legionnaires get sick in 1976? Officials never confirmed the source of the disease, but it is suspected that the water cooling towers in the hotel may have had something to do with it.

Path 28: Before we go any further, it's important for us to go over a few definitions to make sure that we are all on the same page.

Path 29: First, we need to define what an exposure is, in regards to Legionellosis. In this case, an exposure is any inhalation contact with Legionella bacteria when it is present in aerosolized water. An exposure can also occur from direct aspiration of water with Legionella bacteria in it.

Path 30: The definition for a case of legionellosis is very simple. It is simply when a person has been diagnosed with legionellosis

Path 31: A suspected case of legionellosis occurs when a health care provider determines that a person is showing clinical signs, symptoms, laboratory evidence, or a history of exposure, and that he or she has, or may possibly have, legionellosis.

Path 32: There are a number of ways that cases can be classified. These classifications are important in order to understand the impact that the disease may have, and the measures needed to prevent the disease from spreading.

Path 33: We'll start with the most obvious case classification. A single case is when there is a single case at a facility, but for the next 2 years, there are no other reported cases.

Path 34: A cluster is larger than a single case, and shares some similarities with an outbreak. In a cluster, there are 2 or more cases that occur at a single facility within the same two year period.

Path 35: An outbreak is similar to a cluster, but there is one key difference. In an outbreak, there are 2 or more cases associated with the same facility, however in an outbreak, an environmental investigations provide evidence that suggests there is a common source of infection.

Path 36: A fixture is a device connected to the water supply system which is connected to the waste water collection system and/or its disposal.

Path 37: Lastly, an environmental assessment is a detailed component of an overall environmental investigation to determine the source of potential Legionella reservoirs causing exposure within a facility.

Path 38: Okay, remember those water cooling towers that I mentioned at the Bellevue-Stratford Hotel. Well, this is where they come in. Legionellosis is an aerosolized water born disease. Infection occurs when aerosolized water that contains the bacteria is inhaled. It is particularly at home in warm water. There has never been a case of person-to-person transmission, so a large scale outbreak is somewhat unlikely.

Path 39: The most likely source of legionella infection is a warm, stagnant water source. They thrive when the water temperature is anywhere between 68°-122° Fahrenheit. Sources prime for legionella presence include hot tubs, decorative fountains, water tanks, etc. Infection occurs when this water is somehow disturbed and the water is aerosolized. Hot tub jets, air conditioning units, fountains splashing, and more can all cause the mist to be created and for legionella to be transmitted.

Path 40: I know it's blurry, but I included this picture to show situations in which legionella bacteria could exist. Rust in water is a warning sign that legionella could exist in the water source. These pictures are somewhat extreme, but I think that they show how legionella could be nearly anywhere that water is warm and stagnant.

**Path 41:** The attack rate for Legionnaires' Disease is only 5%, which thankfully is much less than the 90% attack rate for Pontiac fever. The attack rate of 9% during the Philadelphia outbreak in 1976 was unusually high considering that up to 2,000 people could have been exposed. And remember, that number does not include the guests of the hotel who were not attending the American Legion convention. The much less severe Pontiac fever has an attack rate of 90%, but thankfully the case-fatality rate is 0%.

Path 42: Even though the United States is somewhat medically advance, many people do not know much, or anything, about legionella and/or Legionnaires' disease. As a result, Legionnaires' disease in the United States is somewhat common.

Path 43: The United States has experienced a troubling increase in cases of legionellosis over the past decade. Every year, nearly 8,000 to 18,000 patients with confirmed cases of legionellosis are admitted into the hospital. This figure does not

include the cases of Pontiac fever that are not admitted into the hospital. The number of legionellosis cases has grown 249% from the period of 2001 to 2011.

Path 44: So, who is the most at risk for becoming infected with the legionella bacteria? The most commonly infected persons are above 50 years old, have a history of smoking, lung disease, and weakened immune systems from both illness like cancer, diabetes, and kidney failure and drugs after a transplant operation or chemotherapy.

