LEGIONELLA PNEUMOPHILA

What It Is and How To Navigate Through an Outbreak

JAMIE MUNDA

- Nalco Water – Water Safety Industry Technical Consultant (2017)
- Dow Chemical – Senior Microbiologist / Industrial Hygiene Auditor (2006)
- University of Illinois – B.S. Molecular Cellular Biology
- Avid Baseball Fan
- Married to Steve
- Mom to 3

AGENDA

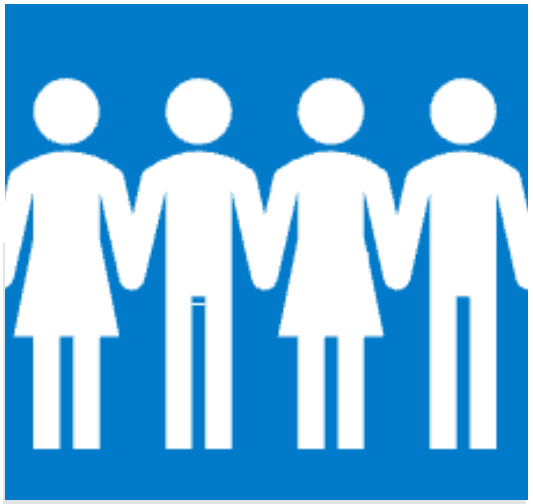
- *Legionella* Review
- Post Implementation of QSO (CMS) 17-30
- I got a “POSITIVE” – Time to Take Action!
- Defining a *Legionella* Outbreak & the Investigation Process
- Short Term/Long Term Control Strategies

WATER SAFETY – ESSENTIAL TO MANAGE RISK

PROTECTING WHAT MATTERS MOST

PATIENT

STAFF



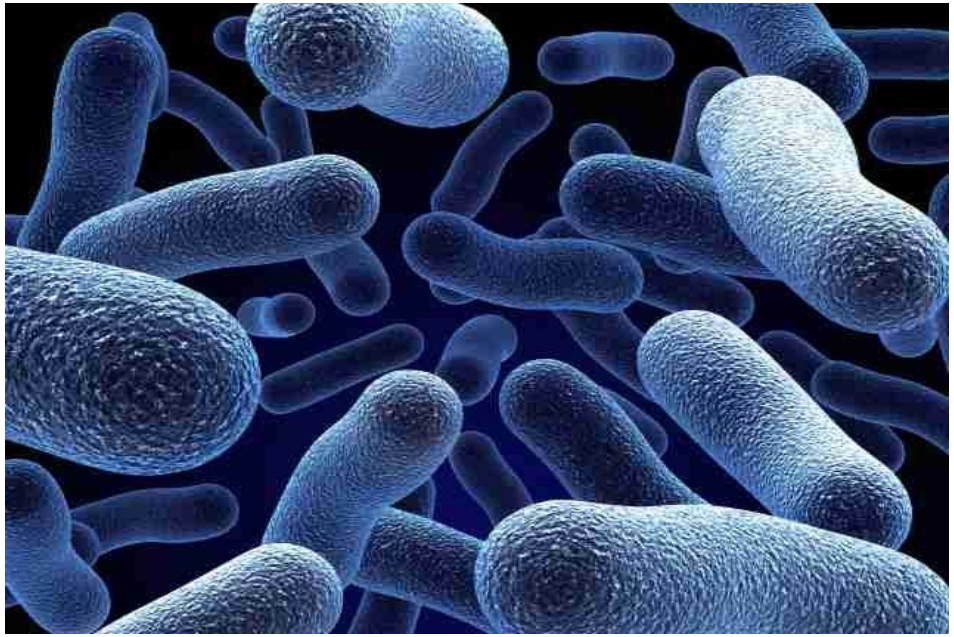
COMMUNITY

BRAND

1ST LEGIONNAIRES' DISEASE OUTBREAK

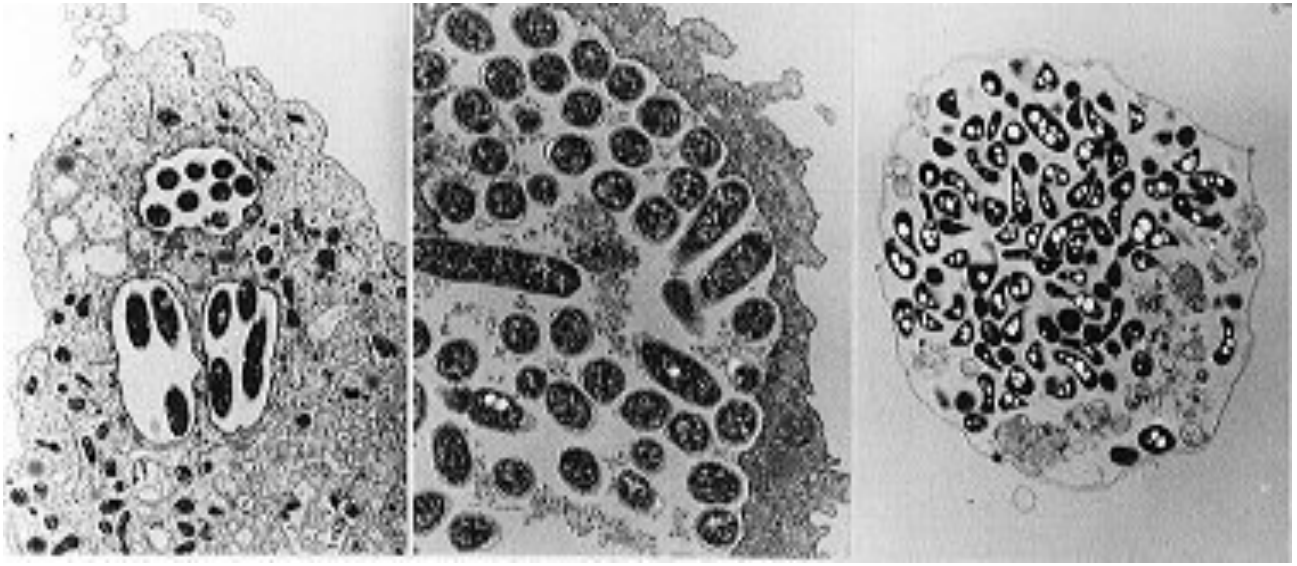
- Disease first recognized in 1976
- Infection occurred in attendees at American Legion's state convention in Philadelphia (Bellevue-Stratford)
  - 221 cases, 34 deaths
- After months of research, CDC identified causative agent – a bacteria
  - Bacteria was named *Legionella pneumophila*
- Source unknown initially, *Legionella* eventually found in cooling tower

