

CSTE All-State Epi Call

The Increasing Challenge of Legionnaires' Disease in the United States

Centers for Disease Control and Prevention

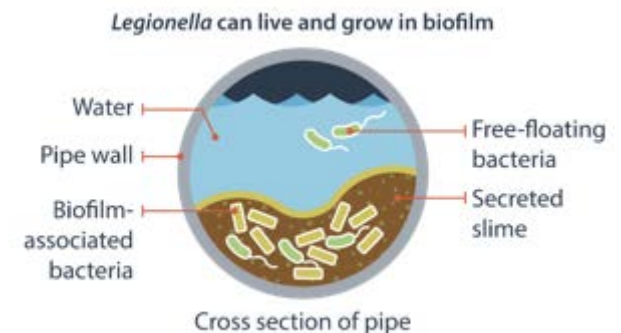
February 26, 2018



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

Legionella

- Gram-negative bacillus
- Intracellular parasite of free-living protozoa primarily found in freshwater
- Can live and grow in biofilm
- More than 60 species
- *L. pneumophila*: ~90% of reported U.S. cases¹



¹ Fields BS et al. *Clin Microbiol Rev.* 2002;15(3):506–26.

From *Legionella* in fresh water to clinical disease: a multi-step cascade

***Legionella* lives in fresh water**



- Natural reservoir for *Legionella*
- Insufficient quantities to cause disease

Certain conditions in large, complex water systems can lead to *Legionella* amplification



- Temperature (77–108°F)
- Stagnation
- Scale and sediment
- Biofilm
- Protozoa
- Absence of disinfectant

Certain devices can aerosolize water containing *Legionella*



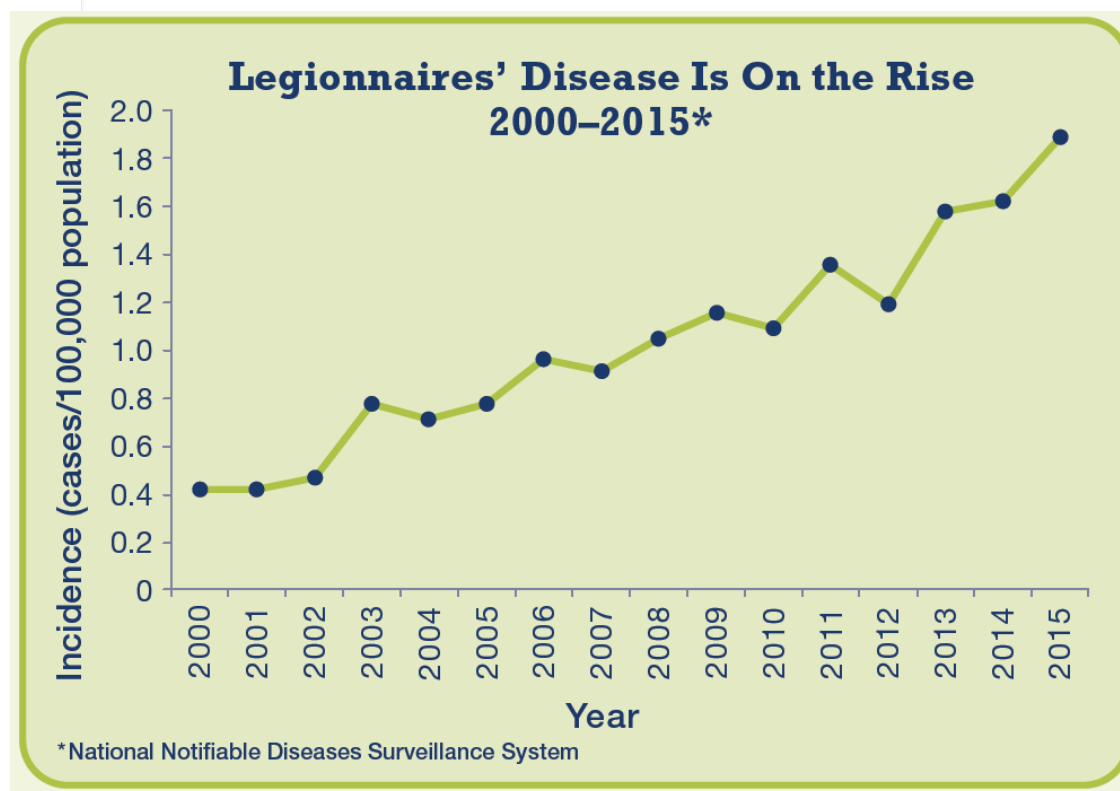
- Showers and faucets
- Cooling towers
- Hot tubs
- Decorative fountains