Path 45: There are a number of ways to diagnose whether someone has Legionnaires' Disease. Less commonly used tests include serology, PCR, and DFA. Serology is not recommended due to the fact that it will occasionally confuse Legionnaires' disease with other causes of community-acquired pneumonia. PCR is rapid, but the assays are different depending on the laboratory and the process is not approved by the FDA for Legionnaires' disease. Direct Fluorescent Antibody testing is over 95% specific, but the sensitivity is often as low as 25%. The two recommended tests are the Urinary Antigen Assay and the Culture of respiratory secretions on selective media. Both of these tests are 100% specific, but they have their limitations. The Urinary Antigen Assay takes less than a day to run, but it only detects for Legionella pneumophila serogroup 1 which only accounts for 80% of cases. This does work as a fast, preliminary test in conjunction with the culture. Using a culture is technically much more difficult, which could result in lower sensitivity and is very slow, usually taking over 5 days. However, it does identify all serogroups and species and can be compared to other isolates.

Path 46: Now, it's time to take a look at how Legionnaires' disease presents itself in infected persons.

Path 47: Roughly 5% of people exposed to the legionella bacteria will begin to develop symptoms of Legionnaires' disease. After exposure to legionella bacteria, Legionnaires' disease symptoms can take anywhere from 2 to 10 days to appear. Many of the symptoms of Legionnaires' disease are flu-like. One early symptom is a high fever that can be as high as or slightly higher than 107° Fahrenheit. A fever of this temperature is grounds for immediate medical attention in adults. In children, a fever this high is deadly. Further flu-like symptoms include headache and muscle ache. What separates Legionnaires' disease, and makes it so deadly, are the respiratory symptoms. Coughing and shortness of breath are early indicators that someone has developed Legionnaires' disease. Pneumonia is the most deadly symptom caused by Legionnaires' disease and is responsible for possible lung failure and death in 5%-30% of the cases. The pneumonia that occurs due to Legionnaires' disease cases is very similar to other forms of pneumonia, making it difficult to recognize. Early identification of all of these symptoms is extremely important for immediate hospitalization and treatment to be most effective.

Path 48: This is an x-ray of someone who has Legionnaires' disease.

Path 49: In terms of mortality, Pontiac fever is a much more mild disease than Legionnaires' disease. The symptoms of both diseases are very similar, but pneumonia does not occur in patients with Pontiac fever. Symptoms for Pontiac fever occur around 72 hours after infection and can occur in 90%-95% of all those exposed to

the Legionella bacteria. The case-fatality rate of Pontiac fever is 0%, so, combined with the mild symptoms, hospitalization is not recommended.

Path 50: So, what can be done to prevent and treat legionellosis?

Path 51: We are going to begin this section talking about prevention. Prevention is key when dealing with legionellosis because it is easily preventable.

Path 52: The key to preventing legionellosis is the maintenance of water systems in which legionella bacteria grow, including drinking water systems, hot tubs, decorative fountains, cooling towers, etc. It is important to constantly monitor for the presence of legionella in a water system to detect it before anyone is infected. Guidelines on how to maintain a water system can be found in the ASHRAE Guideline 12-2000 Minimizing the Risk of Legionellosis Associated with Building Water Systems.

Path 53: For those of you following along with the guidebook, a link to the ASHRAE Guidelines will be included.

<http://legionella.org/media/28614/ashraeguideline12-2000.pdf>

Path 54: Unfortunately, there is no vaccine for the prevention of legionellosis. Furthermore, antibiotic prophylaxis has no effect on legionellosis. The only means of prevention for the individual is to avoid any areas where legionella bacteria may be present.

Path 55: So, what steps should be taken once a case of legionellosis is confirmed?

Path 56: Once a case of legionellosis is diagnosis and confirmed, it is critical to locate the source of infection and to determine if an outbreak is occurring. Legionellosis outbreaks are easily identified by a classic “point-source” epidemiology curve.

Path 57: This is a repeat of the epi curve from the 1976 Legionnaires’ disease outbreak in Philadelphia. I already used this curve earlier in the training course, but it is a classic example of the point-source outbreak.

Path 58: Legionella surveillance is very important to identify the source of an outbreak. Identifying cases quickly is key to preventing outbreaks from continuing to occur at a source.