LEGIONELLA



- Gram-negative, rod like bacterium found in fresh water environments
- > 60 species of *Legionella*
- ~90% of LD cases caused by *Legionella pneumophila*

- Grows inside amoebae which provides protection & nutrients
- Can grow & amplify in human designed water systems



LEGIONELLOSIS

- Legionnaires' Disease (LD)
  - Atypical pneumonia
  - Hospitalization common
  - Incubation ¬ 2-14 days after exposure
  - 6,000 – 18,000 cases/year in USA
  - Fatality rate more than 10%
- Pontiac Fever
  - Less-severe influenza-like illness
  - Hospitalization uncommon
  - Incubation ¬ 24-72 hrs after exposure
  - # of cases/year unknown
  - Not typically fatal

Inhaled as an aerosol or mist

Aspirating water or ice chips has caused disease (rare cases)

Not considered contagious

Drinking contaminated water does NOT cause legionellosis

WHO IS AT RISK?

- > 50 years of age
- Smokers
- Immunocompromised
- Existing Respiratory Disease

1

MUNICIPAL WATER SOURCE

Legionella bacteria can enter the water as an “escapee” from the water treatment facility

2

WATER MAIN DAMAGE

Water infrastructure failures can allow bacteria to enter the drinking water system

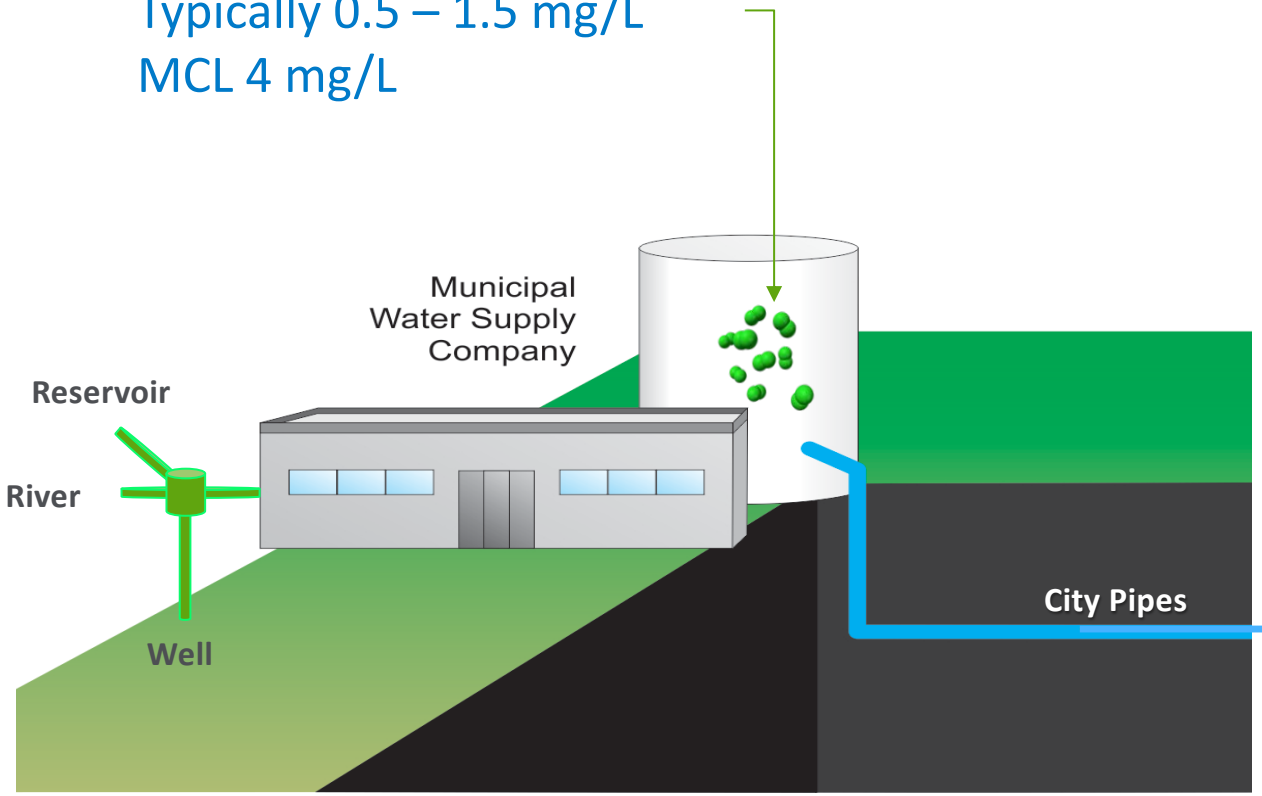
3

CONSTRUCTION

“Stowaway” *Legionella* bacteria can enter a plumbing system during installation or repair

