
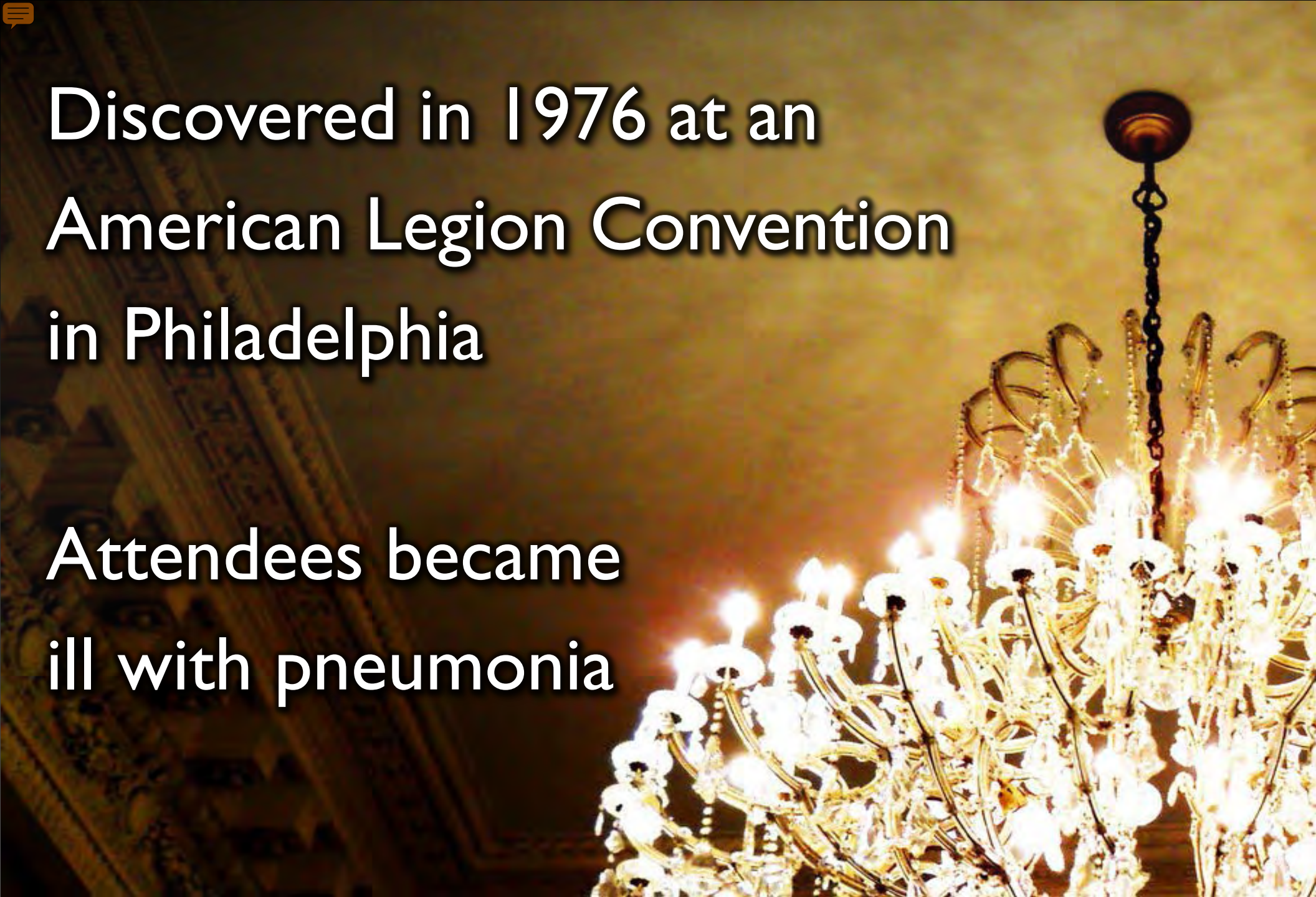


A grayscale, high-magnification micrograph of Legionella bacteria, showing numerous rod-shaped organisms with rounded ends, some appearing to be in a chain or cluster. The background is dark, making the lighter-colored bacteria stand out.

Legionella and Legionnaires' Disease in Southern Nevada

- 
- What is *Legionella*?
 - Where does it come from?
 - How it causes infections
 - Finding, investigating, reporting
 - Preventive steps
 - Case Study



Discovered in 1976 at an
American Legion Convention
in Philadelphia

Attendees became
ill with pneumonia



221

Total Cases

2/3

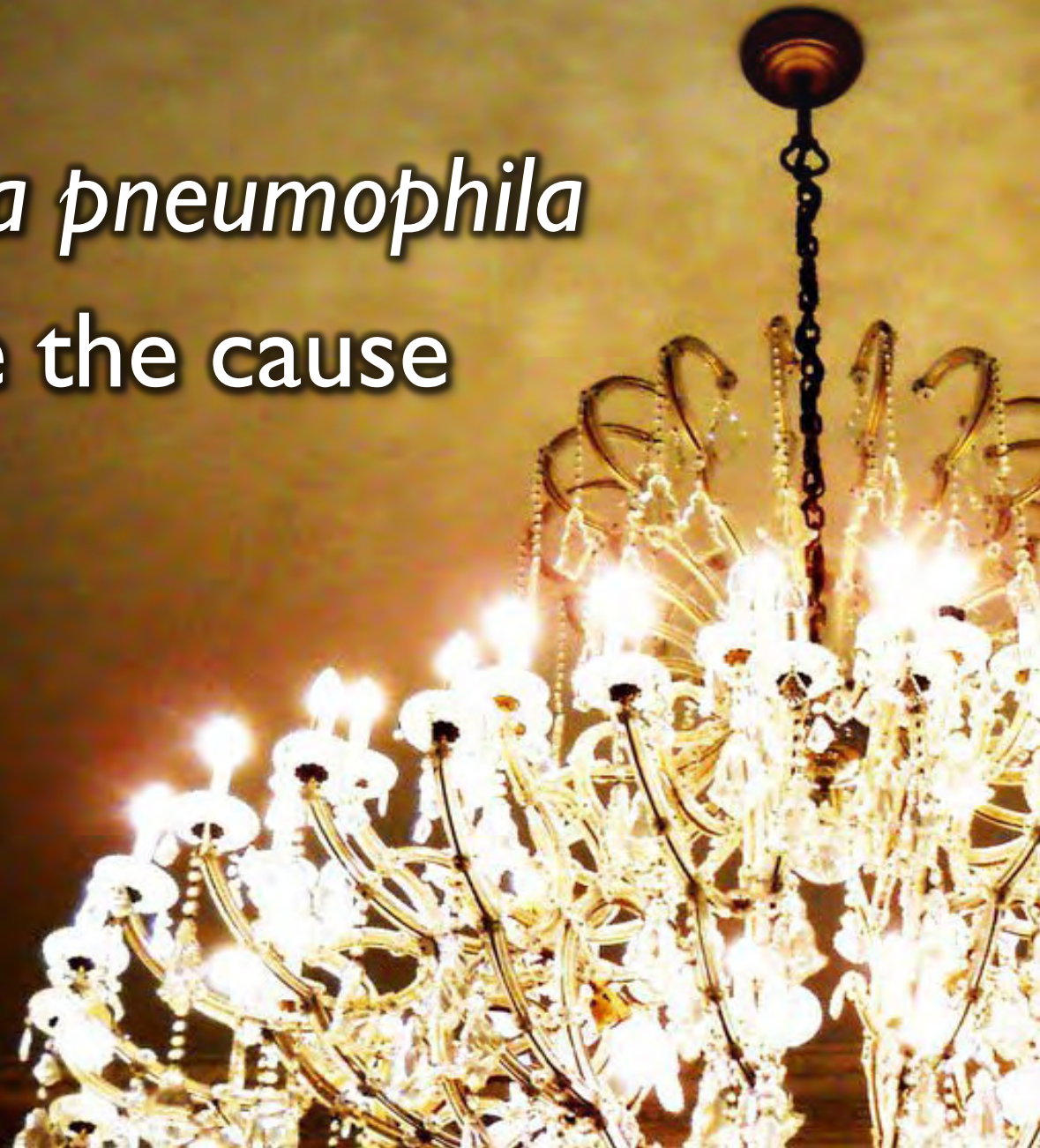
Hospitalized

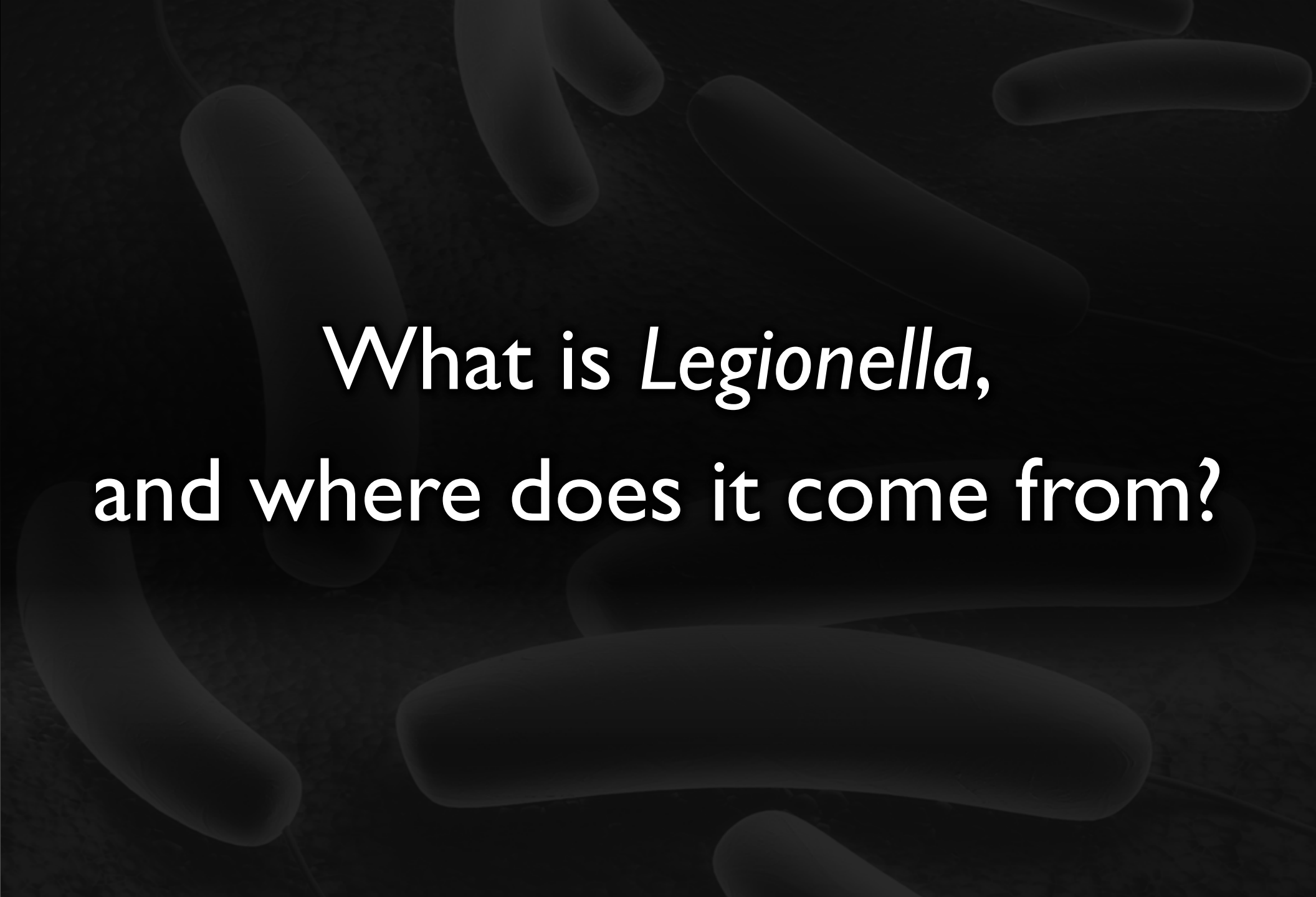
34

Deaths



Bacteria *Legionella pneumophila*
were found to be the cause



The background of the slide is a dark, almost black, field filled with numerous faint, light-gray, rod-shaped structures. These structures are elongated and slightly curved, representing the microscopic appearance of Legionella bacteria. They are scattered across the entire frame, creating a textured, biological background.

What is *Legionella*,
and where does it come from?