Path 59: The first key factor of legionella surveillance is to monitor and describe the incidence and trends of legionellosis cases. This allows public officials to rapidly recognize cases, possible locations, and sources of infection. Understanding risk factors is critical in ensuring that opportunities for control and prevention can be identified. If needed, the CDC is available to assist with any investigation.

Path 60: If a legionella case is not travel-related, it should be reported to the CDC within 30 days, using the Legionellosis Case Report Form. For those of you following along with the handbook, I have provided the link to find this form:

<http://www.cdc.gov/legionella/downloads/case-report-form.pdf>

In order to investigate further into the patient characteristics and recent history, the CDC provides a Legionellosis Hypothesis-Generating Questionnaire. Once again, the link is provided in the handbook.

<http://www.cdc.gov/legionella/downloads/hypothesis-generating-questionnaire.pdf>

Path 61: This is the first page of the Legionella Case Report.

Path 62: The water-borne nature and location of the legionella bacteria creates a dynamic in which travelers make up a large portion of those who get infected.

Path 63: This can be caused by hotel hot tubs, hotel air-conditioning, cruise ships, etc. Over 20% of cases are travel-related. Current surveillance lacks the timeliness and sensitivity to detect outbreaks of travel-associated cases. As a result, it is critical to be watchful for cases and to react quickly to those cases.

Path 64: Once a traveler develops symptoms of legionellosis, it is important to act quickly.

Path 65: In order to prevent a protracted outbreak, it is important that investigators achieve the following goals. First, within 7 days of the legionellosis case notification, public health officials must determine whether or not the infected patient spent one or more nights away from home during the 10 days before the onset of symptoms. If that patient travelled within that time, public health officials will report the travel destination and dates to the state of travel and the CDC. The CDC will report to the state within one day if there are epidemiologically linked cases and will work in conjunction with the state to investigate further.

Path 66: Travel cases of legionellosis can be difficult to detect and difficult to trace back to the source. In order to expedite the reporting process, the CDC has an email in place to quickly exchange information about cases of legionellosis. This email is listed on screen in the presentation, as well as in the handbook for this training presentation. It is:

[travellegionella@cdc.gov](mailto:travellegionella@cdc.gov)

This email address was not created for official reporting of legionellosis cases. The official Legionella Case Report form should still be filled out and submitted to the CDC.

Path 67: Collecting samples of legionella is very important, but can be dangerous if it is not done properly.

Path 68: Once a suspected source of infection is discovered, the next step is to retrieve samples to verify the presence of Legionella bacteria. Collecting the samples must be done carefully to avoid mistakes in identification of the bacteria. For this reason, the CDC has developed a guide for how to properly collect legionella samples and how to process them. In the handbook, I have included a link to the legionella sample collection guide provided by the CDC.

<http://www.cdc.gov/legionella/health-depts/inv-tools.html>

Path 69: This is the first page of the sample collection guide provide by the CDC.

Path 70: The CDC will not accept routine sample collections without authorization. The only way the CDC will authorize and accept samples is if they are actively involved in the investigation of an outbreak or if prior permission has been given. This includes cultures, urinary antigen assays, or any other submission. However, if authorized, the CDC had provided instructions for submission. This link can be found in this presentation's training handbook.

<http://www.cdc.gov/legionella/downloads/shipping-instructions.pdf>

Path 71: Without vaccination or antibiotic prophylaxis, treatment for legionellosis becomes far more important.

Path 72: According to a journal article in *Clinical Infectious Diseases*, treatment for Legionnaires' disease is a strict antibiotic regimen aimed at combating the pneumonia. The preferred antibiotics are macrolides (eg. Azithromycin) and Fluoroquinolones (eg, Levofloxacin). Alternatively, doxycycline is acceptable for treatment, but not preferable. Along with antibiotic treatment, supportive care is recommended for Legionnaires' disease. This can include treatment in the ICU, if or when it becomes necessary. Antibiotic treatment is not recommended for Pontiac fever due to its less serious symptoms and non-existent case-fatality ratio. Instead, patients who develop Pontiac fever symptoms should be treated at home.