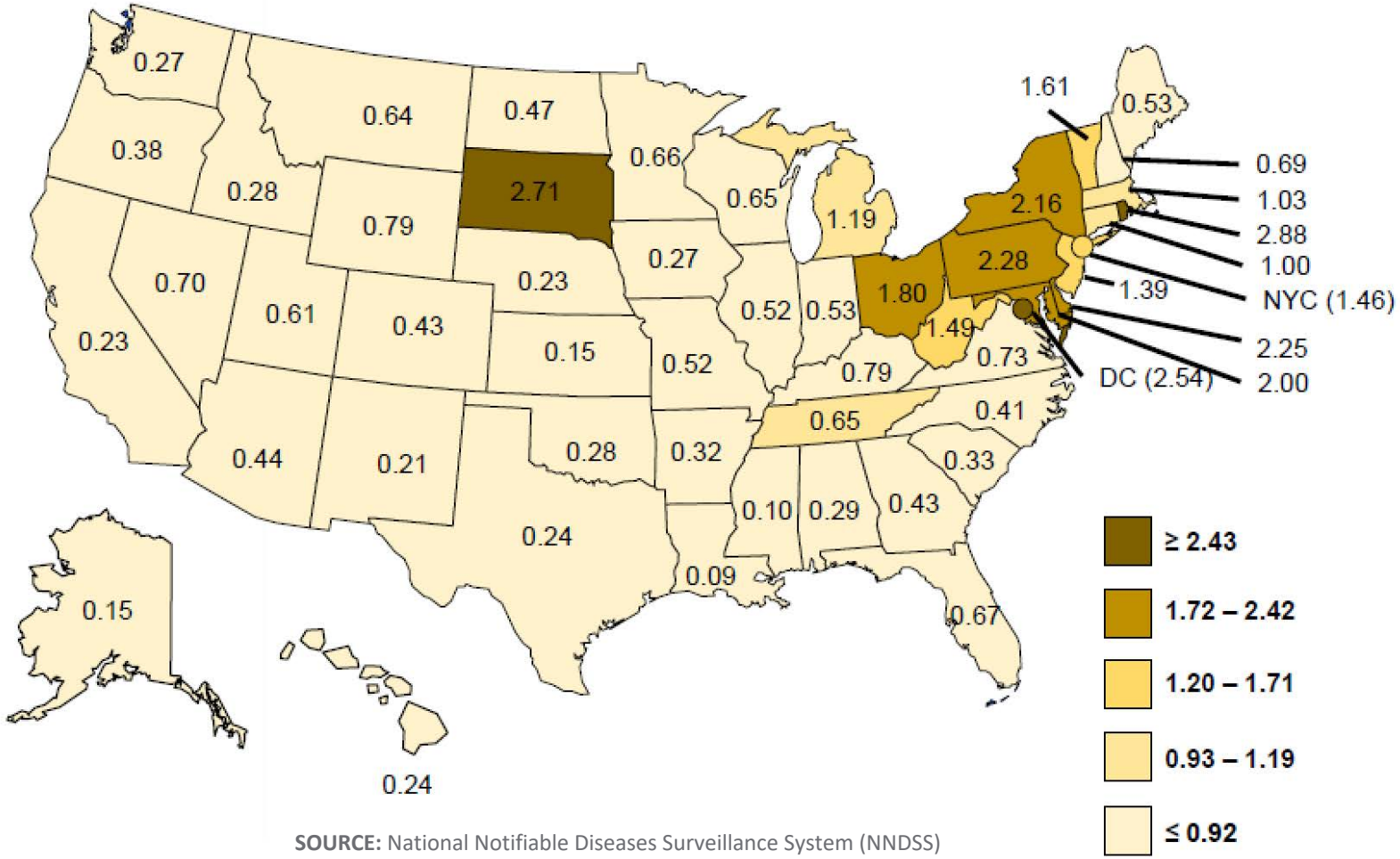
WATER IS NOT STERILE

Chlorine or Chloramine
Typically 0.5 – 1.5 mg/L
MCL 4 mg/L



2005 LEGIONELLOSIS CASES

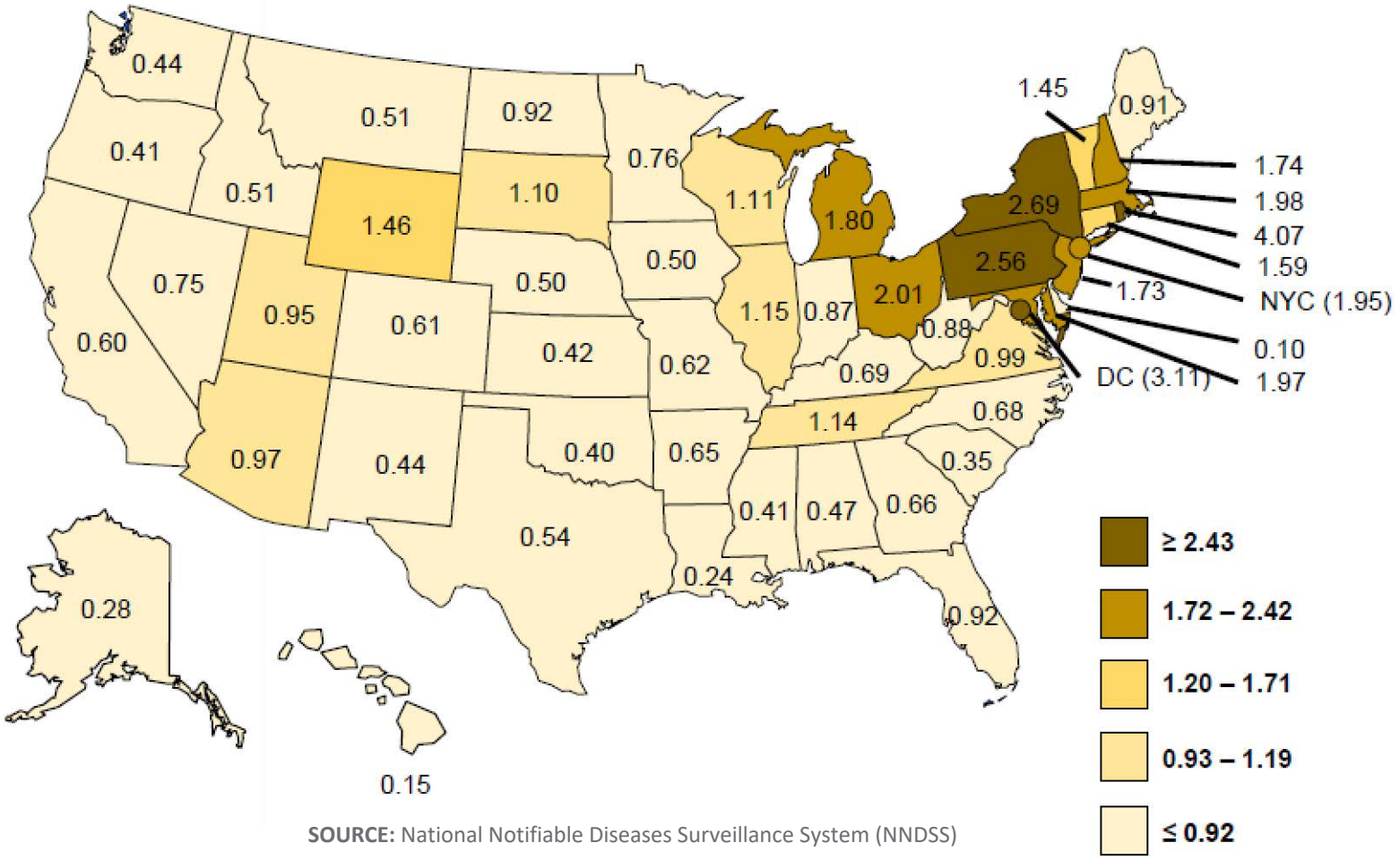
Rates of reported legionellosis cases by state / 100,000 Population



SOURCE: National Notifiable Diseases Surveillance System (NNDSS)