***Legionella* can be transmitted to susceptible hosts and cause disease**



- Age > 50 years
- Smoking
- Weakened immune system
- Chronic disease

Legionnaires' disease is on the rise in the United States

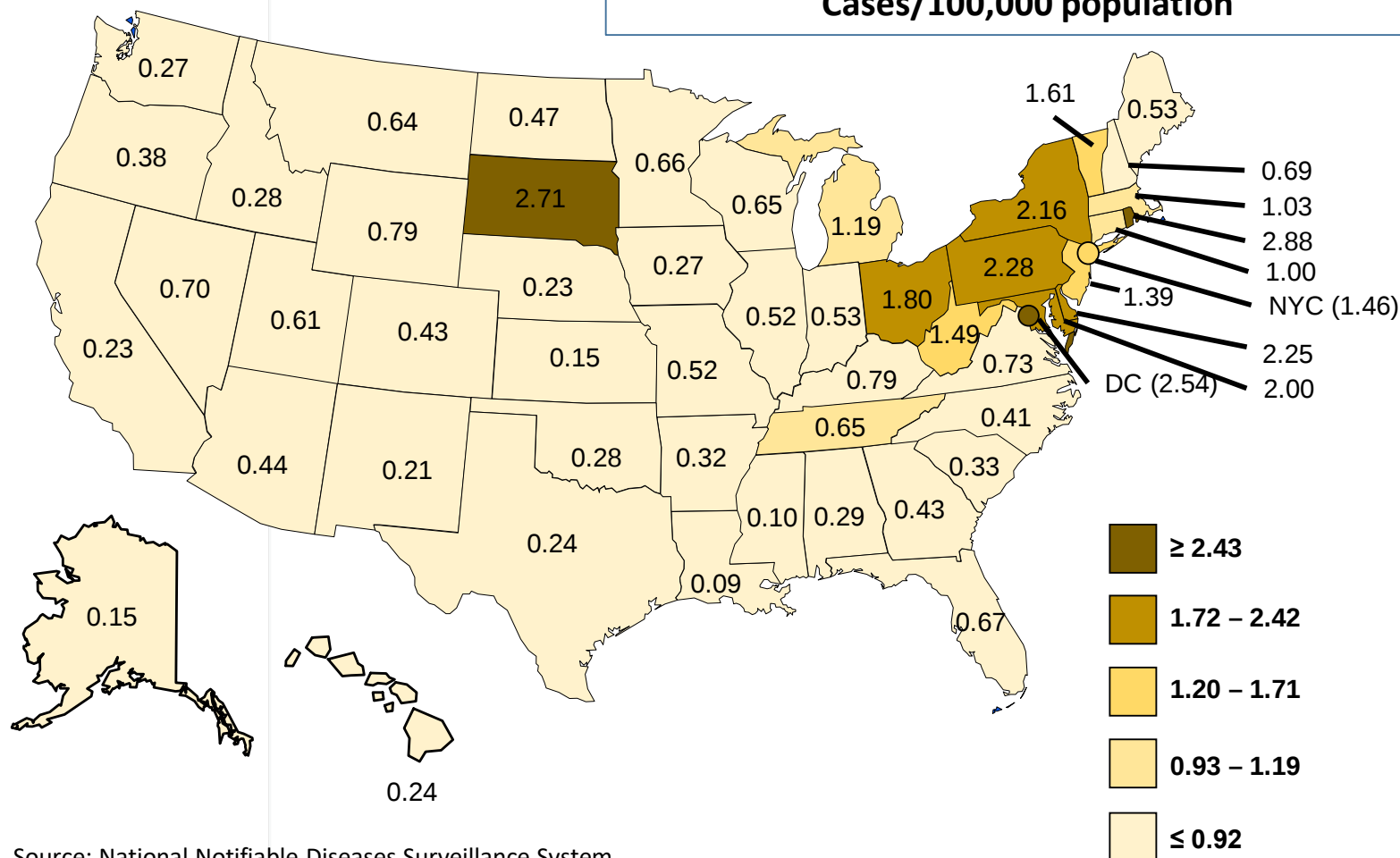


Rate of reported cases nearly quadrupled (2000–2015)

Source: National Notifiable Diseases Surveillance System

Increases are apparent across the country, even with geographic differences in incidence — 2005

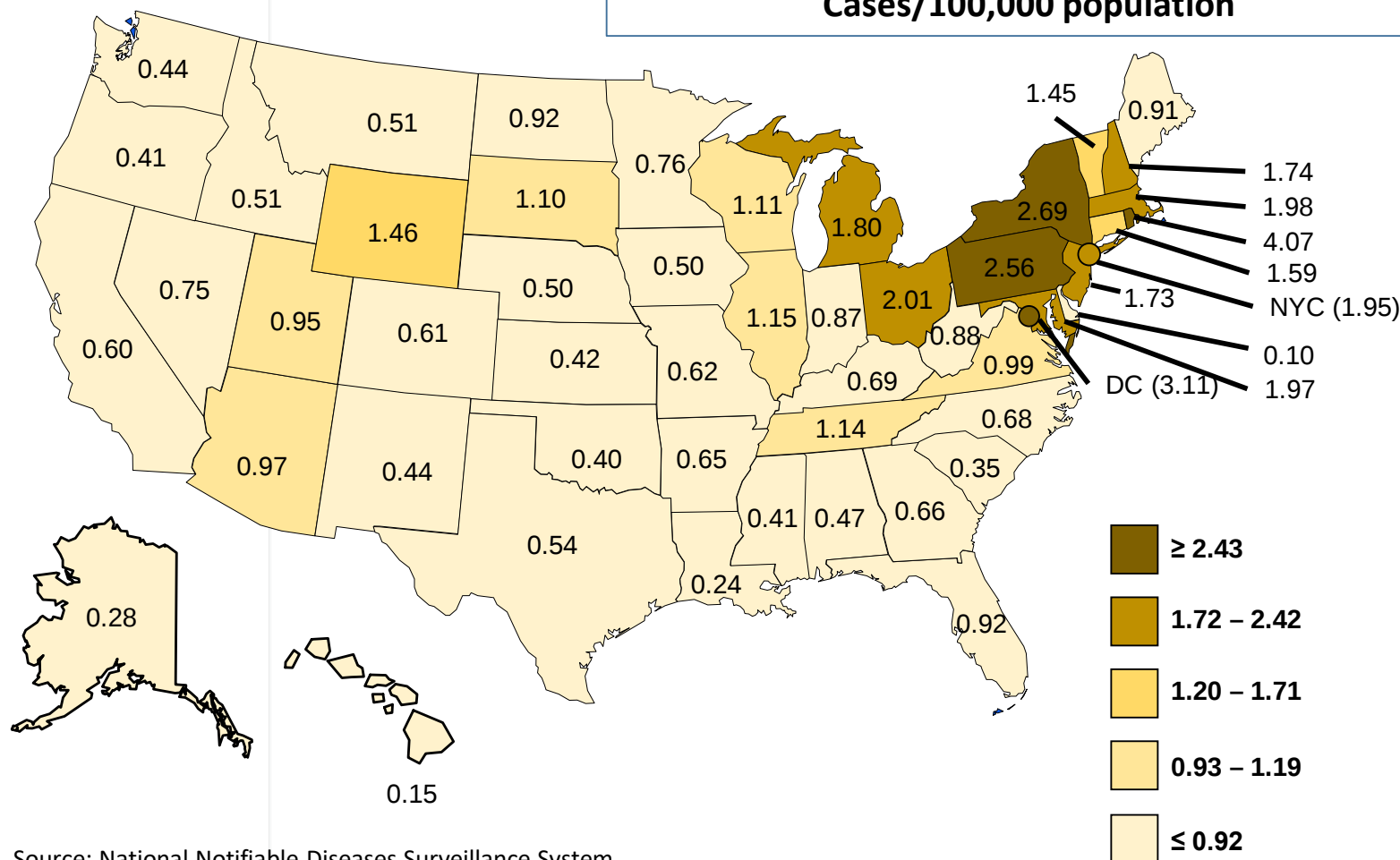
Rates of reported legionellosis cases by state, 2005
Cases/100,000 population