Path 73: If you would like more information about how to treat Legionnaires' Disease, specifically the community-acquired pneumonia that it causes, it can be found in this article from the journal *Clinical Infectious Diseases*. This is the article that I used to gather information about the antibiotic regimen. It is somewhat old, but has had no critical changes to the antibiotic treatment in the 17 years since publication. If you are interested more information about the changes in treatment since 1998, you can find it in the 2007 journal article Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults from *Clinical Infectious Diseases*.

Path 74: Legionellosis is not spread from person-to-person, so isolation and quarantine are unnecessary measures for containing infection. However, as soon as an infection has been traced back to a source, it is critical that the source be completely isolated from public access.

Path 75: Personal protective equipment is absolutely critical for anyone who may come into contact with any location that may be the source of legionella infection. In the event that there is a suspected or confirmed outbreak in a domestic system such as a hot tub, air conditioning unit, etc., the Occupational Safety and Health Administration, or OSHA, requires only that a dust mask is worn. The N95 mask is sufficient to meet this requirement.

Path 76: In the event of an infection in a cooling tower, evaporative condenser, or a fluid tower OSHA recommends the use of, and I'm quoting the OSHA technical manual here, a Tyvek-type suite, protective gloves, and a properly fitted respirator with a high-efficiency particulate (HEPA) filter or a filter effective at removing one micron particles. This recommendation falls in line with the pre-established Wisconsin Emergency Protocol. The presence of legionella in cooling towers has been responsible for a large portion of the large-scale legionellosis outbreaks.

Path 77: I included this picture to show what one might look like while entering an area where legionella presence may be suspected. The protective eyewear may not be required for this process, but it is better to take extra precautions rather than risk legionella infection.

Path 78: Legionella can live in so many different bodies of water, many of which are not the first that would come to mind. As a result, public health officials must consider all possible sources when attempting to determine the source of an infection.

Path 79: In the United States, water birth is a growing preference among pregnant women. With proper sanitation procedures, there should be no possibility of infection. However, proper sanitation procedures are not always followed. In 2014, the first recorded case of Legionnaires' disease in an infant was recorded after a water birth. The infant was 6 days old upon admission to the hospital with respiratory fever and died 19 days later. Urinary antigen testing, and PCR testing confirmed that *Legionella pneumophila* serogroup one was present and was the cause of death.

Path 80: Legionella outbreaks occur most often in public places. However, infection can occur in the home. In an Italian study, legionella was found in over 23% of the home hot water sources. Obviously, the presence of legionella in a home water source increases the risk of developing legionellosis. In fact, in homes with legionella in the water, the risk of legionellosis was nearly double that of homes without legionella in the water. This seems a bit obvious, but it just shows the importance of maintaining a clean water system, no matter the location.

Path 81: In many warm, humid parts of the world legionella will commonly be found in puddles on the road. In fact, a Japanese study found that up to 35.6% of puddles contained legionella. Whenever it rained or a car drove through them, the water splashed in the air and became a prime source for legionella infection to any person walking along the road, or driving by with a window open. Researchers theorized that patients with legionellosis may have been infected in this manner, with no possibility of locating the source.

Path 82: Unfortunately, as with many other types of infection, hospitals have been a source of legionella infection. 70% of hospitals have been shown to have legionella bacteria residing somewhere within. Of those hospitals, 20% may be responsible for legionellosis cases. Furthermore, many infections can go undiagnosed due to the fact that these hospitals may not have legionella diagnostic test materials. These infections are likely to cause hospital re-admittance and can be very dangerous to anyone who is already ill or may have a weakened immune system.



Path 83: So, you've identified the source of an outbreak and the infected people are getting treated, good job. But the job isn't done.

Path 84: Now, it's time to remove the legionella bacteria from the source.