2010 CASES - INCREASE APPARENT

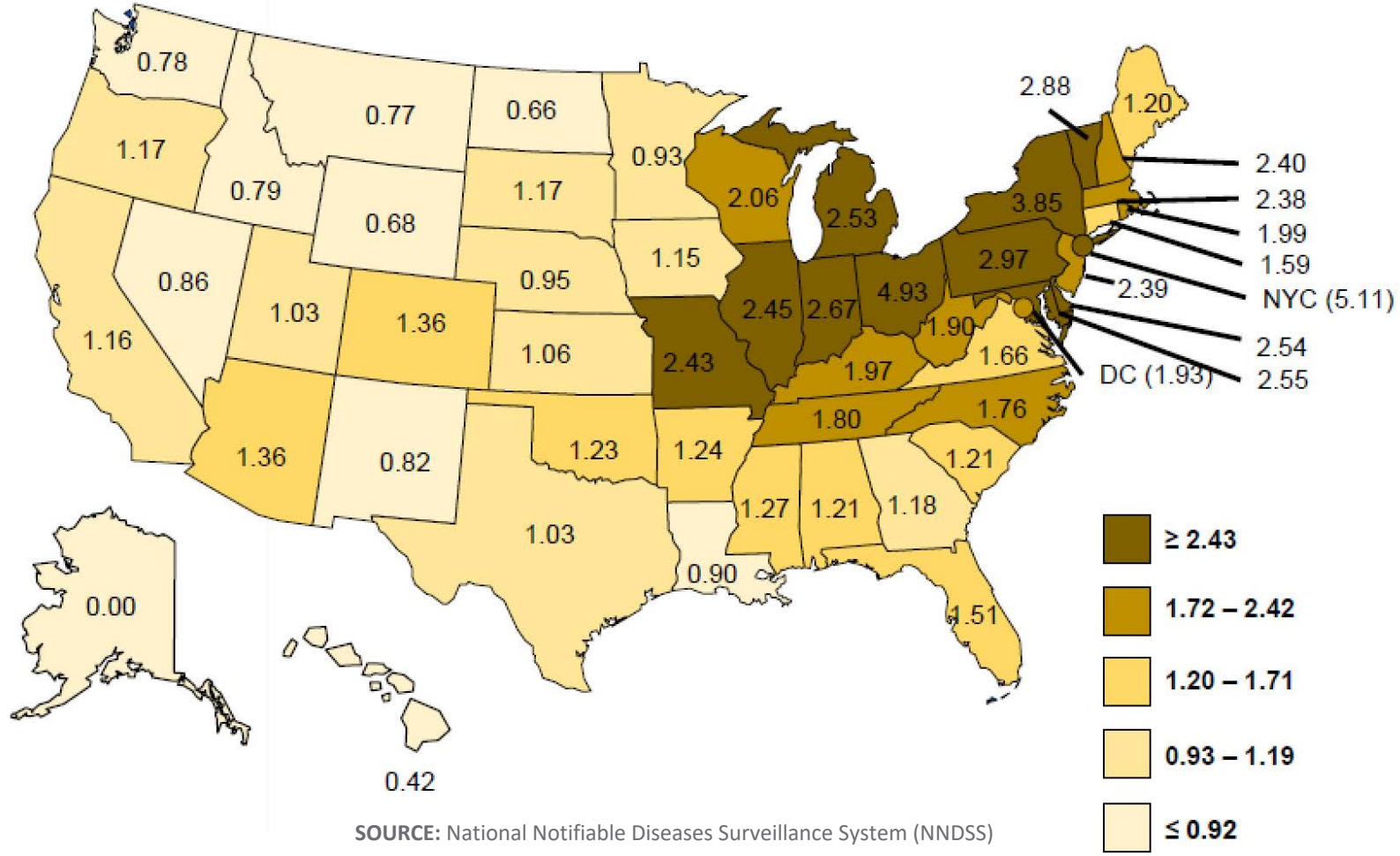
Rates of reported legionellosis cases by state / 100,000 population



SOURCE: National Notifiable Diseases Surveillance System (NNDSS)