Source: National Notifiable Diseases Surveillance System

Increases are apparent across the country, even with geographic differences in incidence — 2010

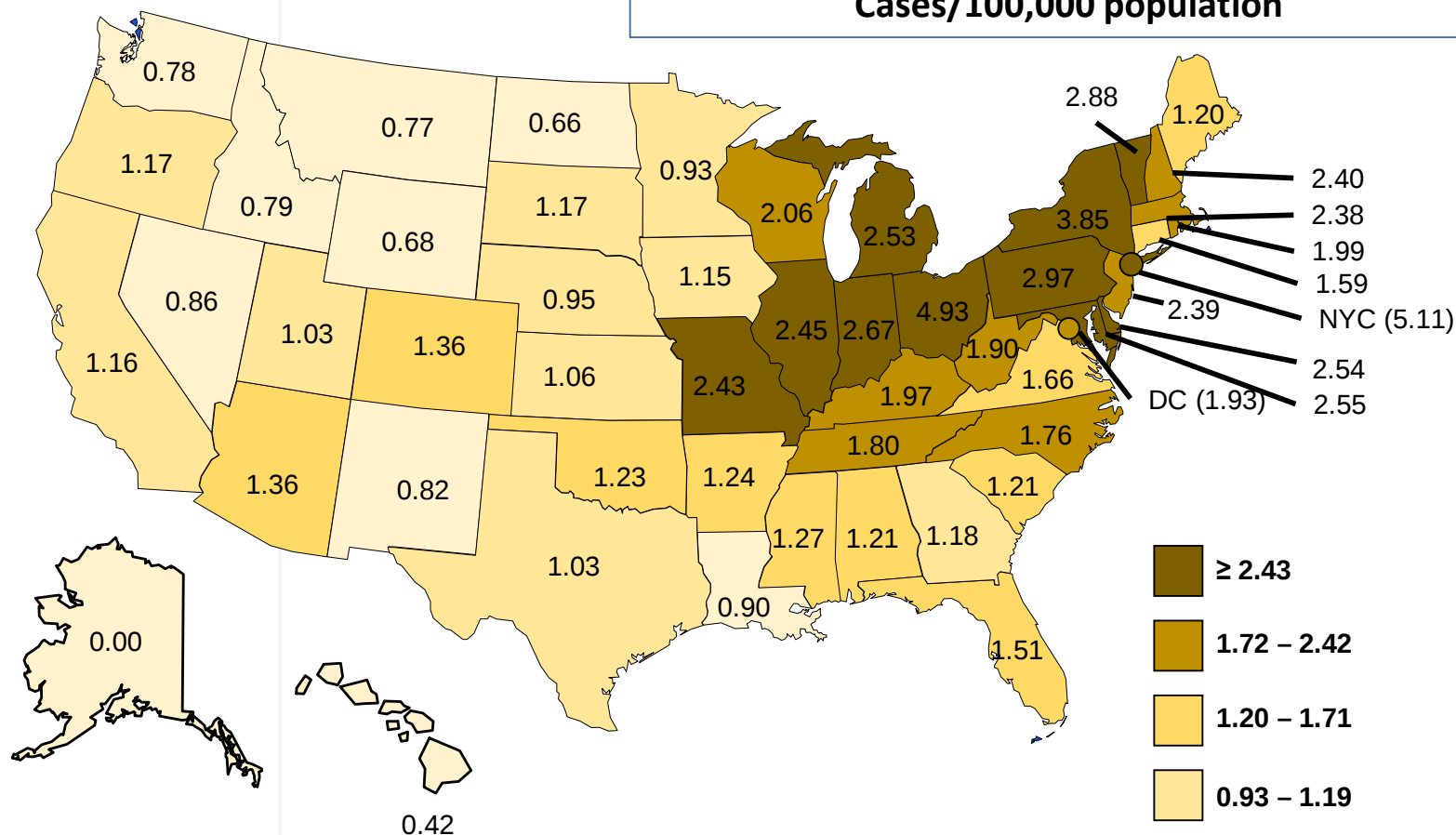
Rates of reported legionellosis cases by state, 2010
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Increases are apparent across the country, even with geographic differences in incidence — 2015

Rates of reported legionellosis cases by state, 2015
Cases/100,000 population



Source: National Notifiable Diseases Surveillance System

Possible reasons for the increasing number of reported cases?

- **Increased susceptibility of the population**
 - Aging U.S. population
 - More people on immune suppressing medications
- **More *Legionella* in the environment**
 - Warmer temperatures
 - Aging infrastructure
 - Water-saving building modifications
- **Improved diagnostic capabilities**
 - Urinary antigen test (UAT) availability
- **Improved diagnosis and reporting**
 - Increased awareness and testing
 - Increased surveillance capacity



What do we know about source attribution?