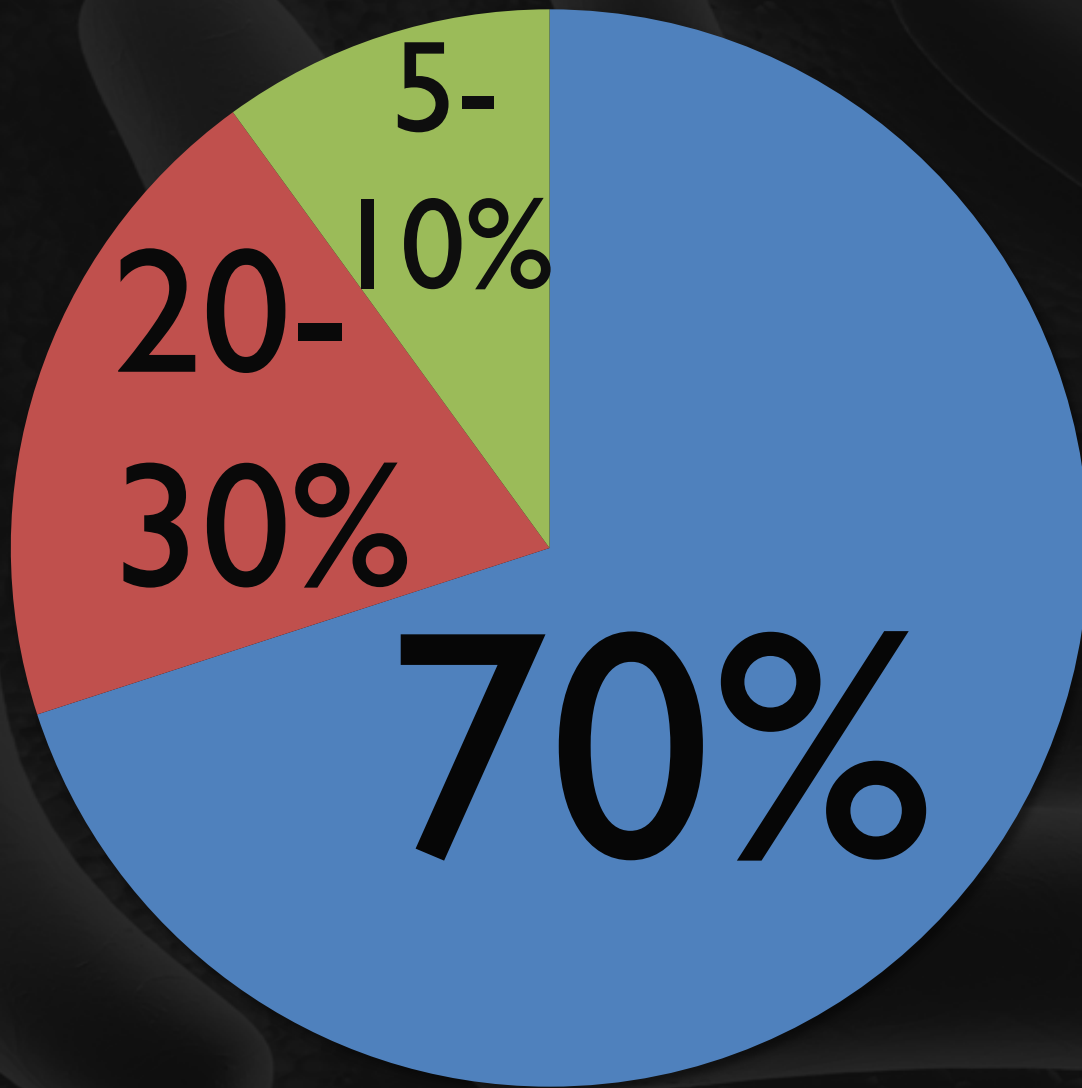
Organism Characterization

Kingdom Bacteria, Genus *Legionella*

43 or more identified species of *Legionella*

Multiple **Serogroups**, with over 60 serogroups presently identified for the genus

Many of the species serogroups are further differentiated into numbers of **subtypes**



- Legionella Pneumophila, Serogroup I
- Other L. pneumophila serogroups
- Other species of Legionella

Ecology of *Legionella*


Grow best at 68 to 115° Fahrenheit

(Water supply systems often kept at 77 to 108°F)


Can be found in natural surface waters and in buildings

Infect/replicate in both protozoa and human white blood cells

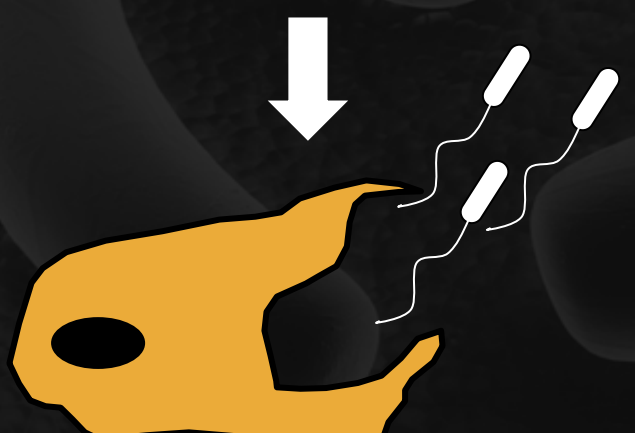
The protozoa/blood cells infected with *Legionella* burst and release the bacteria into the water



Legionella enters the amoeba or white blood cell macrophage



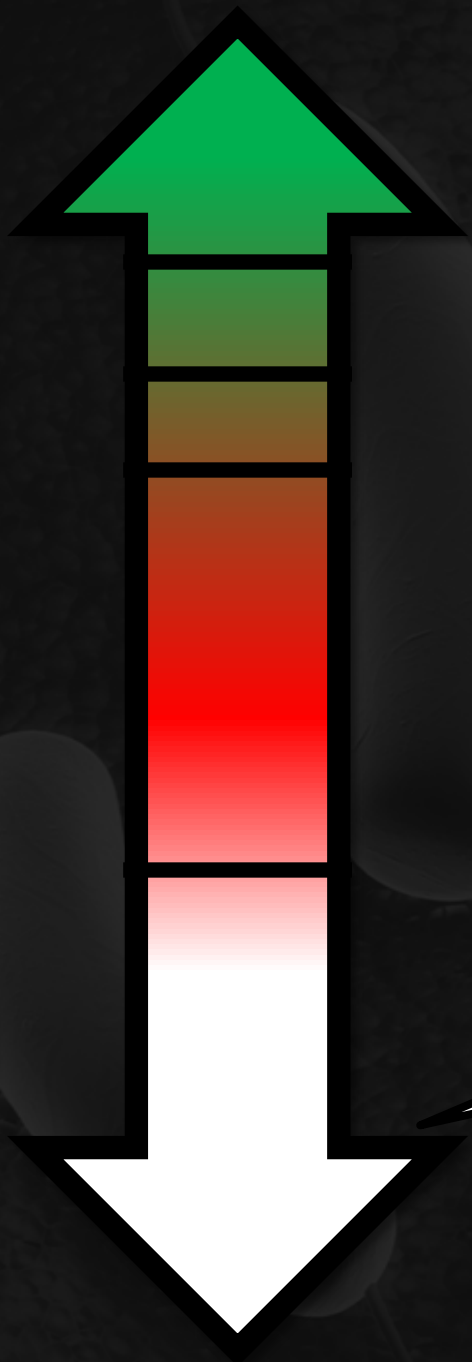
Legionella fuses with the cell's endoplasmic reticulum-inside a membrane-bound vacuole and replicates



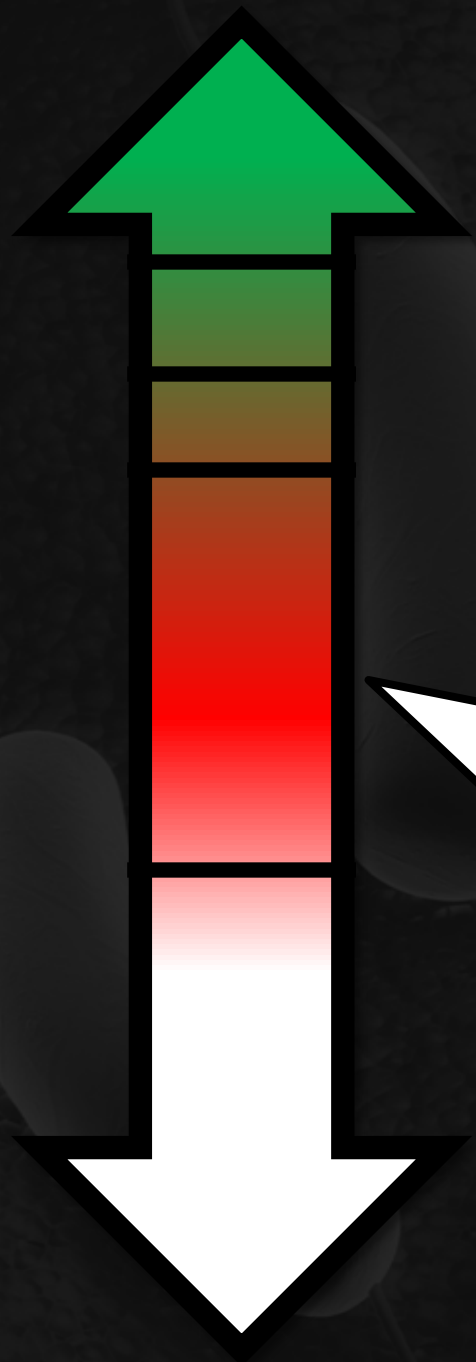
Legionella releases from amoeba/white blood cell, exiting as the cell dies by forming a pore and exploding

Growth curve

Like other bacteria, *Legionella sp.*
have optimum growth temperatures

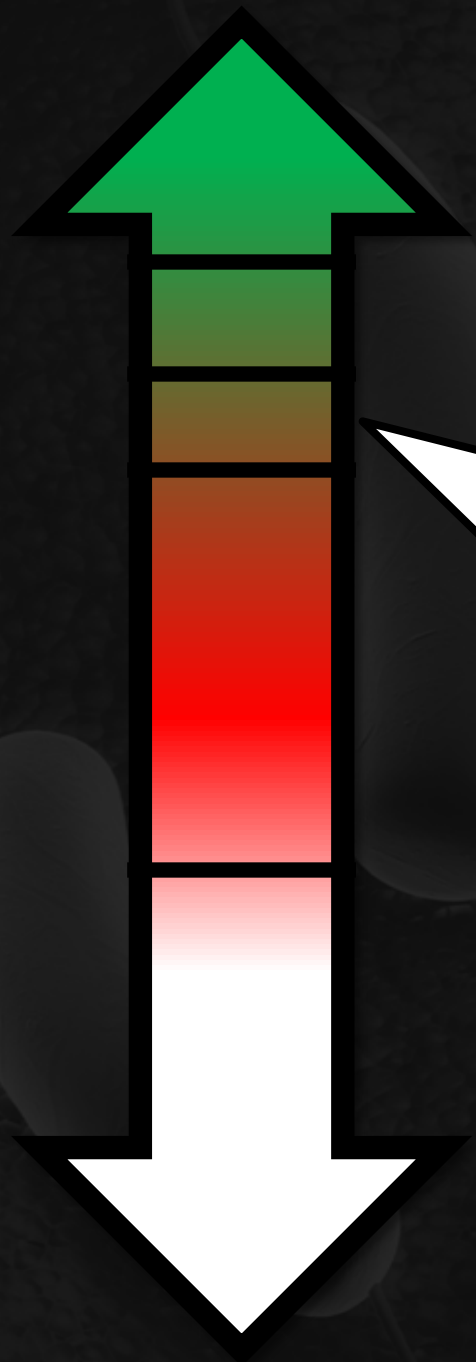


<20° C (68° F)
Predominantly dormant,
but still viable

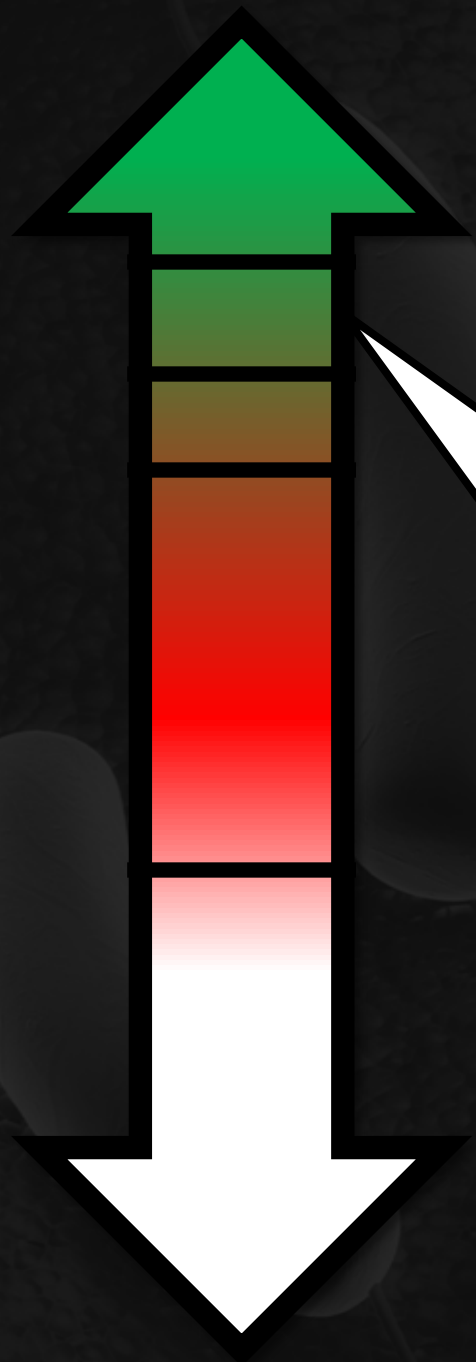


35-46°C (95-115°F)