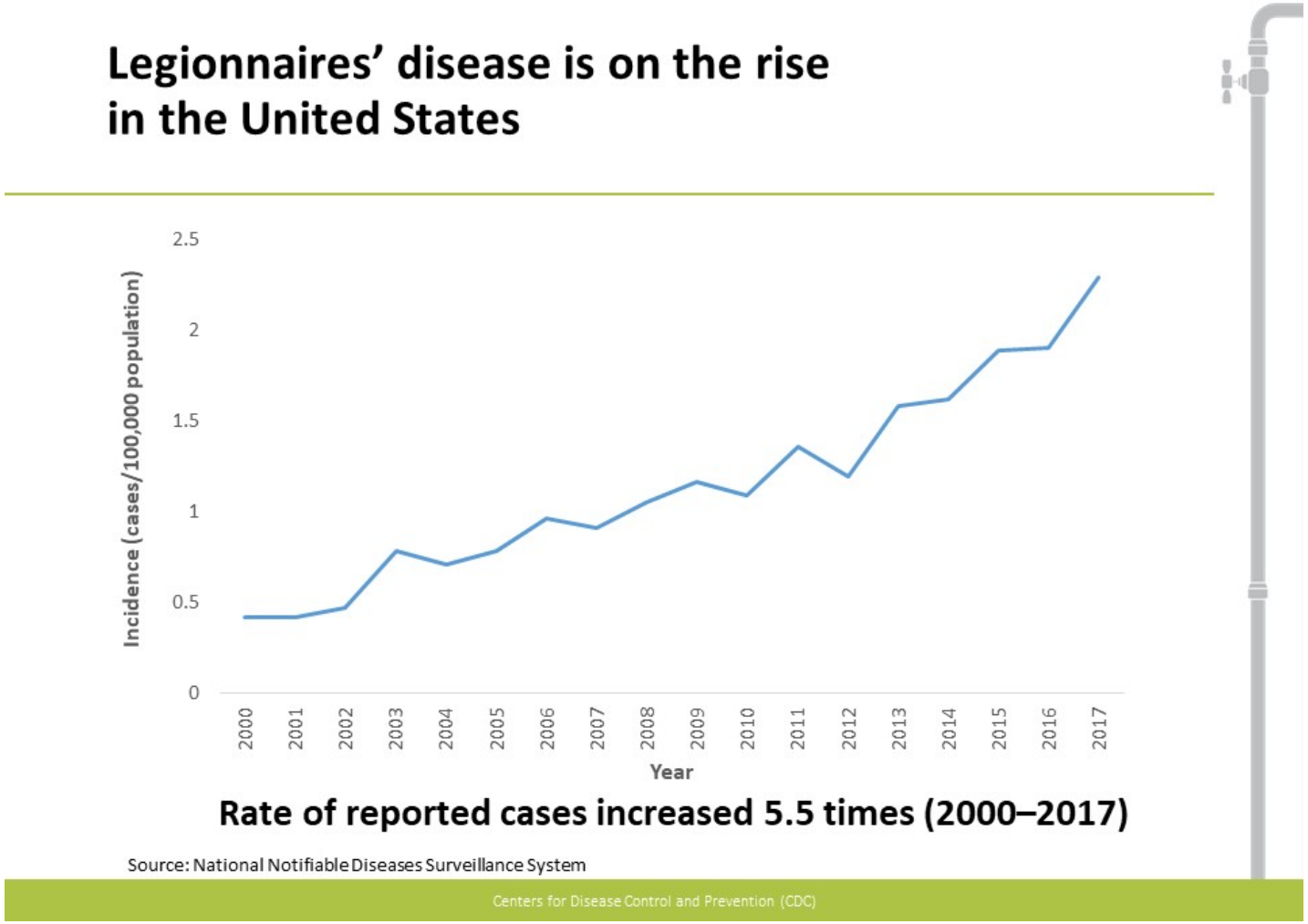
2015 CASES - INCREASE CONTINUES

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



SOURCE: National Notifiable Diseases Surveillance System (NNDSS)

LEGIONNAIRES DISEASE IS ON THE RISE



Possible Reasons

- Urine antigen test
- Increased awareness, more testing
- Aging population, more immunocompromised people
- More engineered water systems
- Aging infrastructure
- Water-saving building modifications

ASHRAE STANDARD 188 – JUNE 2015

American Society of Heating, Refrigerating and Air-Conditioning Engineers

Mandates building owners and managers to establish a **water management program**

Applies to almost every type of human-occupied building

Intended for use by owners and managers of buildings

Intended for those involved in the construction, commissioning, maintenance, and service of building water systems

First US Standard to define the minimum legionellosis risk management requirements for building water systems

CMS REQUIREMENT S&C 17-30

Centers for Medicare and Medicaid Services (CMS)

- A facility must
  - Conduct a Risk Assessment
  - Implement a Water Management Program per ASHRAE Standard 188 & CDC Toolkit
  - Define and specify testing protocols, control measures/limits & document specific actions
- Developed to prevent illness caused by Legionella and other opportunistic pathogens in water

THE JOINT COMMISSION

Relevant Standards to Address Infection Prevention & Control

Standard	Definition
EC.01.01.01	Hospital has written plan for managing utility systems
EC.02.01.01	Organization manages safety & security risks
EC.02.05.01	Organization manages risks associated with utility systems
EC.02.05.05	Organization inspects, tests & maintains utility systems
IC.01.03.01	Organization identifies risks for acquiring & transmitting infections
IC.01.05.01	Organization has an infection prevention (IP) & control plan
IC.02.01.01	Organization implements its IP & control plan
IC.03.01.01	Organization evaluates effectiveness of its IP & control plan