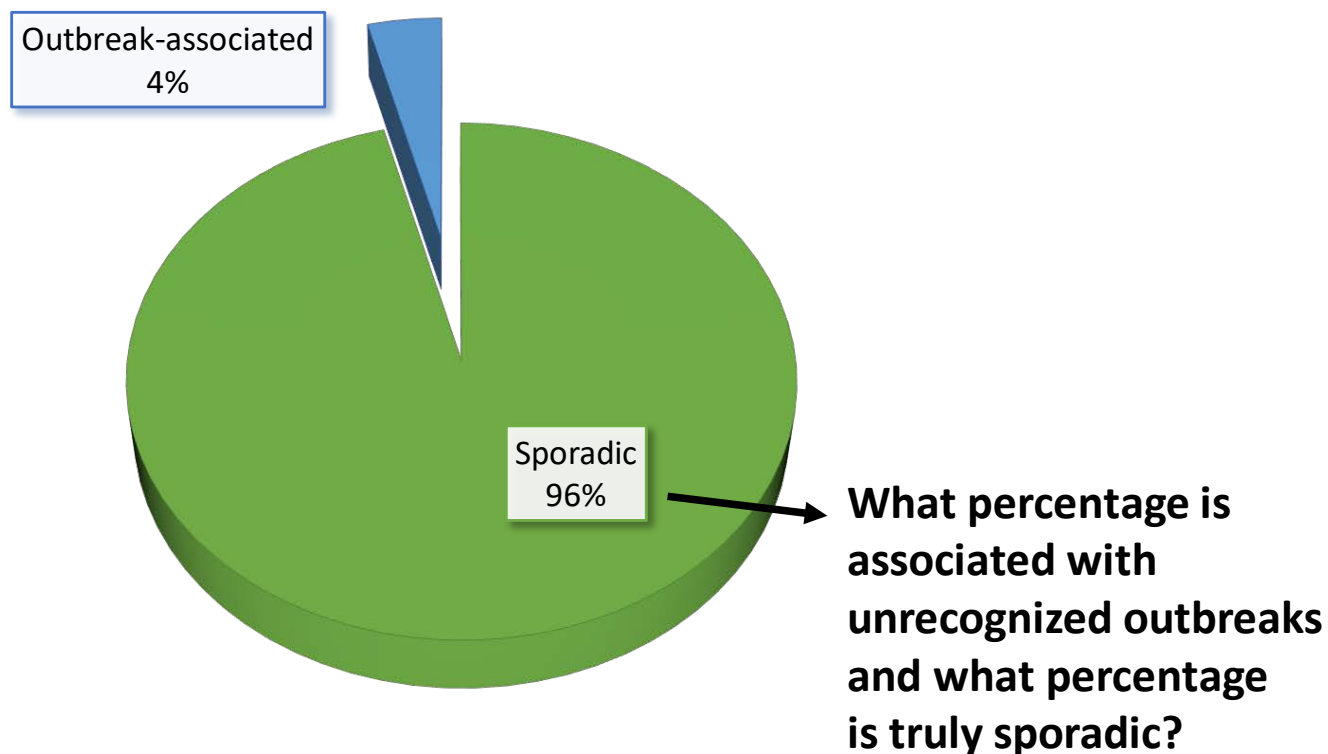
- **2016: CDC analyzed data from 27 building-associated outbreaks (2000–2014)**
- **Common settings**
 - Hotels (44%)
 - Long-term care facilities (19%)
 - Hospitals (15%)
- **Common sources**
 - Showers and faucets (56%)
 - Cooling towers (22%)
 - Hot tubs (7%)
 - Decorative fountains (4%)
 - Industrial equipment (4%)



Source: Garrison LE et al. *MMWR*. 2016;65(22):557–61.

Most legionellosis cases in the United States are not associated with a known outbreak

Legionellosis cases reported among U.S. residents, 2005–2009



Source: Hicks L et al. *MMWR*. 2011;60(32):1083–6.

Two tests are preferred for diagnosing Legionnaires' disease

- ***Legionella* UAT**

- Detects *L. pneumophila* serogroup 1 (Lp1)

- **Culture of lower respiratory secretions (e.g., sputum, BAL) on selective media**

- Isolation of *Legionella* by culture is important for detection of **non-Lp1 species or serogroups** and to improve capture of Lp1
- Cultures are useful for **comparing clinical to environmental isolates** during an outbreak investigation

Urinary
antigen test

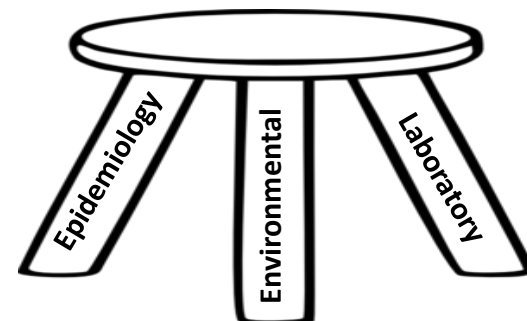


Legionella
growing on
BCYE plate



Source attribution can be challenging and requires a multidisciplinary response

- **Epi: Connecting dots between cases requires case diagnosis + identification of common exposures**
 - Cases are likely underdiagnosed
 - Not all cases are investigated thoroughly for possible exposures and epidemiologic links
 - Exposure information is not always captured by surveillance
- **EH: Capacity varies by jurisdiction**
 - For performing an environmental assessment to identify areas of risk for *Legionella* growth/transmission varies
 - For performing environmental sampling
- **Lab: Microbiologic comparisons support epidemiologic investigations**
 - Respiratory specimens for culture are not commonly obtained
 - Lab capacity for *Legionella* culture varies



Clinical and epidemiologic challenges

- Data suggest that current recommended criteria for *Legionella* testing may not be adequate ^{1,2}
- Pneumonia etiology studies suggest surveillance numbers underestimate incidence of patients requiring hospitalization for pneumonia due to *Legionella* ^{2,3,4}
- Current, representative burden estimates are needed
 - Waterborne disease burden analysis is underway at CDC

IDSA/ATS CAP Guidelines, 2007: clinical indications for *Legionella* testing

- ICU admission
- Failure of outpatient antibiotic therapy
- Active alcohol abuse
- Recent travel (within the past 2 weeks)
- Pleural effusion

Mandell L et al. *CID*. 2007;44:S27–72.