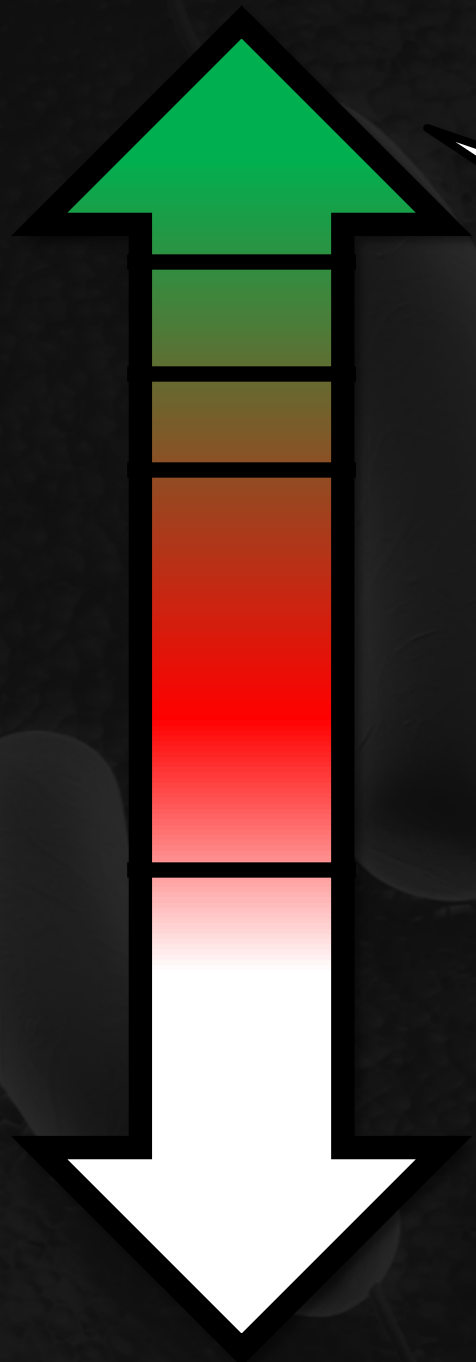
Legionella's optimal
growth temperature



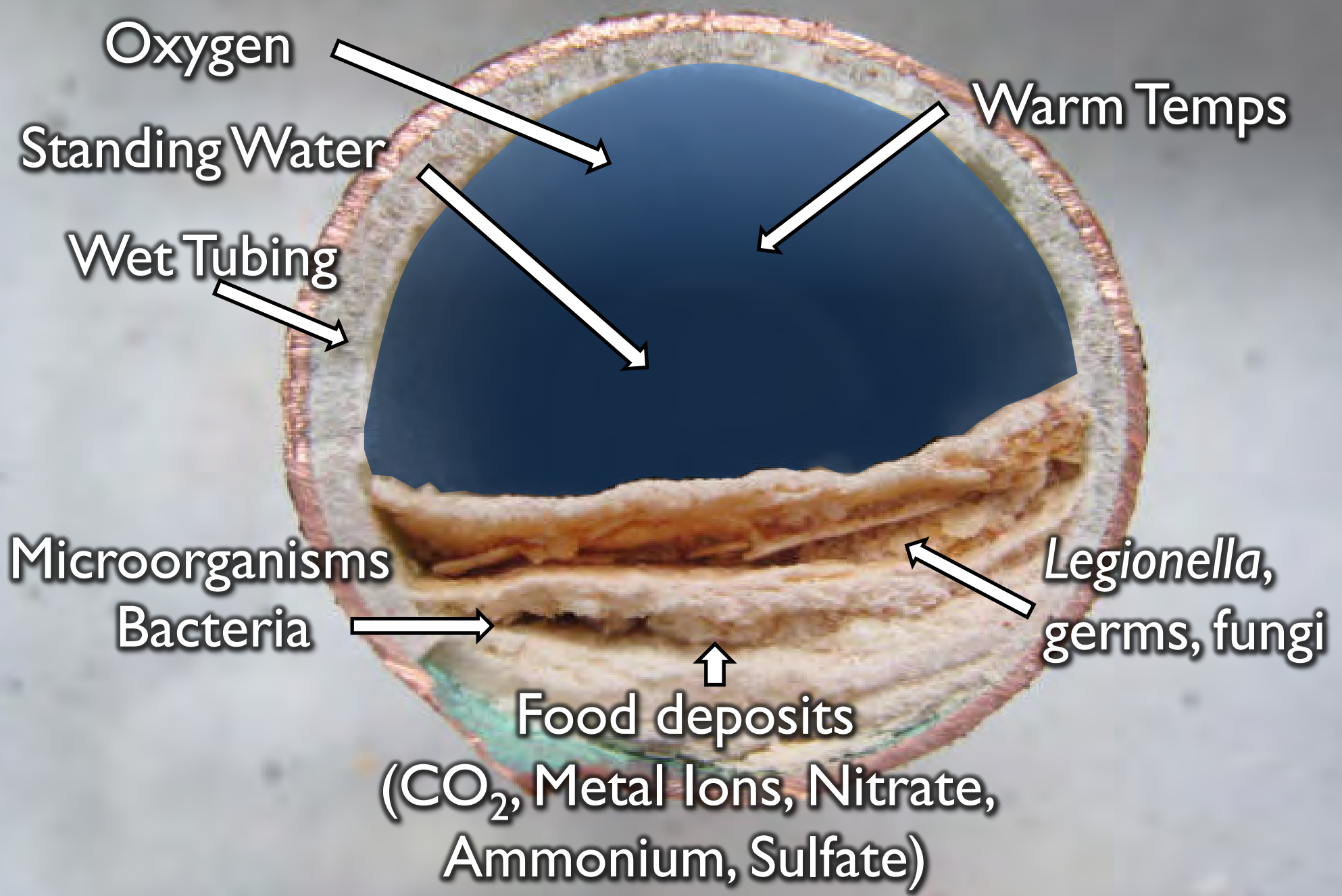
50°C (122°F)
90% Kill in 2 Hours



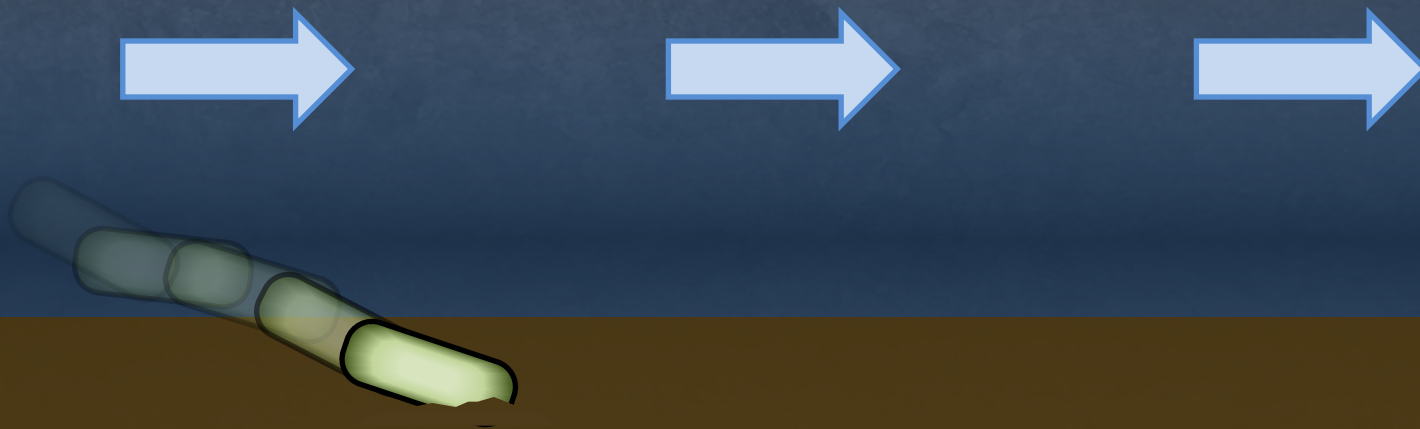
60°C (140°F)
90% Kill in 2 Minutes



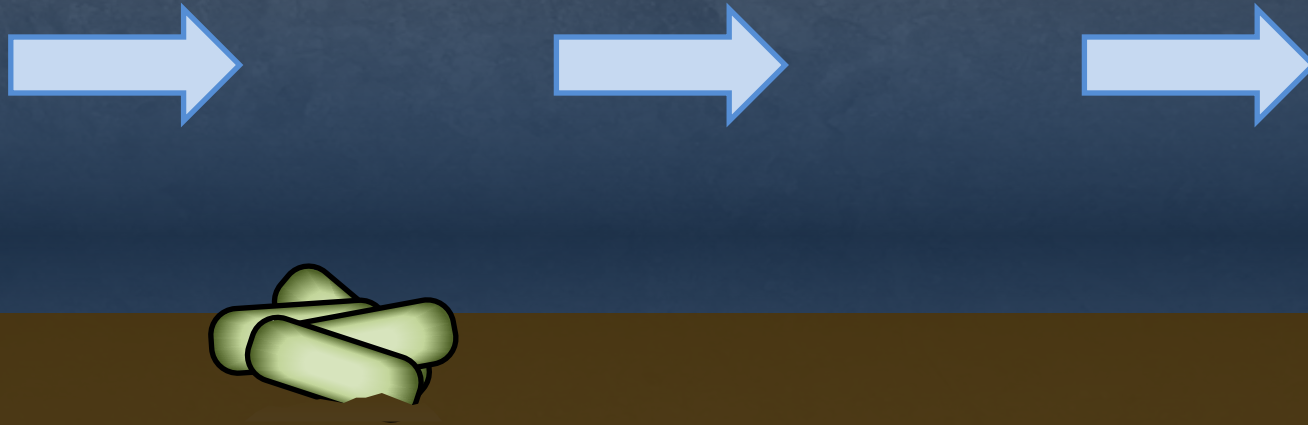
$>70^{\circ}\text{C}$ (158°F)
100% Rapid Kill