THE JOINT COMMISSION

Demonstrating Compliance

FACILITY RISK ASSESSMENT

1

IDENTIFY WHERE BACTERIA COULD GROW & SPREAD

WATER MANAGEMENT PROGRAM

2

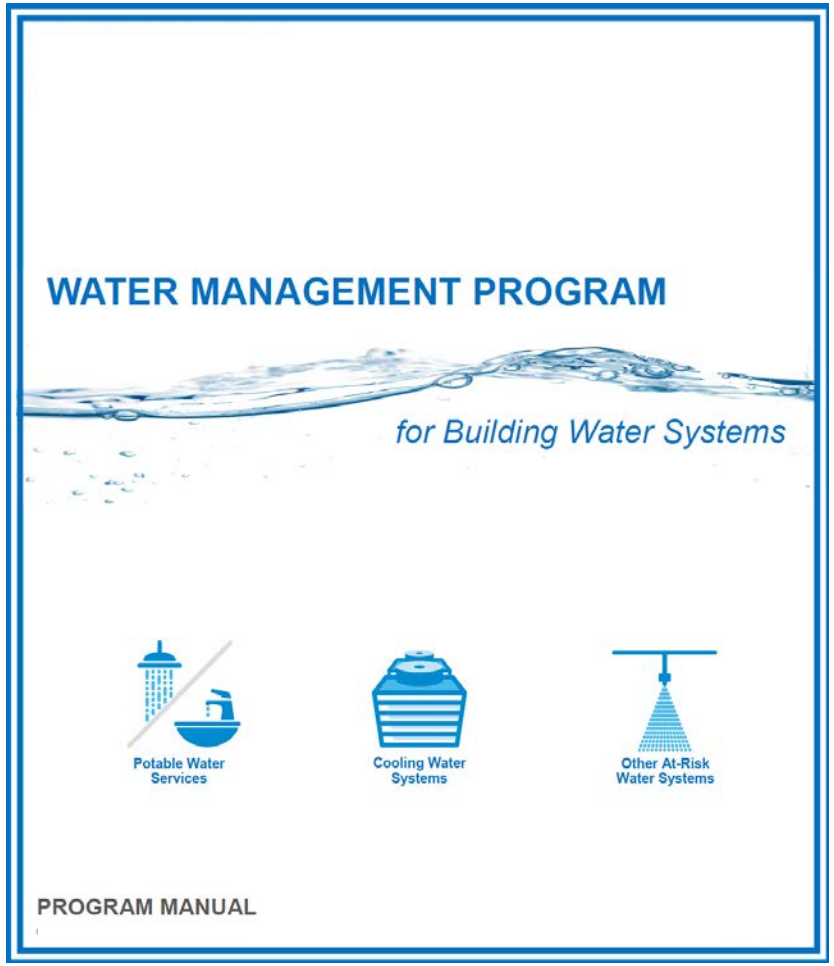
CONSIDER ASHRAE ST. 188 & CDC TOOLKIT

DEFINED TESTING PROTOCOLS & ACCEPTABLE RANGES

3

RESULTS OF TESTING & CORRECTIVE ACTIONS

WATER MANAGEMENT PROGRAM



=

Complete guide for the prevention and control of *Legionella* within building water systems.

EMERGENCY

I GOT A POSITIVE, TIME TO TAKE ACTION!

EMERGENCY – POSITIVE *LEGIONELLA* TEST

My *Legionella* test results came back positive……now what?

- Test results are validating an issue and telling you about your system
- Results ONLY have to be reported to public health authorities IF there is a suspected or confirmed case of *legionellosis*