Path 85: In order to reopen the location of the infection source, it is critical to follow proper sanitization. Once again, the location of the standard sanitation and disinfection protocols can be found in the OSHA technical manual Section III, chapter 7. For those of you using the training handbook that accompanies this training, the link to this section of the OSHA technical manual can be found below:

[https://www.osha.gov/dts/osta/otm/otm\\_iii/otm\\_iii\\_7.html#app\\_iii:7\\_3](https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html#app_iii:7_3)

Source-specific information is provided by the CDC well. For example, the CDC has released a guideline for the disinfection of hot tubs that have been confirmed as the source of legionella bacteria. The link to this guideline can be found below in the training handbook:

<http://www.cdc.gov/legionella/downloads/hot-tub-disinfection.pdf>

Path 86: This is the first page of the CDC guideline for the Disinfection of Hot Tubs Contaminated with Legionella. None of these are requirements for sanitization, however these are the best practices that the CDC recommends based on current scientific information.

Path 87: Disinfection of water cooling towers is incredibly important due to their ability to cause a much larger-scale infection than, for example, hot tubs. The OSHA technical manual is useful for this situation. It provides instruction on water cooling tower disinfection. The link is the same as the previous link provided in the handbook, but I will include it again for simplicities sake:

[https://www.osha.gov/dts/osta/otm/otm\\_iii/otm\\_iii\\_7.html#app\\_iii:7\\_3](https://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_7.html#app_iii:7_3)

The CDC has also provided a guideline of the procedures for cleaning towers contaminated with legionella bacteria. These procedures were adapted from the Emergency Protocol in Control of Legionella spp. in Cooling Towers: Summary Guidelines. I provided the link below in the training handbook:

[http://city.milwaukee.gov/ImageLibrary/Groups/healthAuthors/DCP/PDFs/cdc\\_procedureforcleaningtowerle.pdf](http://city.milwaukee.gov/ImageLibrary/Groups/healthAuthors/DCP/PDFs/cdc_procedureforcleaningtowerle.pdf)

Path 88: Cruise vessels provide complications for any outbreak, and for legionella is no different. The CDC Vessel Sanitation Program was created to assist in the prevention and the control of infectious diseases on board cruise vessels. The focus of the program is very much gastrointestinal illnesses because they are quite common on board ships of these types, but legionella falls under the purview of the program as well. The program inspects, monitors, trains, and provides education to anyone involved. If the ship carries 13 or more people and has a foreign itinerary with United States ports, the CDC Vessel Sanitation Program has jurisdiction. More information

can be found in the 2011 Operations Manual. I provided the link in the training handbook:

<http://www.cdc.gov/nceh/vsp/operationsmanual/opsmanual2011.pdf>

Path 89: If even a single case of legionellosis occurs on board a cruise ship, the ship must report the case to the CDC. The Vessel Sanitation Program will then conduct the investigation. The investigation focuses on laboratory confirmation, the magnitude of the illness, and environmental health.

Path 90: I included this picture because it elegantly shows the goals and the breadth of the CDC Vessel Sanitation Program.

Path 91: The last thing that I wanted to do was provide some more places where you can find more information about legionellosis.

Path 92: I have provided 3 links in the handbook. The first is for the WHO handbook for legionella. This handbook is long, and very thorough in providing the official WHO recommendations and information about legionella and legionellosis

[http://www.who.int/water\\_sanitation\\_health/emerging/legionella.pdf?ua=1](http://www.who.int/water_sanitation_health/emerging/legionella.pdf?ua=1)

The second link is to the CDC homepage for legionella. Exploring this site allows you to access almost any information that you could want on the topic of legionella.

<http://www.cdc.gov/legionella/index.html>

Lastly, I provided the link for legionella.org. This site is run Dr. Victor L. Yu, MD and Dr. Janet E. Stout, PhD. These two have over 60 combined years of experience in researching legionella and have been credited with the identification of water as the source of infection, and much more. This site aggregates a great deal of research and information about legionella into one space. Publications include antibiotic, clinical, transmission, epidemiology, laboratory, and more types of research.

<http://legionella.org/>

Path 93: Well, that's all I have for you, I hope you found this training helpful.

Path 94: These are the references that I used in developing this training course

Path 95: Thanks for watching. For those of you who took this course for credits, please do not forget to take the post-test. Afterwards, please scan and email the results of both tests to me at [jdelliott13@gmail.com](mailto:jdelliott13@gmail.com).