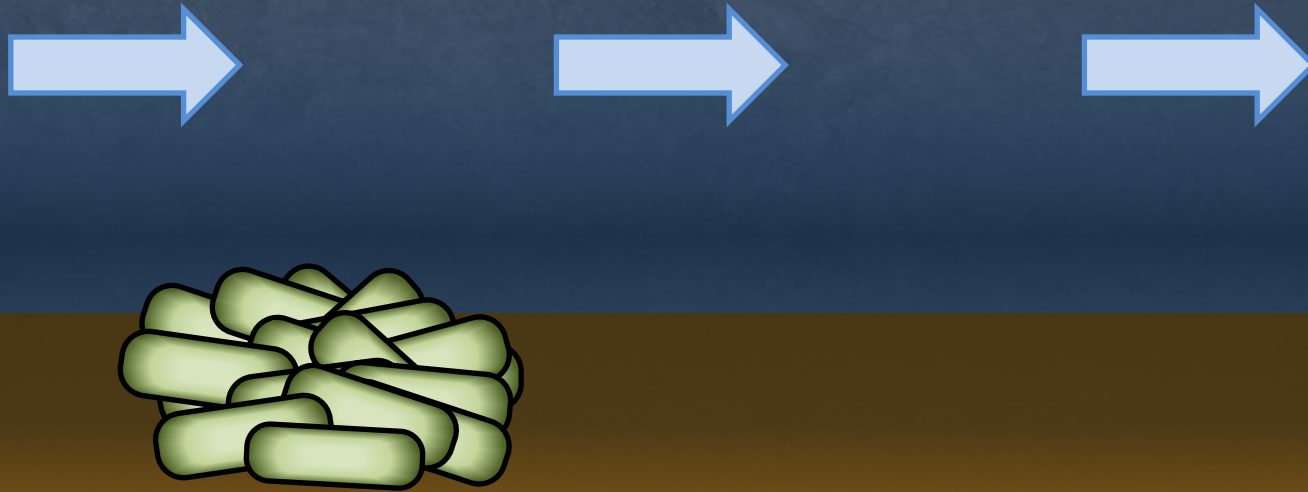
Legionella attaches to biofilm



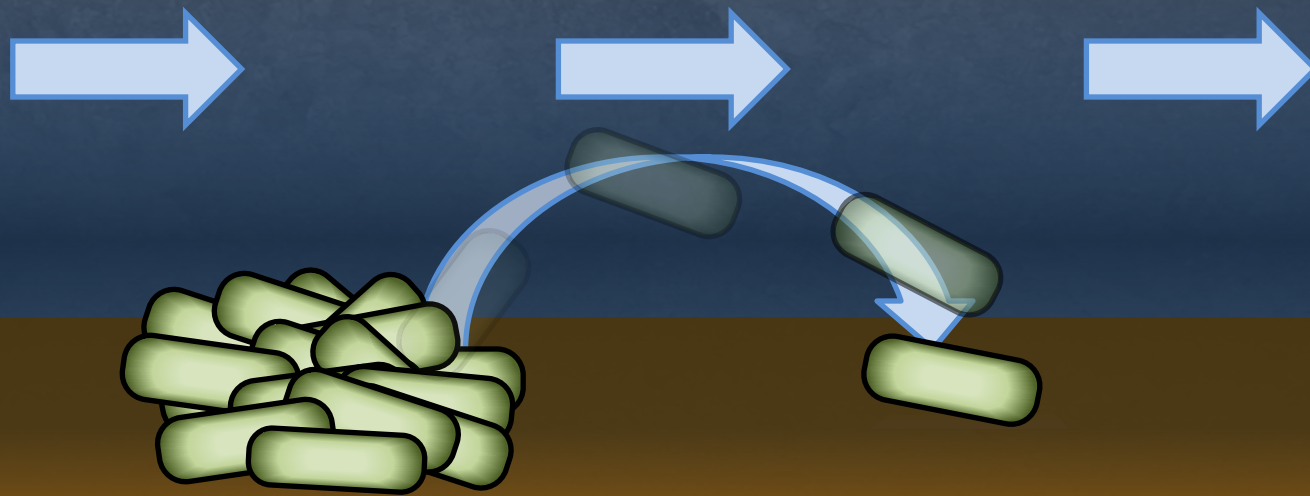
Replication forms a microcolony



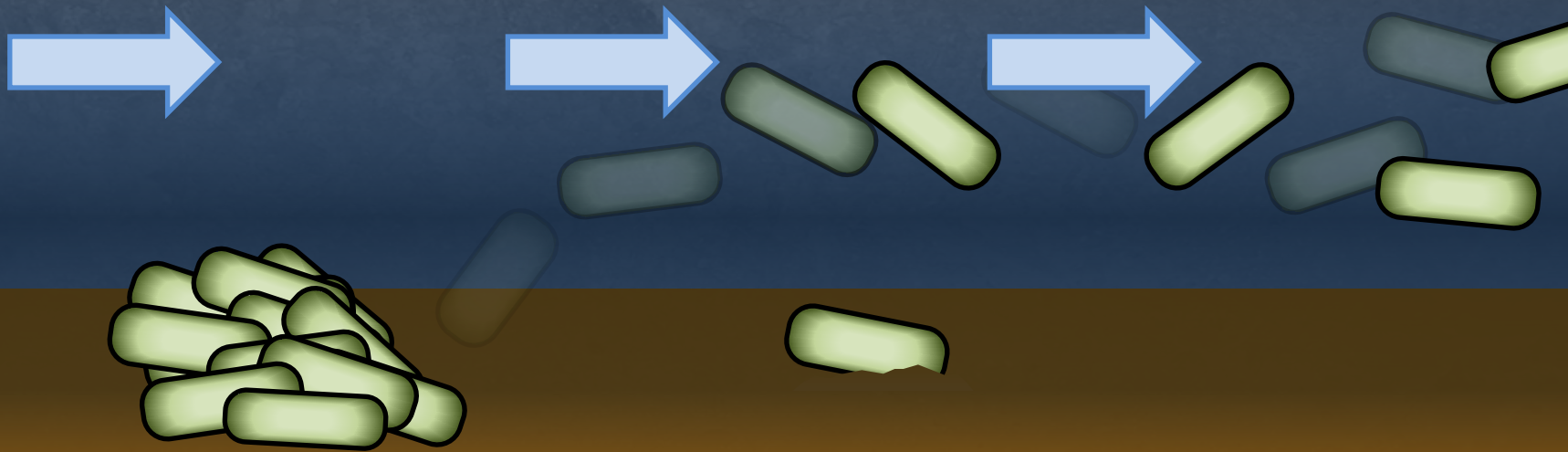
Colony reaches maturation



Some *Legionella* form new colonies



Others continue to end fixture



Legionella are found in the biofilms that accumulate in the built environment:



The background of the slide is dark grey with several large, semi-transparent, light grey rod-shaped bacteria scattered across it. These bacteria are oriented in various directions, some horizontally and some diagonally. The text is centered in the middle of the slide.

How *Legionella* causes human infections

The bacteria travel downstream to locations where it is aerosolized, such as:



Susceptible Individuals:





50+

Years of Age



Has Chronic Lung Disease



Has Weakened Immune System



Is a current or
former smoker



A microscopic view of several rod-shaped bacteria, likely Bacillus anthracis spores, against a dark, textured background. The bacteria are light blue and have a slightly textured surface. They are scattered across the frame, with some appearing in the foreground and others in the background.

**2 day - 14 day
Incubation Period**

A microscopic view of several rod-shaped bacteria, likely Bacillus anthracis spores, against a dark, textured background. The bacteria are light blue-grey and have a slightly textured surface. They are scattered across the frame, with some in sharp focus and others blurred in the background.

High fever

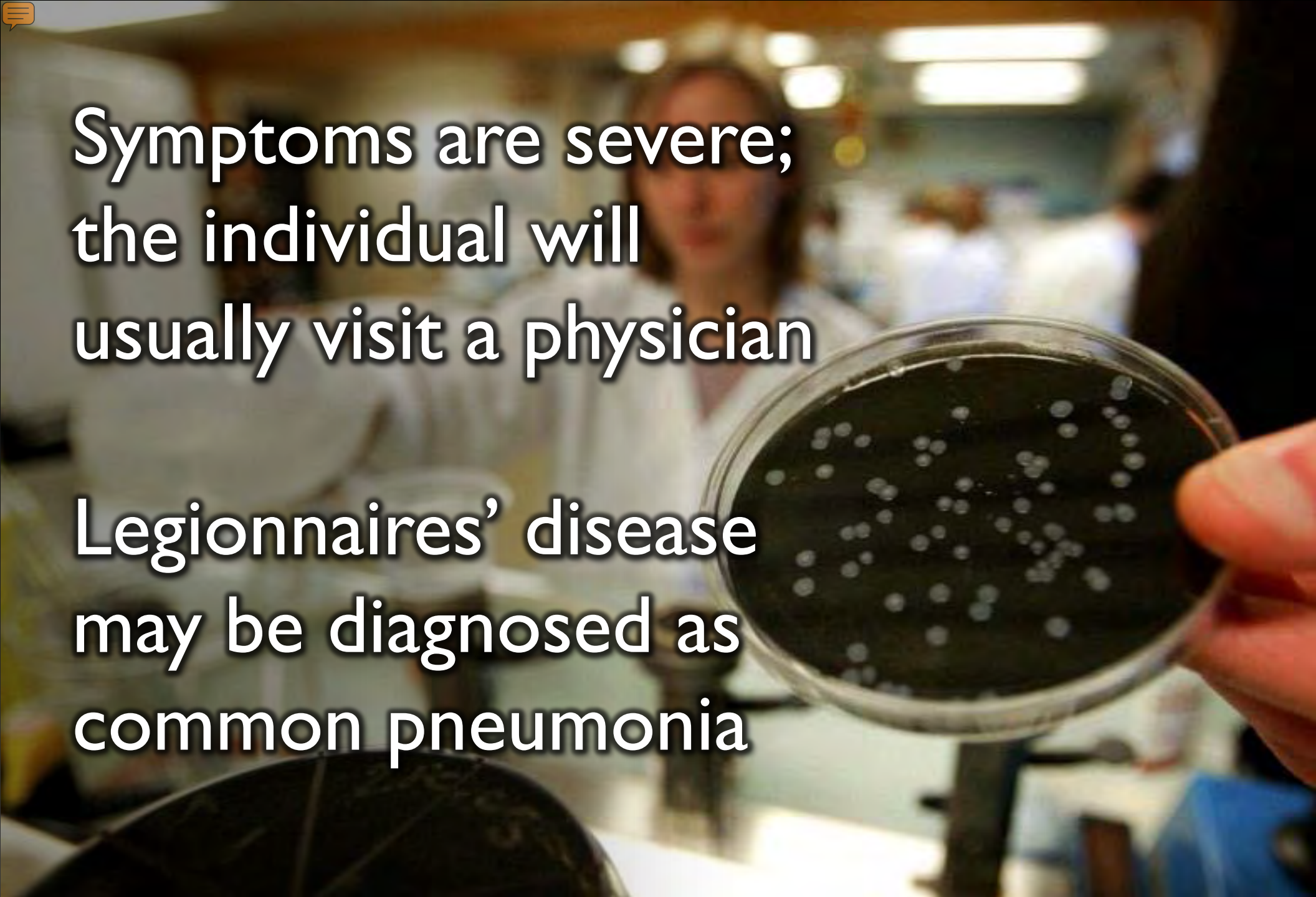
Headache

Chills

Muscle pain

Dry Cough

Difficulty
breathing

A photograph of a laboratory. In the foreground, a hand holds a petri dish containing a dark agar medium with numerous small, white, circular bacterial colonies. In the background, a person in a white lab coat is visible, slightly out of focus. The text is overlaid on the left side of the image.

Symptoms are severe;
the individual will
usually visit a physician

Legionnaires' disease
may be diagnosed as
common pneumonia

Sputum culture or
urine antigen test
is used for positive
identification



A photograph of a hospital hallway with several gurneys lined up. The hallway has a polished floor and walls with a red and white pattern. The lighting is warm and yellowish. The text is overlaid on the left side of the image.