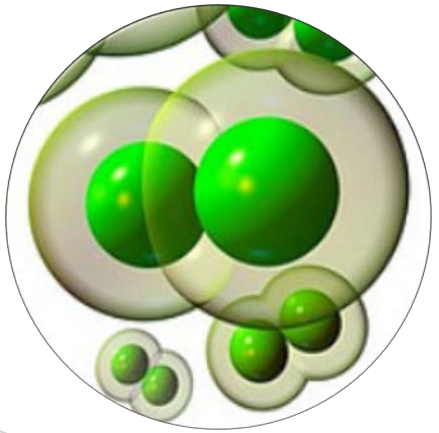
Check your Contingency Response Plan in your Water Management Program

- Procedures for emergency disinfection of potable water systems
- Procedures to be followed if there are known or suspected cases of *legionellosis*

IMMEDIATE RESPONSES

Common Actions to Address & Reduce the Immediate Risk

- Outlet Flushing
- Outlet Cleaning
- Point-of-Use Filters
- Hyperchlorination
- Thermal Shock Treatment



TEMPERATURE & OXIDANT PROFILING

How Water Moves Once It Enters Your System

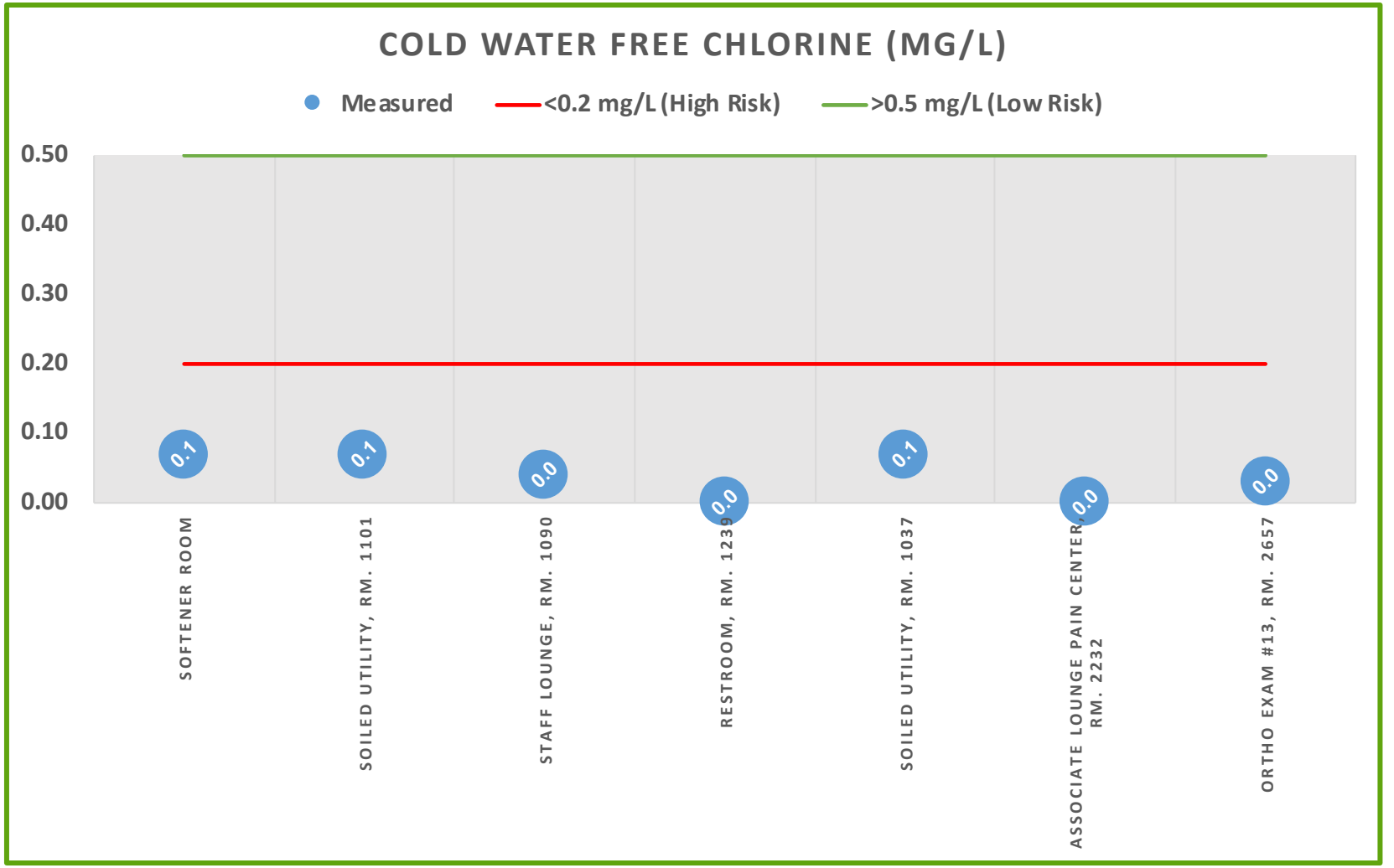
- Highlight areas of stagnation and low-use
- Identify cross connections between hot and cold water systems