## Pre-Test to the 'Legionella' Training Course

Prior to viewing today's online training course, please take a few moments to fill out this pre-test of 20 equally weighted questions. At the completion of today's training course you will be taking a post-test. Once the Pre- and Post-Tests are completed, we ask that you please scan them to Jeff Elliot's e-mail at [jdelliot13@gmail.com](mailto:jdelliot13@gmail.com).

Please fill out this information so we know who completed this test:

<b>First Name:</b>	
<b>Last Name:</b>	
<b>Telephone Number:</b>	(      )
<b>E-mail Address:</b>	

Question 1: *Legionella spp.* is a

- A) Virus
- B) Bacteria
- C) Parasite
- D) Fungus

Question 2: How is legionellosis transferred?

- A) Inhalation of aerosolized water containing the bacteria
- B) Bodily fluid contact
- C) Ingestion of water containing the bacteria
- D) Contact with an infected person

Question 3: True or False:

*Pontiac fever is a more severe form of legionellosis?*

- A) True
- B) False

Question 4: Which of these is NOT a symptom of Legionnaires' disease?

- A) Fever
- B) Pneumonia
- C) Headache
- D) Numbness of extremities

Question 5: What symptom do Legionnaires' disease and Pontiac fever NOT have in common?

- A) Fever
- B) Muscle Aches
- C) Pneumonia
- D) Headache

Question 6: Who is the most at risk for Legionnaires' disease?

- A) People over 50 years old
- B) Hispanics
- C) Someone who has had previous respiratory illness
- D) Travelers

Question 7: What are the recommended antibiotics for Legionnaires' disease treatment?

*Pick all that apply:*

- A) Doxycyclin
- B) Levofloxacin
- C) Erithromycin
- D) Azithromycin

Question 8: True or False?

*Legionnaires' disease is much more common on board cruise vessels.*

- A) True
- B) False

Question 9: What are the recommended tests for legionella identification?

*Pick all that apply:*

- A) Urinary Antigen Assay
- B) DFA
- C) PCR
- D) Serology

Question 10: How many cases of legionellosis occur a year in the United States?

- A) 1,000-8,000

- B) 8,000-18,000
- C) 18,000-28,000
- D) 28,000-38,000

Question 11: What type of epidemic curve will be expected in a legionellosis outbreak?

- A) Point-source
- B) Propagated-source
- C) Continuous point-source
- D) Person-to-person

Question 12: How quickly should non-travel related legionellosis outbreaks be reported to the CDC?

- A) 24 hours
- B) 7 days
- C) 14 days
- D) 30 days

Question 13: True or False?

*The CDC accepts all suspected legionella spp. samples for testing?*

- A) True
- B) False

Question 14: The largest outbreaks of legionellosis are associated with what source?

- A) Hot Tubs
- B) Cruise Ships
- C) Air Conditioning Units
- D) Water Cooling Towers

Question 15: True or False?

*Hospitals have become a much more common form of legionellosis infection.*

- A) True
- B) False

Question 16: How many cases of legionellosis are travel related?

- A) 10%
- B) 20%
- C) 30%
- D) 40%

Question 17: True or False:

**HANDBOOK FOR THE 'LEGIONELLA' TRAINING COURSE**

Legionnaires' disease has an attack rate of over 90%.

- A) True
- B) False

Question 18: What is the recommended treatment/prevention for Pontiac fever?

- A) Heavy antibiotic regimen
- B) Hospitalized supportive care
- C) No recommended treatment
- D) Vaccination, followed by antibiotic prophylaxis

Question 19: True or False:

*The CDC Vessel Sanitation Program's primary focus is on legionella prevention and control?*

- A) True
- B) False

Question 20: What is the best method of legionellosis prevention?

- A) Water Sanitation
- B) Vaccination
- C) Antibiotic prophylaxis
- D) None of the above

## **Post-Test to the 'Legionella' Training Course**

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<b>First Name:</b>	
<b>Last Name:</b>	
<b>Telephone Number:</b>	(      )
<b>E-mail Address:</b>	
<b>License Type and License Number</b>	

**Note:** Each of these questions are weighted equally and are each worth five points each. In order to receive the four CEU credits for completing this course, you can score no less than a minimum of 70% on this Post-test. To meet this minimum score, you can miss no more than six questions.

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