8,000

to

18,000

Hospitalizations

Annually



4,000
Deaths Annually



R
MSA

5–30%
Mortality Rate



Legionnaires' disease is under reported



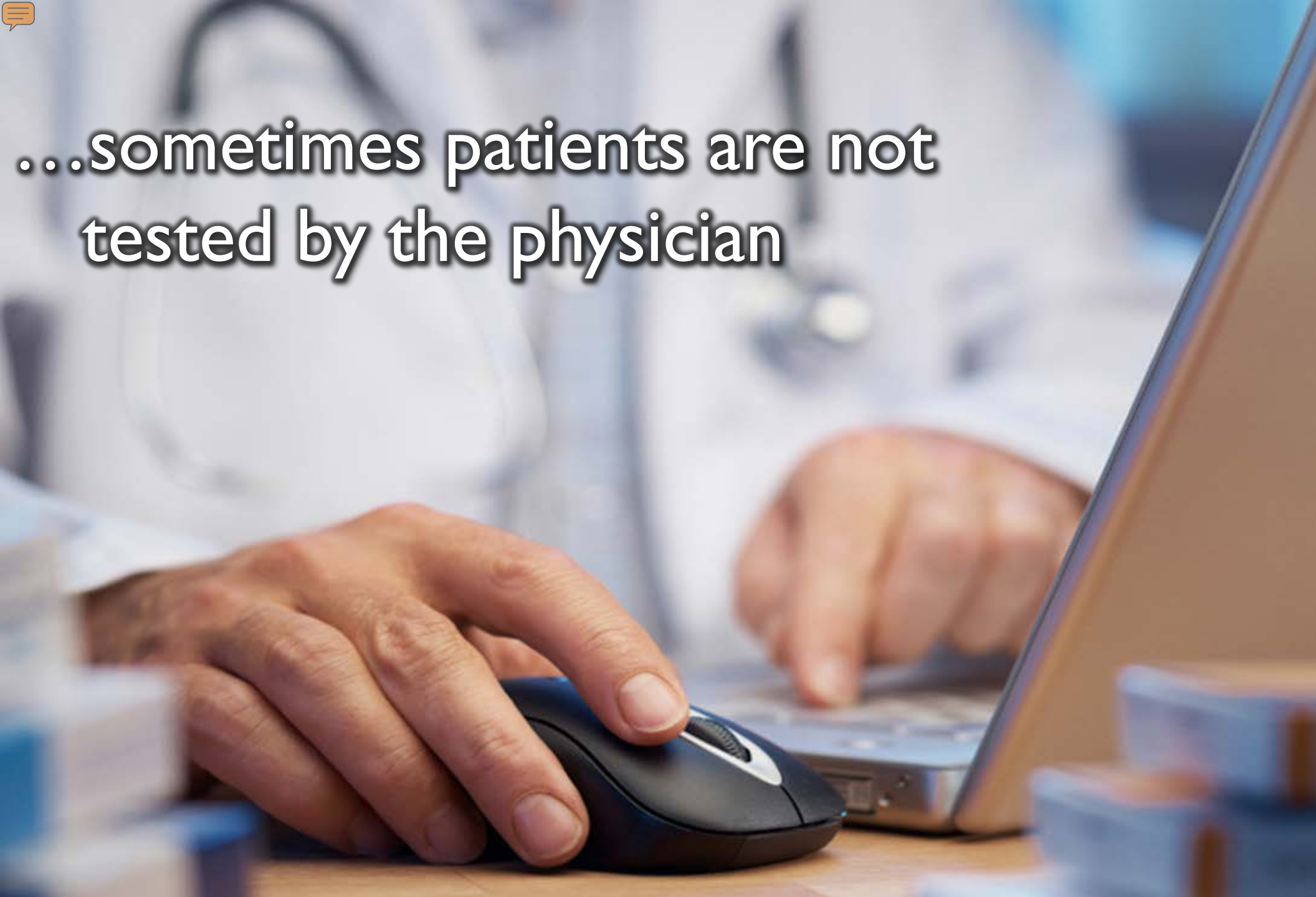


...sometimes patients recover
without medical assistance





...sometimes patients are not tested by the physician

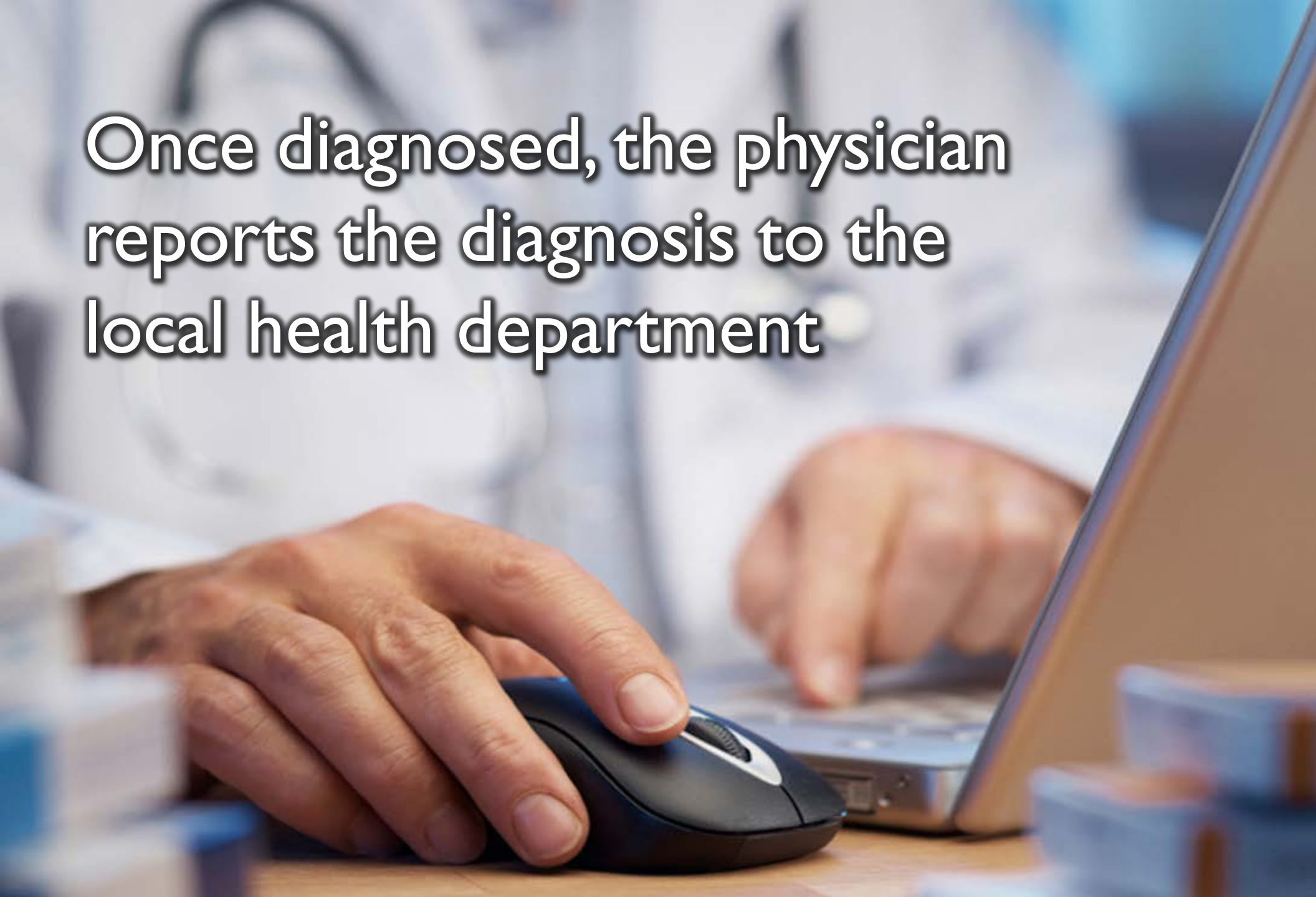




...and sometimes patients receive
a misdiagnosis



Once diagnosed, the physician reports the diagnosis to the local health department





Local Health Department



State Health Department



**Centers for Disease
Control**

More than 20% of cases
are associated with travel



CDC reports the case to the
visited state or community





If a case is associated with an SNHD-permitted facility, SNHD conducts an investigation



Environmental Investigation



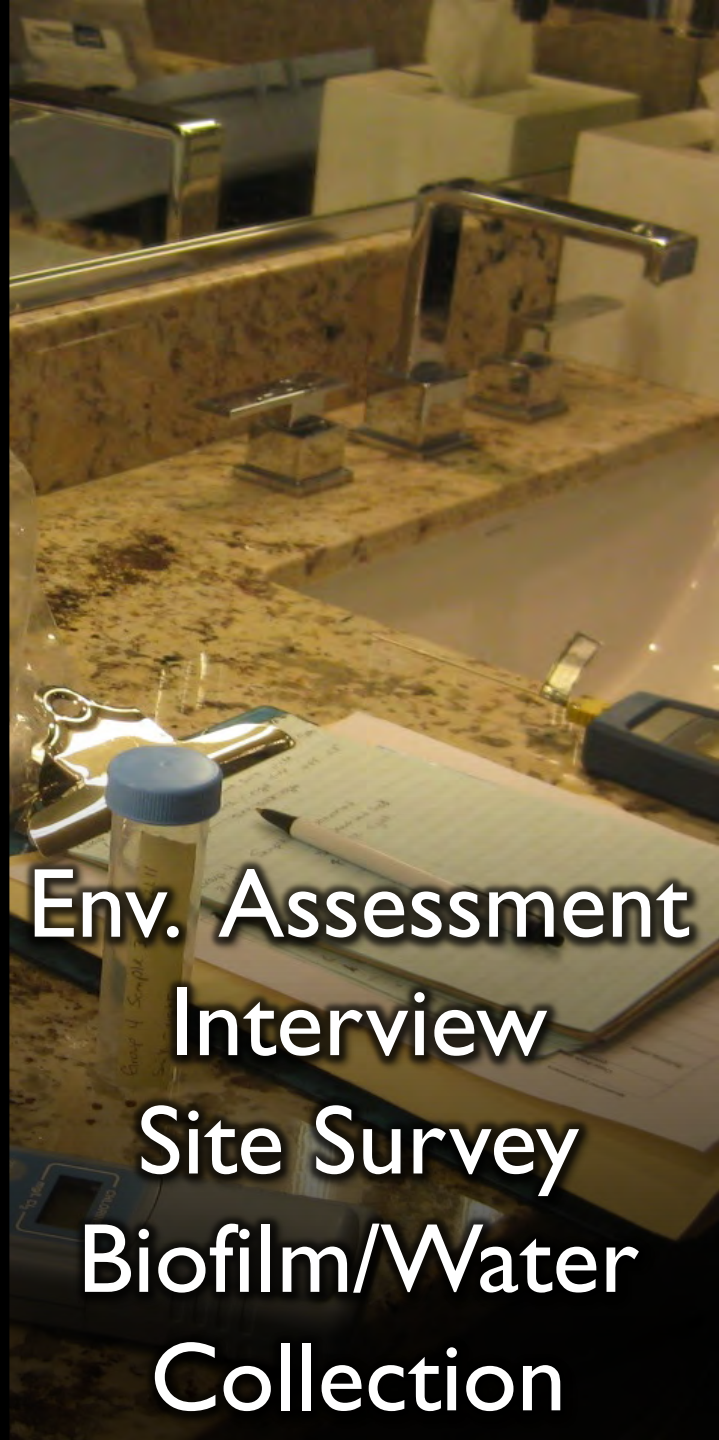
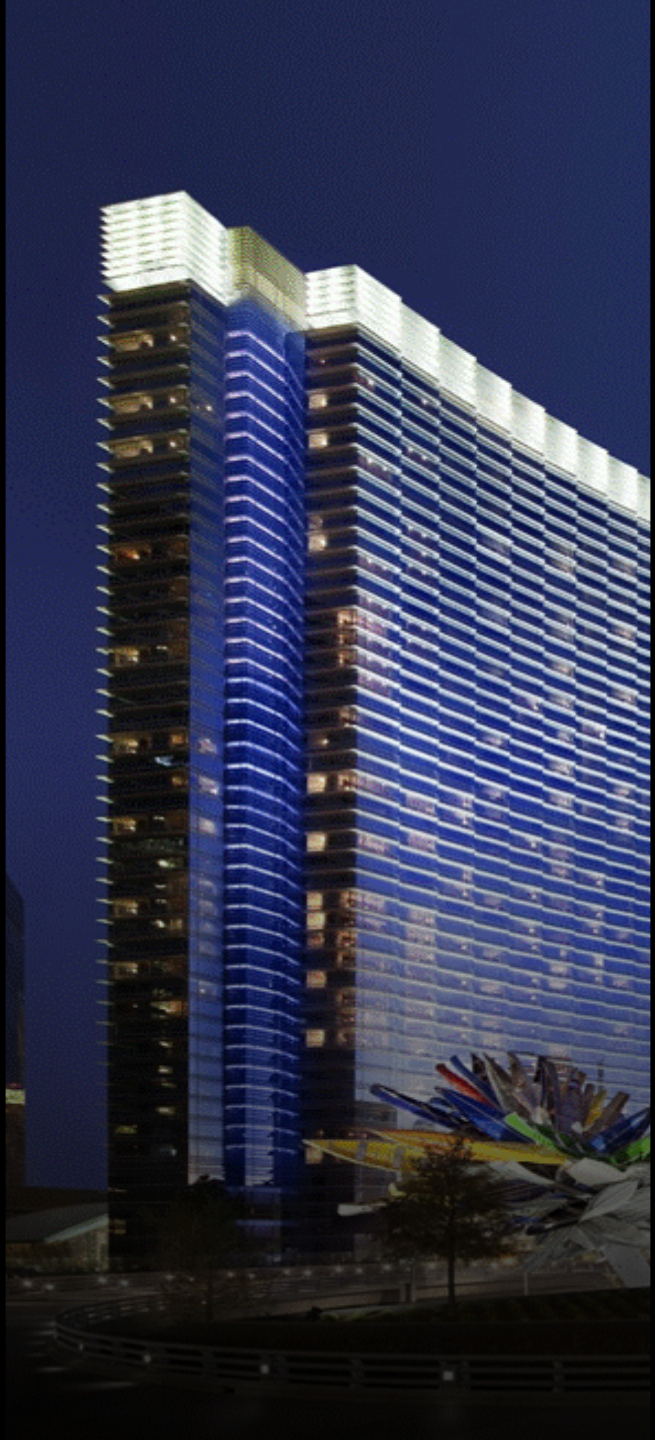
SNHD receives
report of
Legionnaires'
disease





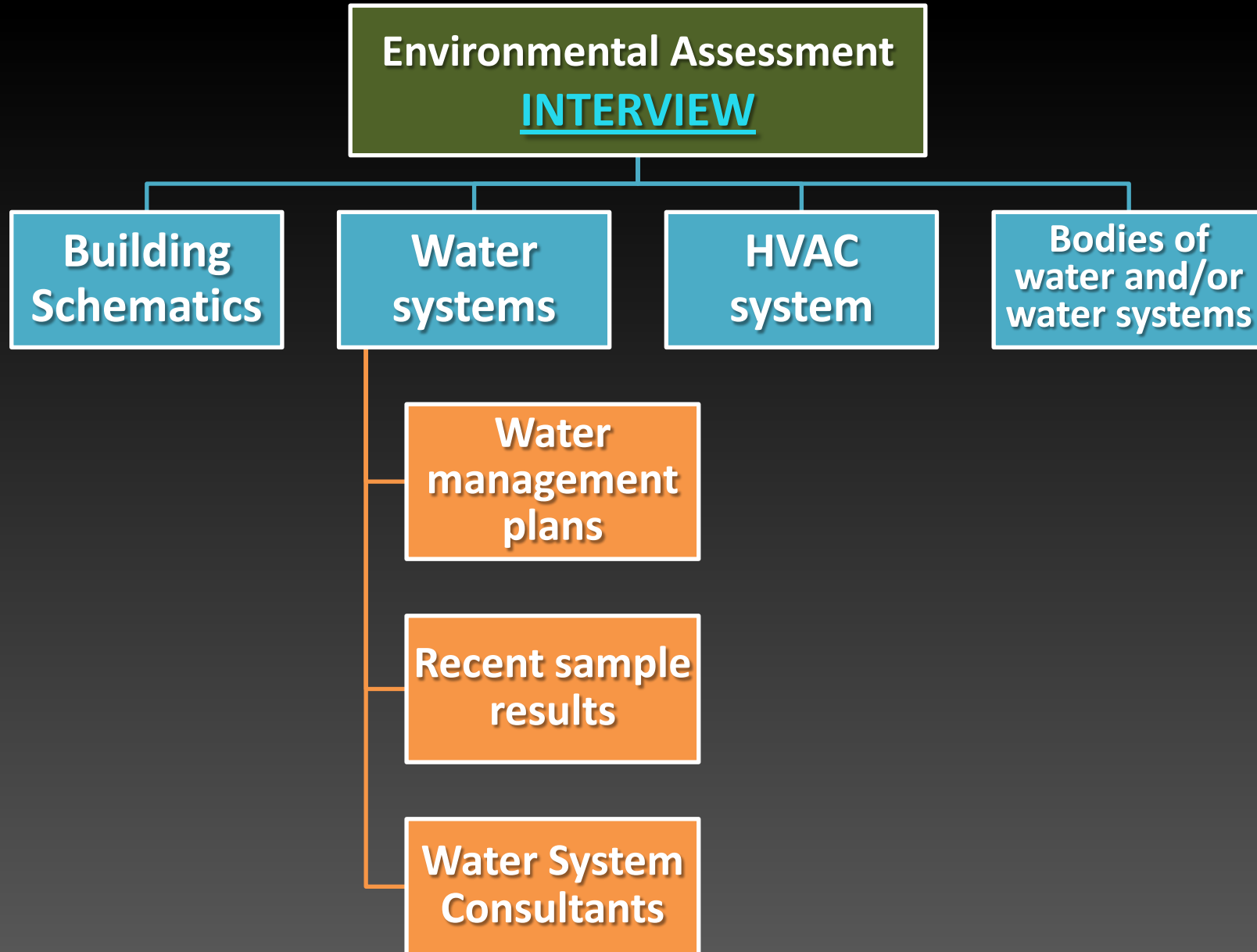
SNHD informs
facility of case
(Visit/Letter)