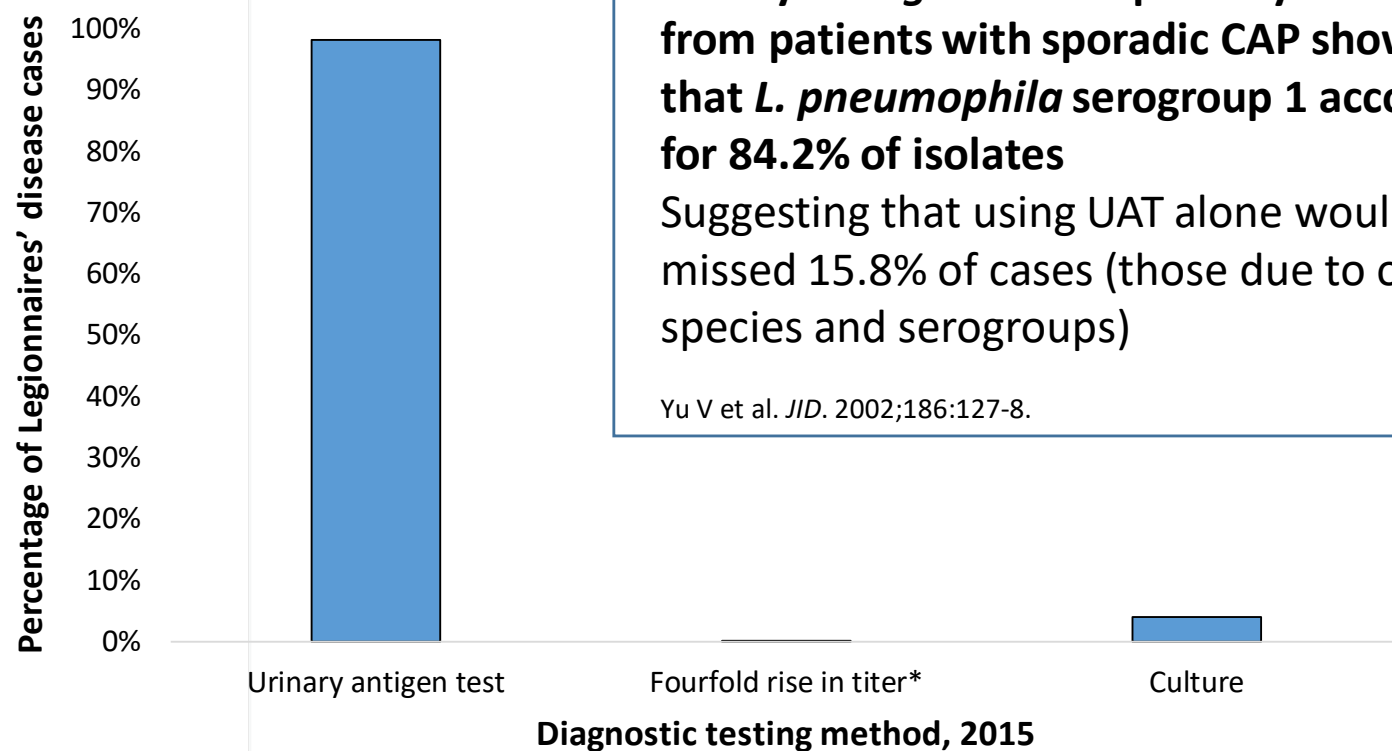
¹ Hollenbeck B et al. *BMC Infectious Diseases*. 2011;11(237):1–4.

² Decker B et al. *Annals ATS*. 2016;13(8):1289–93.

³ Marston B et al. *Arch Intern Med*. 1997;157:1709–18.

⁴ Jain S et al. *NEJM*. 2015;373(5):415–427.

Nearly all reported cases of Legionnaires' disease in the United States are diagnosed by UAT



***Four-fold rise in antibody titer to *Legionella pneumophila* serogroup 1**

From 24 complete reporting jurisdictions (those that report additional epidemiologic data for at least 90% of confirmed cases)

Source: Supplemental Legionnaires' Disease Surveillance System

For reported cases of Legionnaires' disease, what is known about possible exposures to *Legionella*?

- Basic demographic data are reported for all cases to CDC¹
- CDC requests additional information for all cases² about exposure to³:
 - Travel accommodations
 - Healthcare facilities
 - Assisted living/senior living facilities
 - Whirlpool spas/hot tubs
 - Respiratory therapy equipment
- This additional information is received from some but not all jurisdictions
 - Ex: 21 of 52 jurisdictions reported exposure information for at least 90% of confirmed cases in 2015 (2017 *MMWR* Vital Signs on healthcare-associated Legionnaires' disease⁴)
- More detailed case exposure information is not routinely reported to CDC in real-time

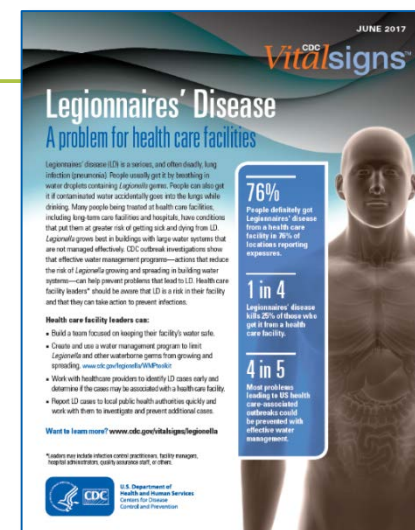
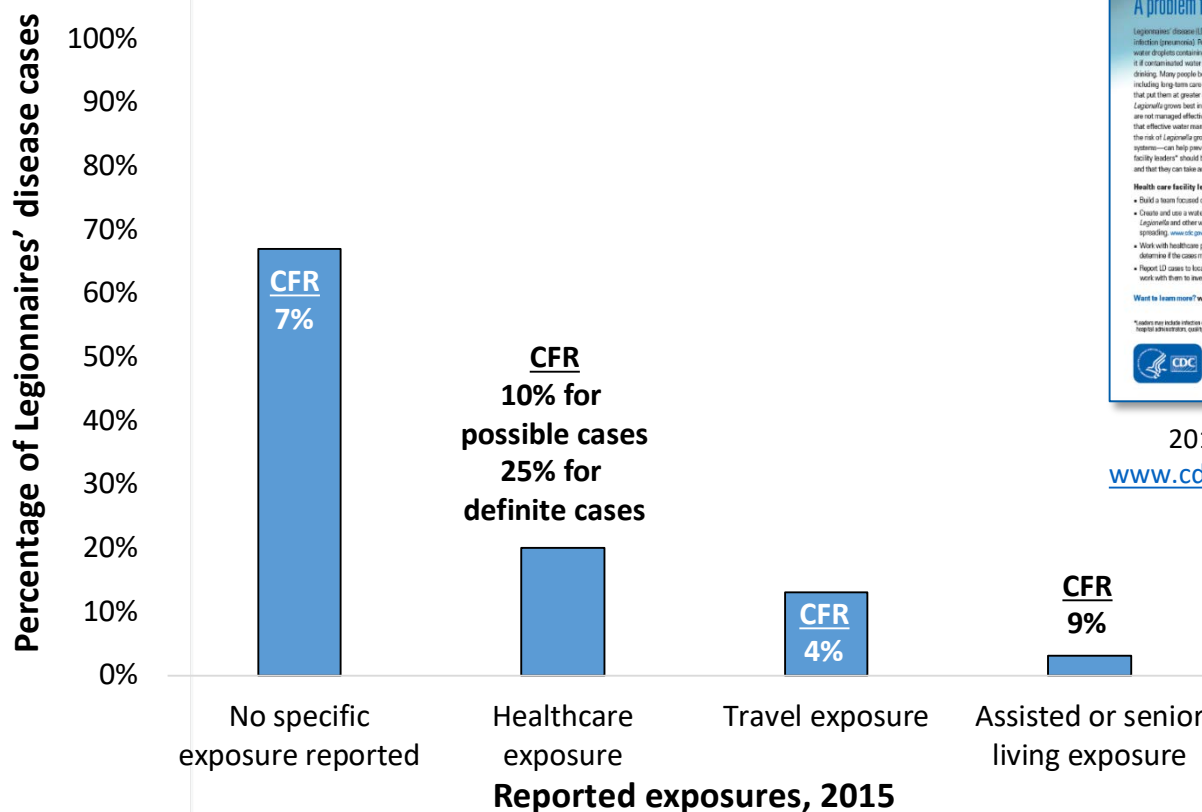
¹ National Notifiable Diseases Surveillance System

² Supplemental Legionnaires' Disease Surveillance System

³ <https://www.cdc.gov/legionella/downloads/case-report-form.pdf>

⁴ Soda EA et al. *MMWR*. 2017(22);66:584–89. (52 jurisdictions reporting: 50 states + New York City and Washington, DC)

A fifth of Legionnaires' disease cases reported exposure to a healthcare facility during the 10 days before date of symptom onset in 2015



2017 MMWR Vital Signs
www.cdc.gov/vitalsigns/legionella

Percentages are not mutually exclusive

CFR: case fatality rate

From 24 complete reporting jurisdictions (those that report additional epidemiologic data for at least 90% of confirmed cases)

Source: Supplemental Legionnaires' Disease Surveillance System

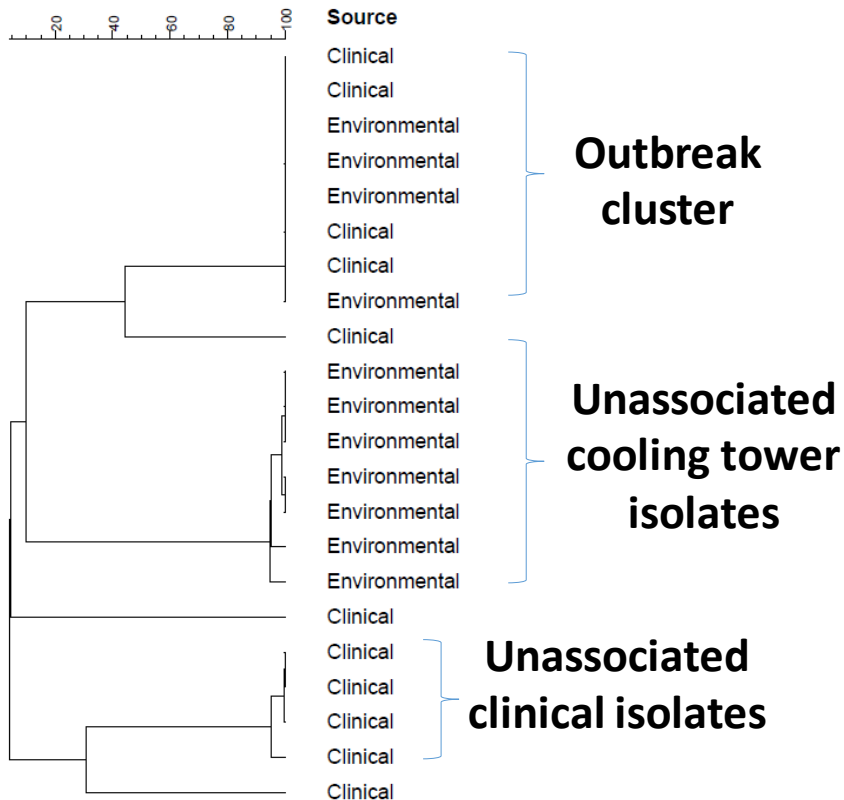
Environmental health expertise is key



- To prevent Legionnaires' disease we must understand **environmental** factors that allow *Legionella* bacteria to survive and reach susceptible host
- Laboratory + Epidemiology + **Environmental** expertise is needed to identify and control *Legionella* associated outbreaks
- Developing and adopting evidence-based **environmental** prevention practices = reducing risk of disease
- **Environmental** health Legionnaires' disease capacity is lacking completely or is inadequate in many states