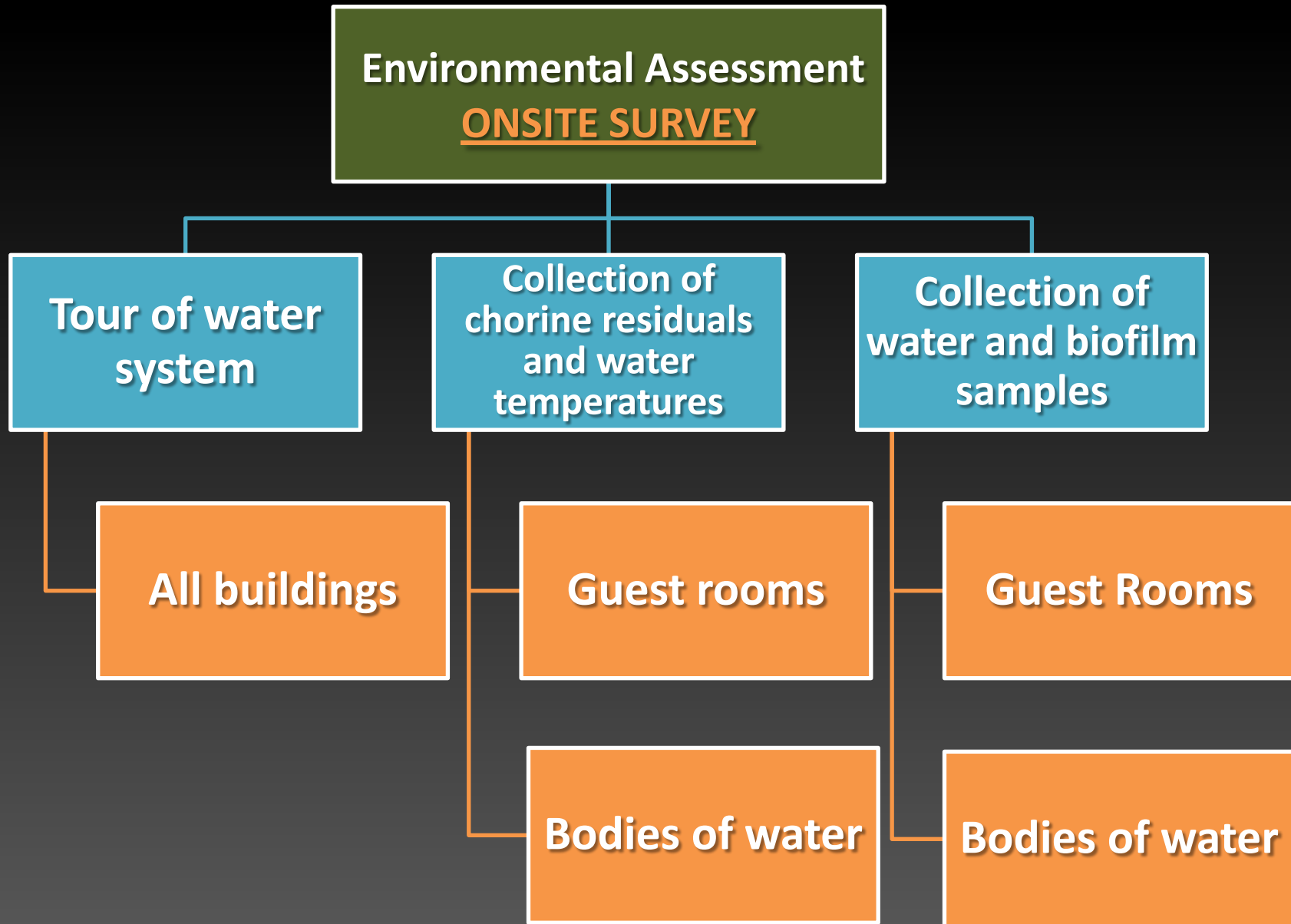


Env. Assessment
Interview
Site Survey
Biofilm/Water
Collection

Investigation



Investigation



SAMPLING EQUIPMENT

- Sterile plastic 1 L bottles
- Sodium Thiosulfate
- Pipettes and bulbs
- Chlorine analyzer
- Thermometer
- Labels
- Chain of Custody
- Dacron-tipped swabs
- Sterile Plastic screw top tubes



SAMPLING-PROCEDURE

- Pre-Flush sampling the Hot and Cold water
- Post-1 minute flush sampling the Hot and Cold water
- Swab samples of faucets / emitters

108°F



Types of rooms tested

- Case room
- Terminal end of loop
- One additional room
- Riser vs. System
- Other possible sources

Test Results: 10-14 Days

SNHD reviews results and
sends to facility





Action will be taken if the results have identified the organism that caused the illness

This is the target organism

For example, in the case that had a positive urine antigen test, the target organism will be *L. pneumophila*, serogroup 1



Results

If the target organism is identified in the results of room fixtures or hot water system, SNHD will require that the water system supplying the room water system be remediated based on the following results:

- Target organism in bulk water greater than 10 cfu/ml
- Environmental swabs from two different fixtures greater than 10 cfu/ml
- Water or environmental swabs from two different fixtures less than 10 cfu/ml

Results

If a single water sample or environmental swab returns with results less than 10 cfu/ml, but is the target organism, then the SNHD shall determine what type of remediation is required

Results

If the results find other *Legionella* in the samples, SNHD will make a recommendation based on results

Results

Environmental samples collected from areas that are not guest room fixtures must meet the OSHA standards

If the samples do not meet OSHA standards, then remediation of the system will be required



Marley
Phone
971-1000
QUALITY
AIR CONDITIONING COMPANY

100 CFU

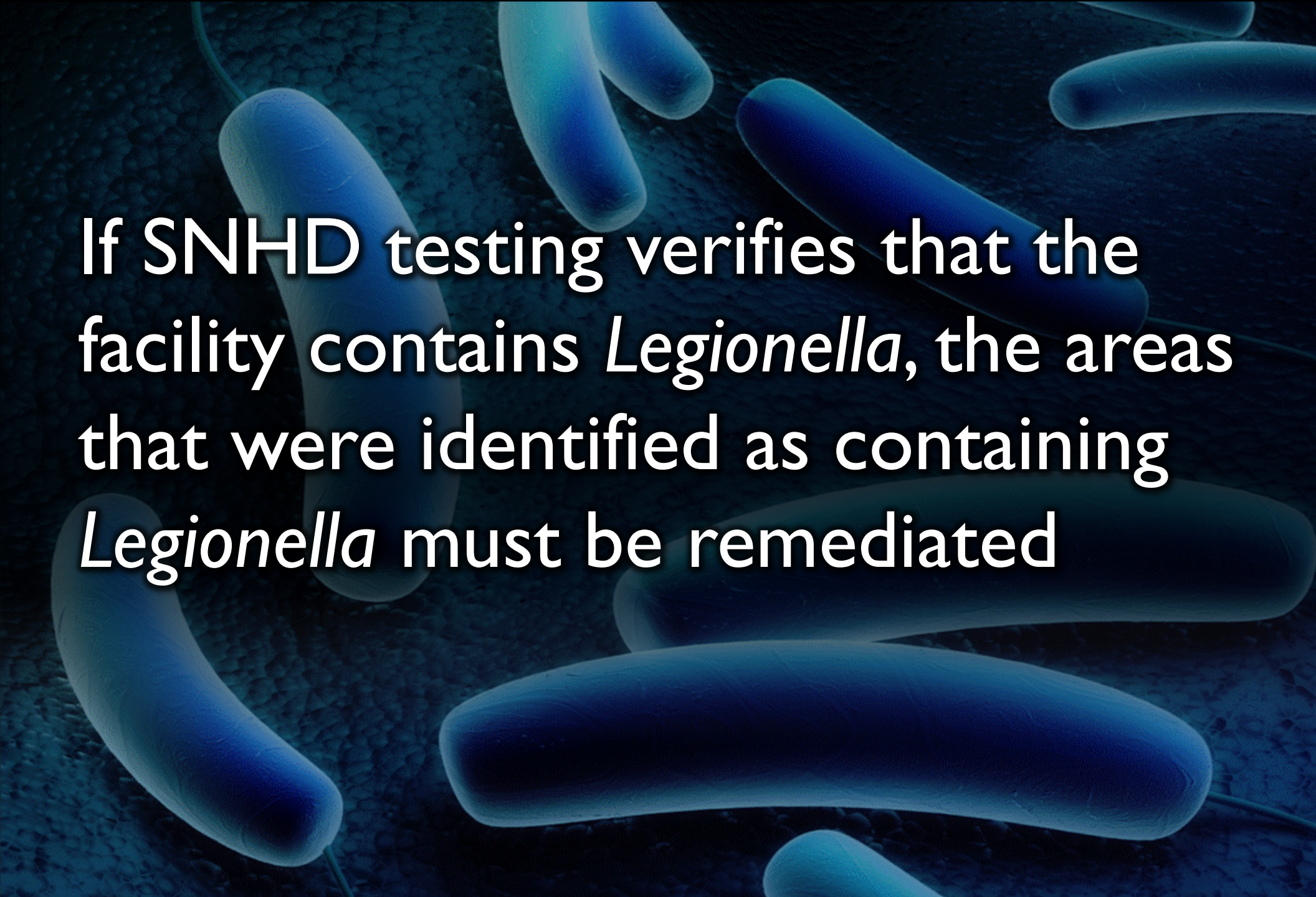




10 CFU



I CFU

A microscopic view of Legionella bacteria, which are rod-shaped and appear in various orientations and sizes against a dark blue background. The bacteria are rendered in shades of light blue and white, with some showing fine surface details.

If SNHD testing verifies that the facility contains *Legionella*, the areas that were identified as containing *Legionella* must be remediated

A microscopic view of several Legionella bacteria, which are rod-shaped and have a slightly tapered appearance. They are set against a dark blue background with a fine, textured pattern. The bacteria are illuminated from the side, creating a gradient of blue and white highlights that emphasize their three-dimensional structure.

Remediation of *Legionella* is dependent upon where it is found

Additional testing or remediation of the other water systems will be required

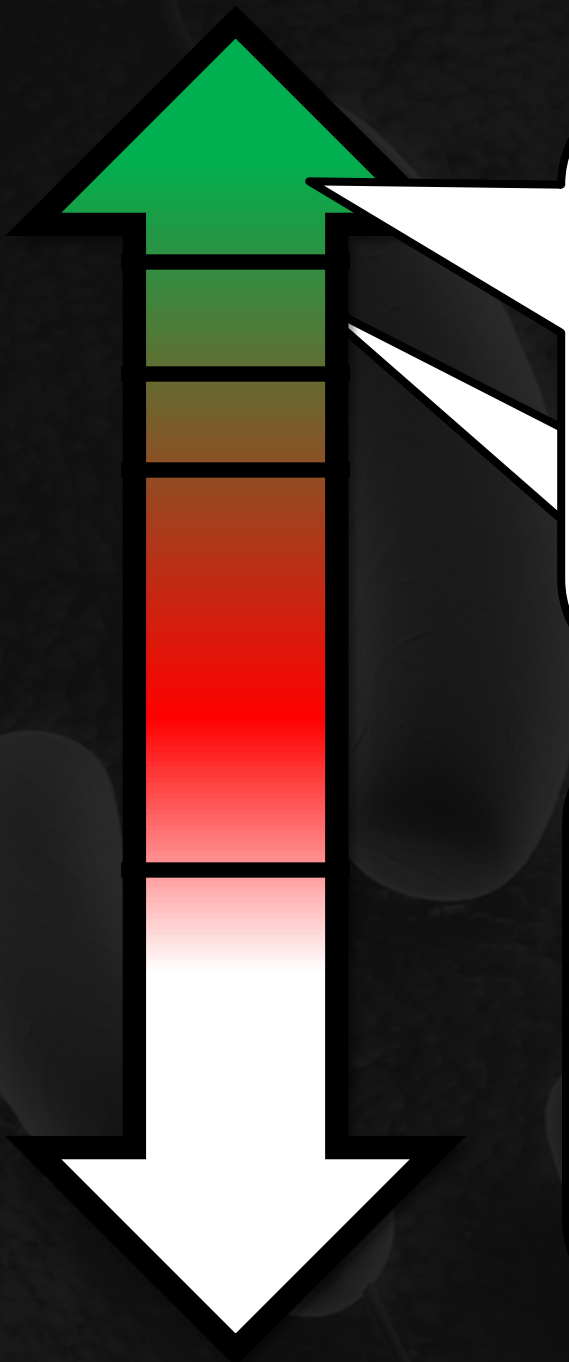
Remediation

ASHRAE recommends two
methods to remove *Legionella*:



I: Hot Water Flush (160 - 170°F)



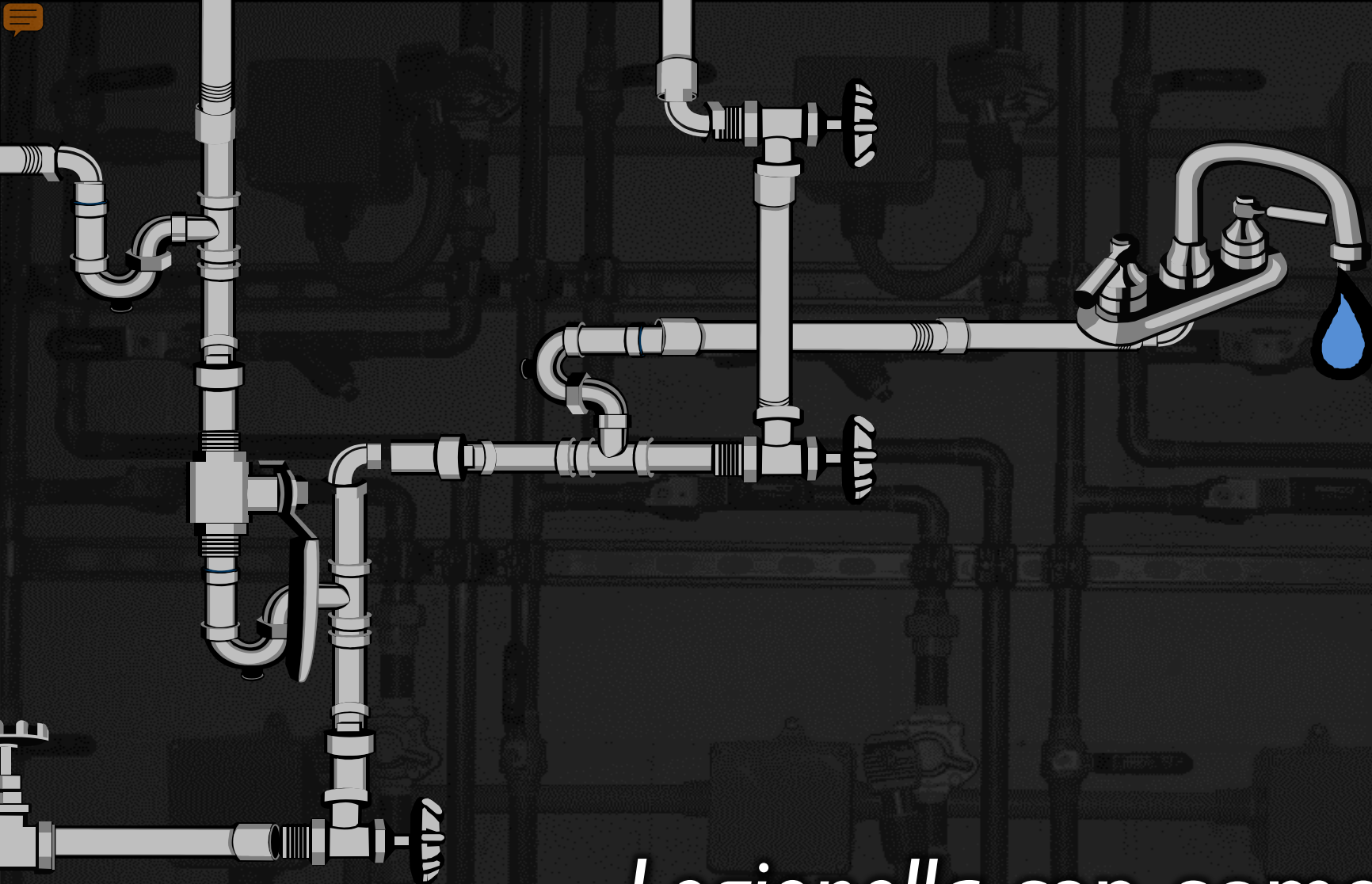


>70°C (158°F)
100% Rapid Kill

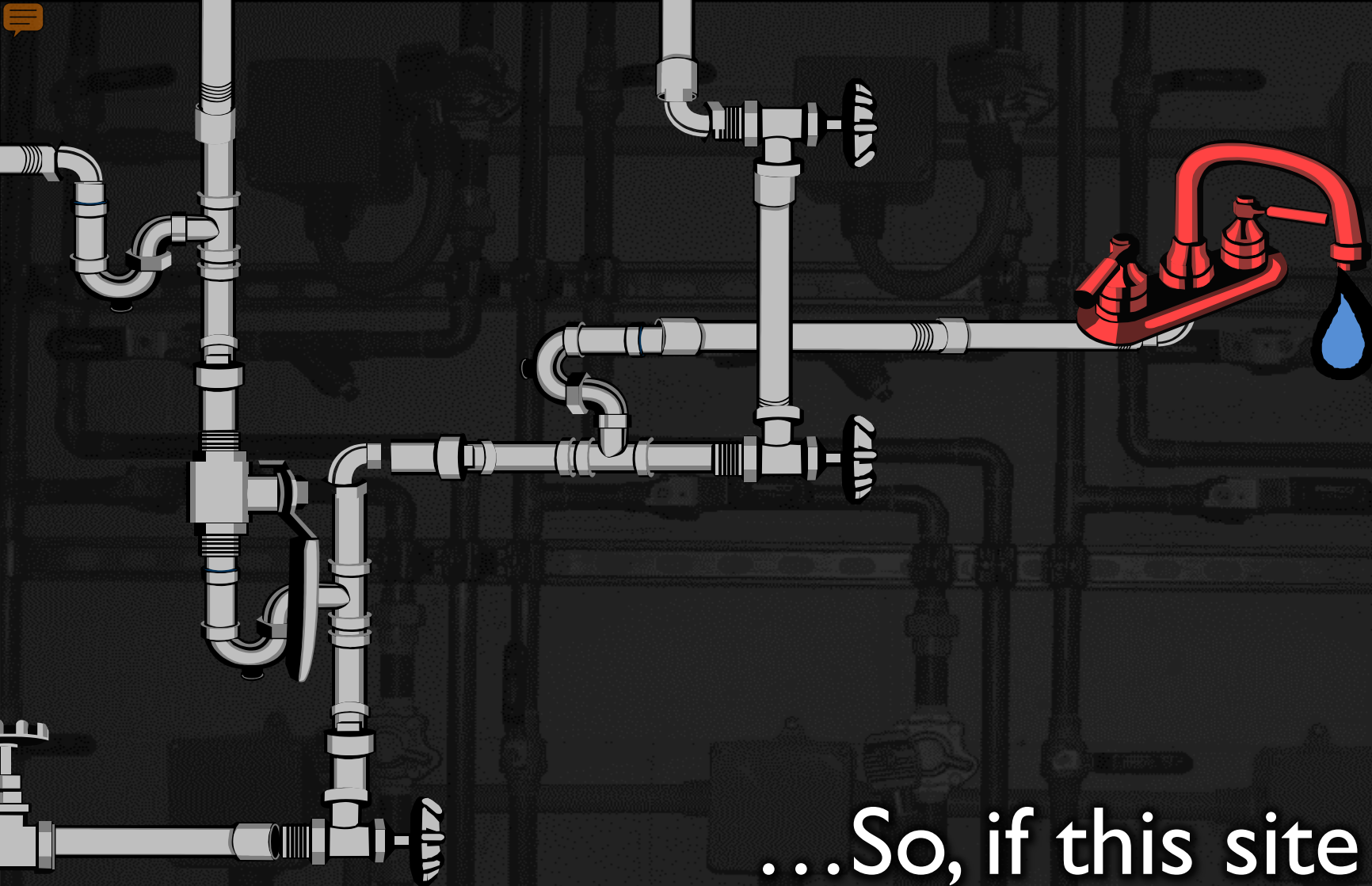
60°C (140°F)
90% Kill in 2 Minutes

2: System chlorination
(min 2 ppm, 2 hours)

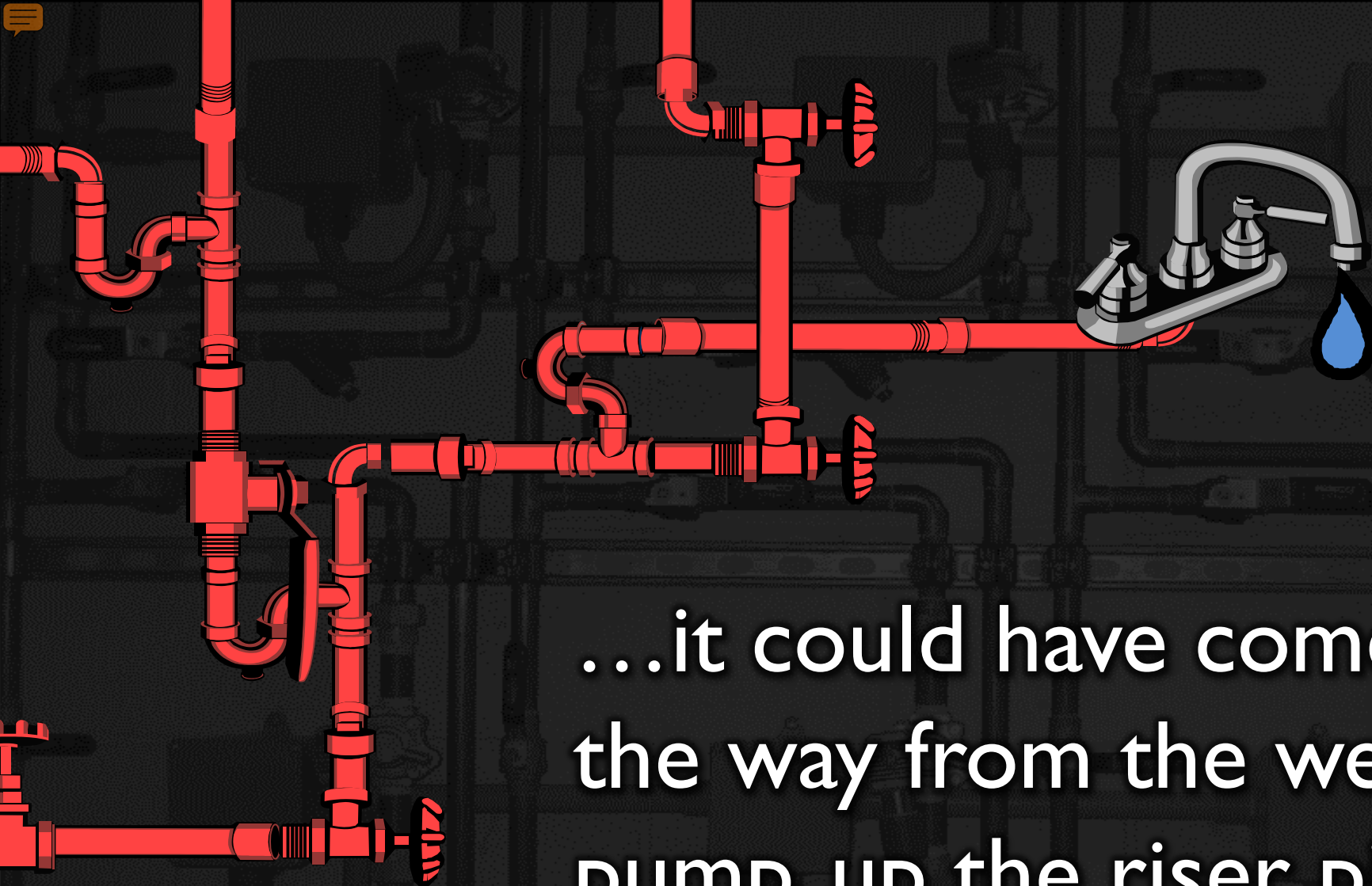




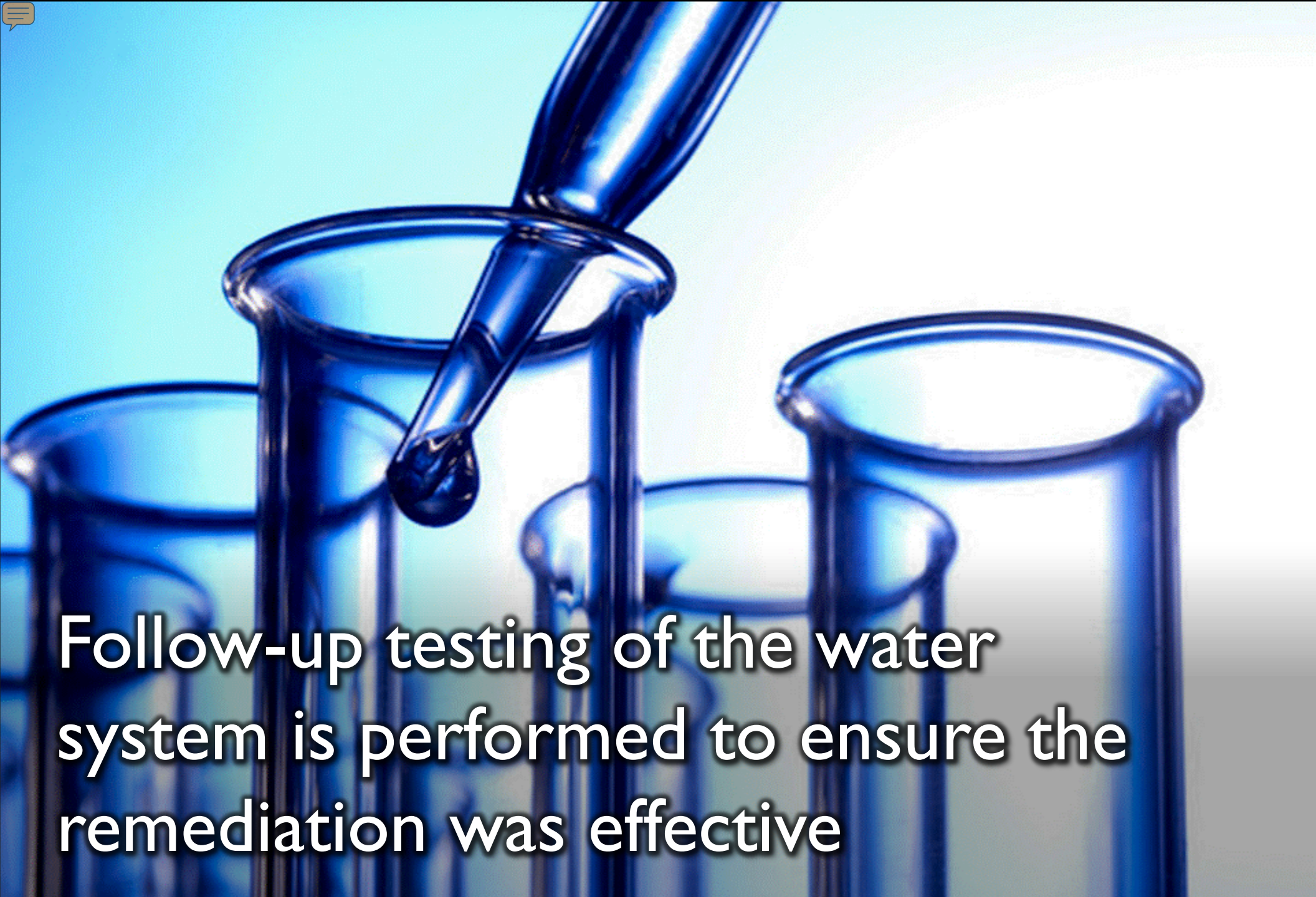
Legionella can come from
any source upstream...