Distinguishing *Legionella* using genome sequences

Community-associated outbreak – 2016

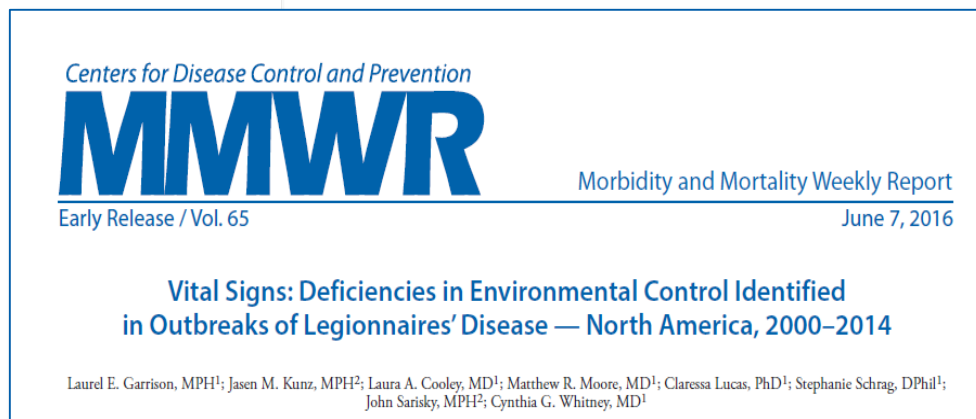


Whole genome MLST (wgMLST) conducted on isolates which can take weeks to recover from clinical specimens and environmental sources.

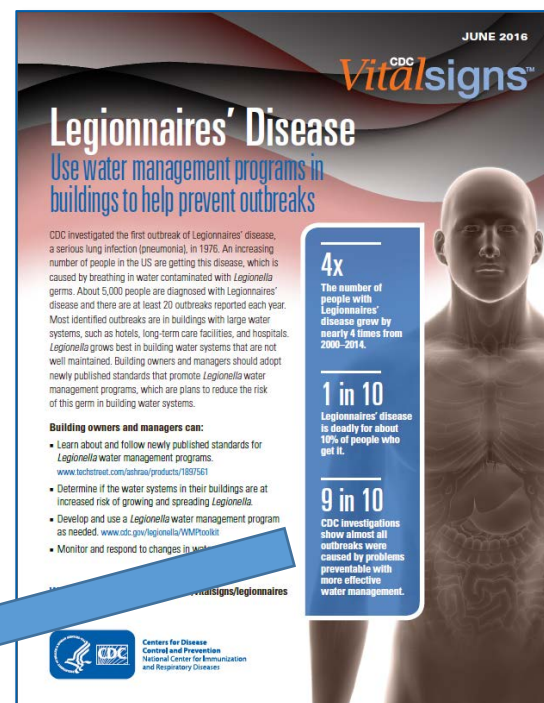
wgMLST demonstrates shared allele content between isolates in the outbreak cluster.

What can be done to prevent Legionnaires' disease?

- Inadequate water management programs can increase the risk of Legionnaires' disease

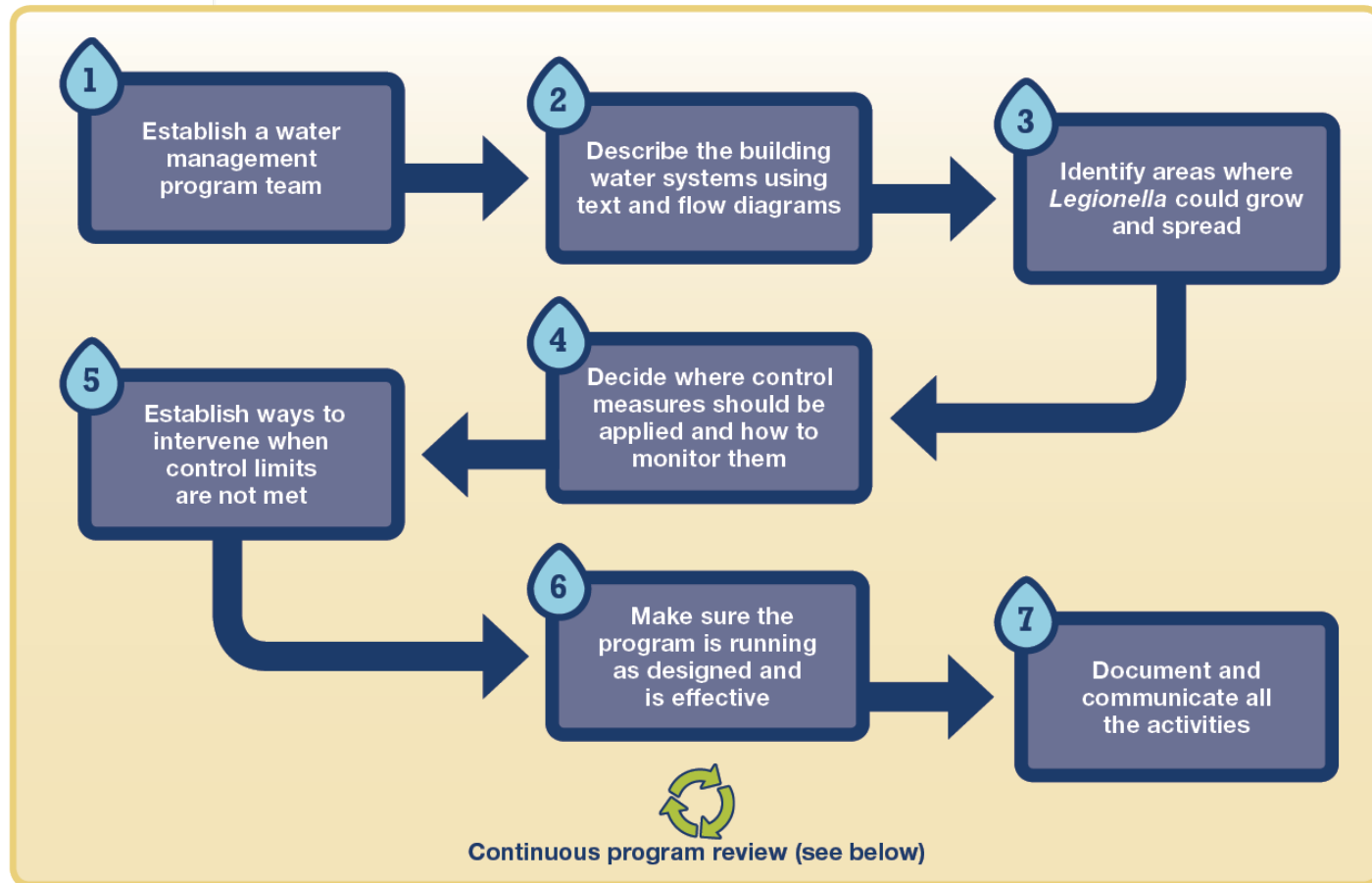


9 in 10
CDC investigations show almost all outbreaks were caused by problems preventable with more effective water management