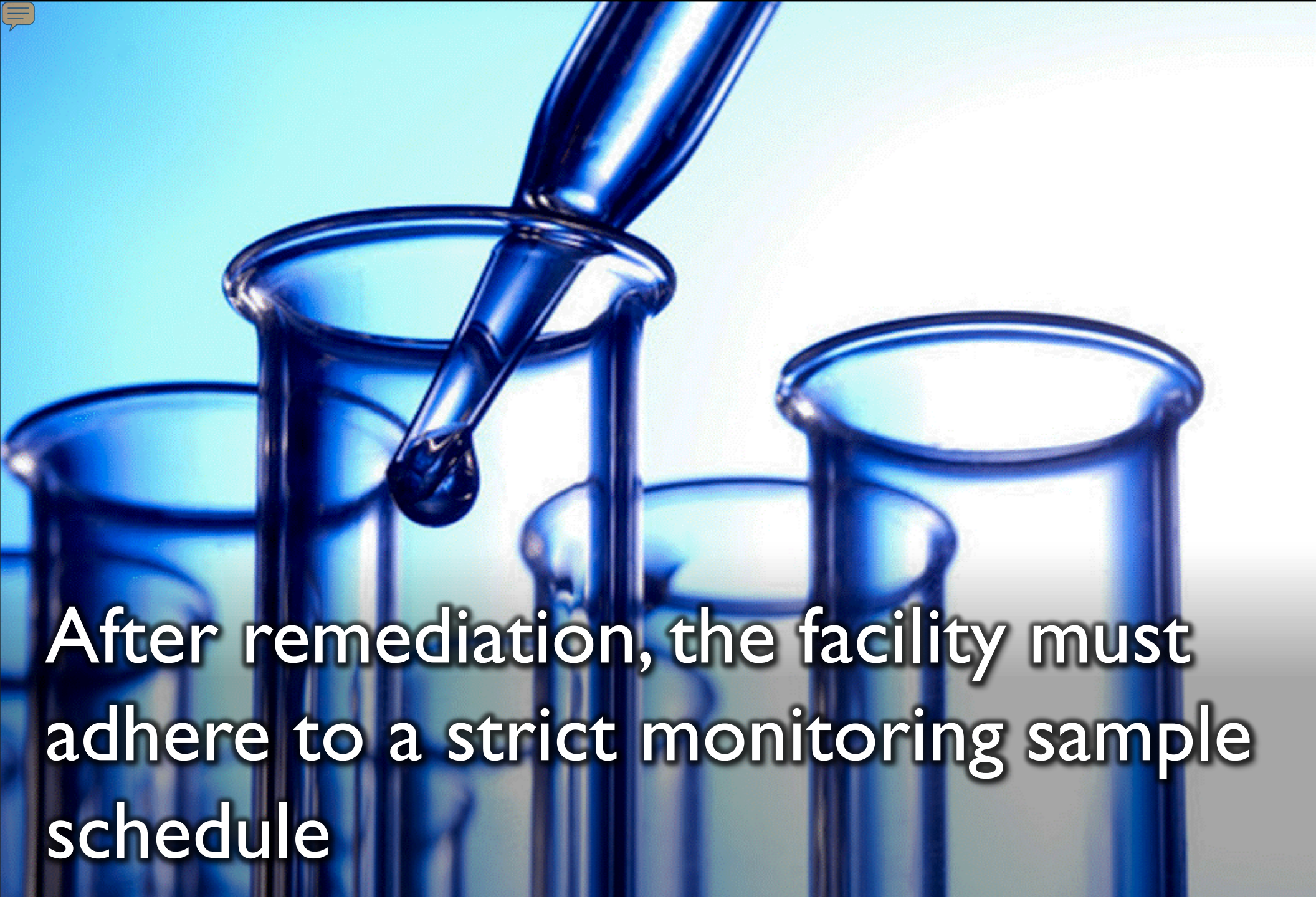
...So, if this site tests positive for *Legionella*,...



...it could have come all the way from the well pump, up the riser pipes, and into the faucet



Follow-up testing of the water system is performed to ensure the remediation was effective



After remediation, the facility must adhere to a strict monitoring sample schedule



3

Biweekly
Monthly
Quarterly

Communication with Public during an Outbreak Investigation

During an outbreak investigation, SNHD will issue reports updating the public on the ongoing investigation and what has been found

Timing of the reports will be dependent upon the activities of Environmental Health and the Office of Epidemiology



Ongoing control is necessary to ensure that the facility does not pose an increased risk to occupants

ASHRAE Standard

A person in a blue shirt is working on a complex industrial water system. The system consists of various pipes, valves, and tanks. The person is holding a tool or device near one of the components. The background is dark, and the overall scene is industrial.

- Proposed New Standard 188, Prevention of Legionellosis Associated with Building Water Systems
- The goal of the document is to specify a Standard Practice for use by facility managers/owners to prevent legionellosis associated with building water systems
- Requires a Hazard Analysis Critical Control Point (HACCP) plan

A person in a blue shirt is working on a large industrial machine, possibly a pump or motor, in a factory setting. The machine is made of metal and has various pipes and components. The person is looking at the machine and has their hands on it. The background is dark and industrial. The text "Active Control Measures currently in use" is overlaid on the image in white, bold, sans-serif font.

**Active Control Measures
currently in use**



Control can include raising the temperature of the water or adding secondary disinfection



If secondary disinfection is used as a control, the facility may need to obtain public water system (PWS) permit



Ongoing secondary control
options that...

...may not require a **PWS** permit

- Heat-and-Flush (Heat Shock)
- Ultraviolet (UV) Radiation
- Ozonation



Ongoing secondary control
options that...

...may require a PWS permit

- Chlorination
- Copper-Silver Ionization
- Chlorine Dioxide
- Monochloramine



Public Water System Requirements

Application to Nevada Department of
Environmental Protection, Bureau of Safe
Drinking Water

PWS Classification

- Community
- Non-Transient Non-Community
- Transient Non-Community

Tri-annual sanitary survey



Public Water System Requirements

Water Quality Monitoring

- Chlorine Residuals
- Disinfection By- Products
 - Total Coliforms
 - Lead and Copper

Water Operator Certification

- Distribution operator
- Treatment operator

Public Notice Requirements/ Consumer Confidence Reports

Case Study

CDC

- Multiple cases different time periods
- Urine Antigen Positive
- Provided information on the facilities and rooms where the cases stayed

SNHD

- Informed Facility
- Performed Environmental Assessment
- Collected water and biofilm samples


Facility

- Assisted SNHD with all requests


The positive urine antigen tests indicated that the cases' Legionellosis were caused by *Legionella pneumophila* serogroup I

Facility

Environmental sample results indicated the presence of *Legionella pneumophila* serogroup I in the riser tested.



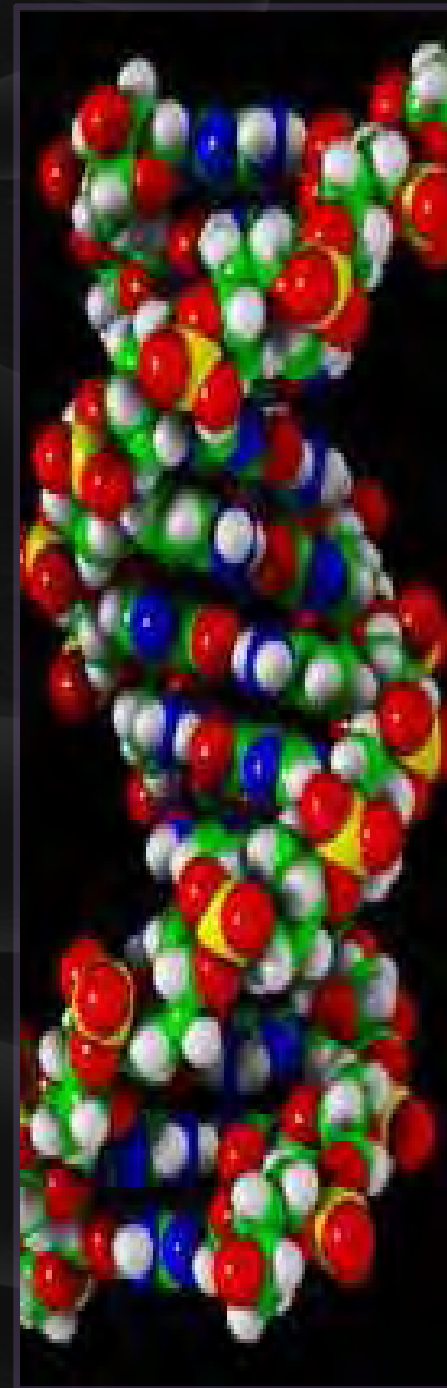
SNHD required remediation of the hot water system in addition to additional testing of the remaining hot water risers



The facility decided to remediate all of the risers beginning with the riser where the most recent case stayed

The most recent case had a sputum isolate of *Legionella pneumophila* serogroup I, the CDC requested cultures from the case and environmental isolates be sent to them for DNA sequencing

The DNA sequencing found that all of the environmental isolates either matched the case isolate or varied by a single nucleotide mutation on one gene





Follow-up post remediation testing did not detect *Legionella* in the hot water system

The facility was then placed on the additional testing protocol discussed earlier

To date, *Legionella pneumophila* serogroup 1 has not been identified in the facility

Reports on the recent investigations can be found at

- www.snhd.info
- Click 'Health Topics'
- Then click 'Statistics, Surveillance and Reports'

The screenshot shows the Southern Nevada Health District website. The header includes navigation links: Home, Contact Us, Locations, A-Z, How Do I?, New & Noteworthy, and Feedback. A search bar is on the right. The main banner features the text "CELEBRATING THE PAST. PROTECTING THE FUTURE." and "50 YEARS SOUTHERN NEVADA HEALTH DISTRICT". Below the banner are social media icons for Twitter, Facebook, YouTube, and a "Tweet" button, along with "Print" and "Email Page" options. A navigation bar contains links for Programs, Clinics, Permits & Regulations, Health Topics, News & Information, and About Us. The "Health Topics" link is circled in orange, with an arrow pointing to it. Below this, a list of health topics is displayed, with "Statistics, Surveillance & Reports" at the bottom circled in orange and an arrow pointing to it. A vertical sidebar on the left contains the SNHD logo. On the right side of the page, there is a vertical strip of images showing various people and health-related scenes.

Home | Contact Us | Locations | A-Z | How Do I? | New & Noteworthy | Feedback

Search GO

CELEBRATING THE PAST. PROTECTING THE FUTURE.

50 YEARS

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- » [Food & Product Recalls](#)
- » [H1N1 Influenza](#)
- » [Health Care Professionals](#)
- » [Hepatitis C Outbreak Investigation](#)
- » [Infection Control Breach at Physician's Office](#)
- » [Low-Cost Health Services](#)
- » [Nevada Clean Indoor Air Act](#)
- » [Perinatal Hepatitis B Prevention](#)
- » [Public Health Laboratories](#)
- » [Seasonal & Pandemic Flu](#)
- » [Statistics, Surveillance & Reports](#)

Summary

Ultimate Goal is for us to work together
in a proactive way

- Not working together in a proactive manner will result in:
 - Rolling the dice for the second case

- Two cases with no response will result in an **OUTBREAK** response from SNHD, including:
 - Need for SNHD to notify the public
 - SNHD requesting guest lists
 - Notification of new guests regarding the outbreak while investigation is ongoing
 - Potential/likely posting of outbreak locations by CDC on their website
 - **MEDIA WILL BE VERY INVOLVED/INTERESTED**



VERSUS

- Being proactive by looking at one reported case as a canary in a mine:
 - Facility has a proactive Water Management Plan
 - If SNHD gets report of a case, SNHD will work with you to review the Water Management Plan and take samples to identify potential sources
 - Implement disinfection and take corrective action before sample results are received

- By SNHD responding and investigating and the facility using the best practices/taking the appropriate corrective action:
 - Any second case reported prior to the disinfection requires no further action
- If the SNHD investigation does not identify the target organism, then the investigation is closed and potential outbreak can be ruled out
- If a case subsequently occurs, and the SNHD does not identify a source, there will be no outbreak identified
- Minimizes the need for public notification/media attention

Discussion

Contact Information:

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SNHD EH Special Programs
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