2016 MMWR Vital Signs
www.cdc.gov/vitalsigns/legionnaires

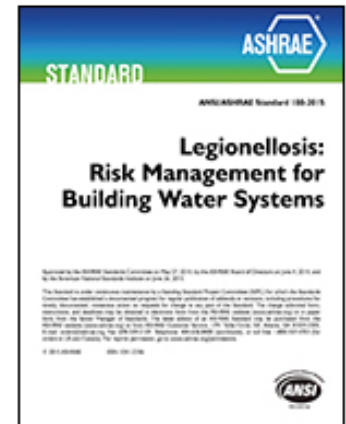
Steps in a water management program



www.cdc.gov/legionella/WMPtoolkit

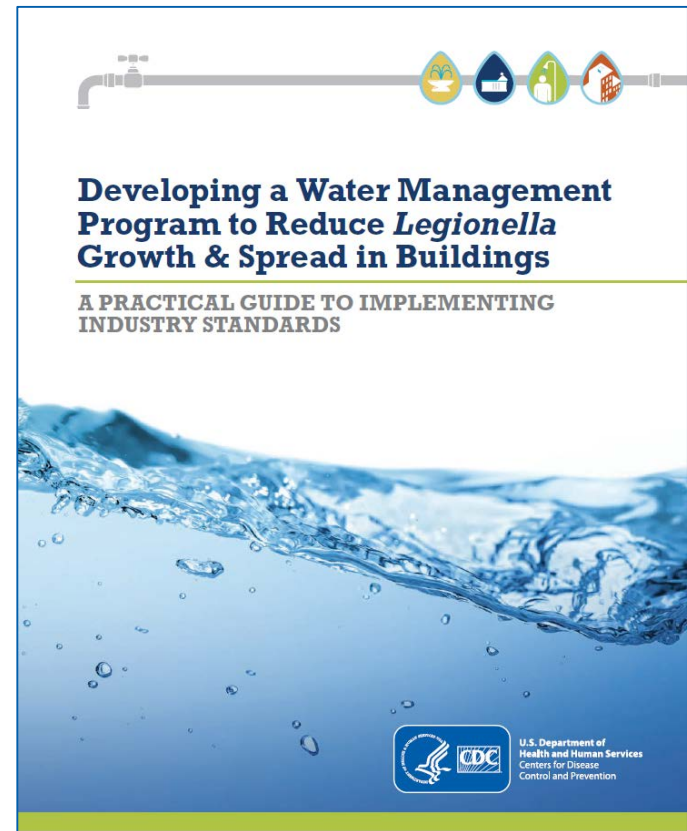
Primary prevention of Legionnaires' disease

- Ensuring proper maintenance of building water systems and aerosol-generating devices is key
- Current guidelines, standards, and protocols
 - HICPAC (2003, 2004)
 - ASHRAE Guideline 12 (2000)
 - VHA Directive 1061 (2014)
 - **ASHRAE Standard 188 (2015)**
 - AIHA Guideline (2015)
 - NYC/NYS regulations (2015, 2016)
 - NSF 453 (2017)
 - CMS Memo (2017)
 - Others in development (NSF 444, ASHRAE 12 revision, others)



Translating ASHRAE 188 for wider audiences

- CDC *Legionella* water management program toolkit
- Plain language
- Step-by-step guide to creating a water management program



www.cdc.gov/legionella/WMPtoolkit

Pulse Check: Water management program uptake

- CMS released requirement for water management programs in hospitals and skilled nursing facilities in June 2017¹
- 2017 survey of 84 hospitals in Minnesota² conducted prior to the release of the CMS memo revealed:
 - 27% had a water management program
 - 51% had knowledge of ASHRAE 188
 - 76% expressed interest in the health department providing assistance in setting up a program
- Since release of CMS memo:
 - Requests for CDC technical assistance have increased
 - Downloads of CDC toolkit have increased
 - 12,700 (during 12 mo prior) to 23,600 (during 8 mo following)

¹ <https://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/SurveyCertificationGenInfo/Downloads/Survey-and-Cert-Letter-17-30.pdf>

² Danila R et al. *Infect Control Hosp Epidemiol*;2018:1-3.



What's needed from clinical and epidemiologic perspectives?

- **Increased use of appropriate *Legionella* testing among patients at risk**
 - UAT *and* respiratory culture
- **Development of better, quicker diagnostic options**
- **Improved understanding of potential sources of exposure to *Legionella*, especially for sporadic cases**
 - Increased capacity to investigate cases and to identify possible sources and common exposures
 - Increased capacity to perform environmental assessments and water sampling

What's needed from the environmental health perspective?

- **Environmental health Legionnaires' disease expertise at the state and local levels**
- **Research to measure and describe effectiveness of water management programs in varying devices and settings**
- **Improved understanding of:**
 - Barriers to uptake of water management programs
 - Features of different water systems that make them more or less likely to support *Legionella* growth
 - The role of policies, regulations, codes, and guidelines in prevention of Legionnaires' disease

What's needed from the laboratory perspective?

- **Improved detection and typing (clinical & environmental)**
 - Culture can take 1-2 weeks. Culture-independent diagnostic tests can dramatically reduce the time-to-result.
 - Can we detect more cases? Are our assumptions based on current diagnostics accurate?
- **Increased informatics/databases to discern more risky strains recovered from the environment**
 - Promote more genome sequencing; not just clinical isolates
- **More baseline data**
 - Prevalence of *Legionella* in various settings (healthcare, sporadic, etc.)
 - Geographical differences among strain populations



Questions?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.