PROCESS:

- Temperature and Chlorine levels are recorded throughout the entire facility
- Results are plotted on a graph
- Compare systems, buildings, floors, risers, loops to find trends and help identify areas that may be of concern

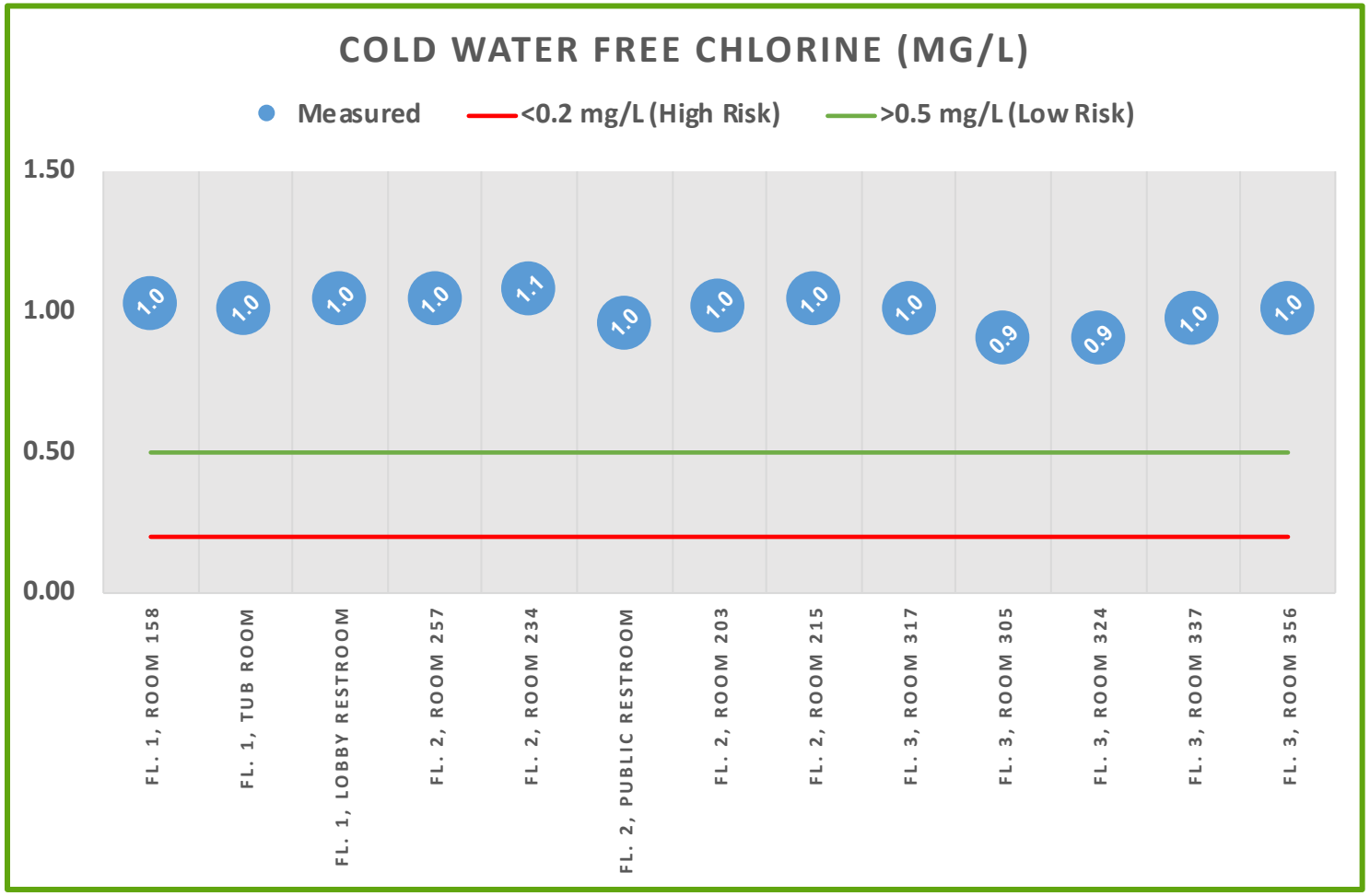
INVESTIGATING SYSTEM PROFILES

Real-Life Example



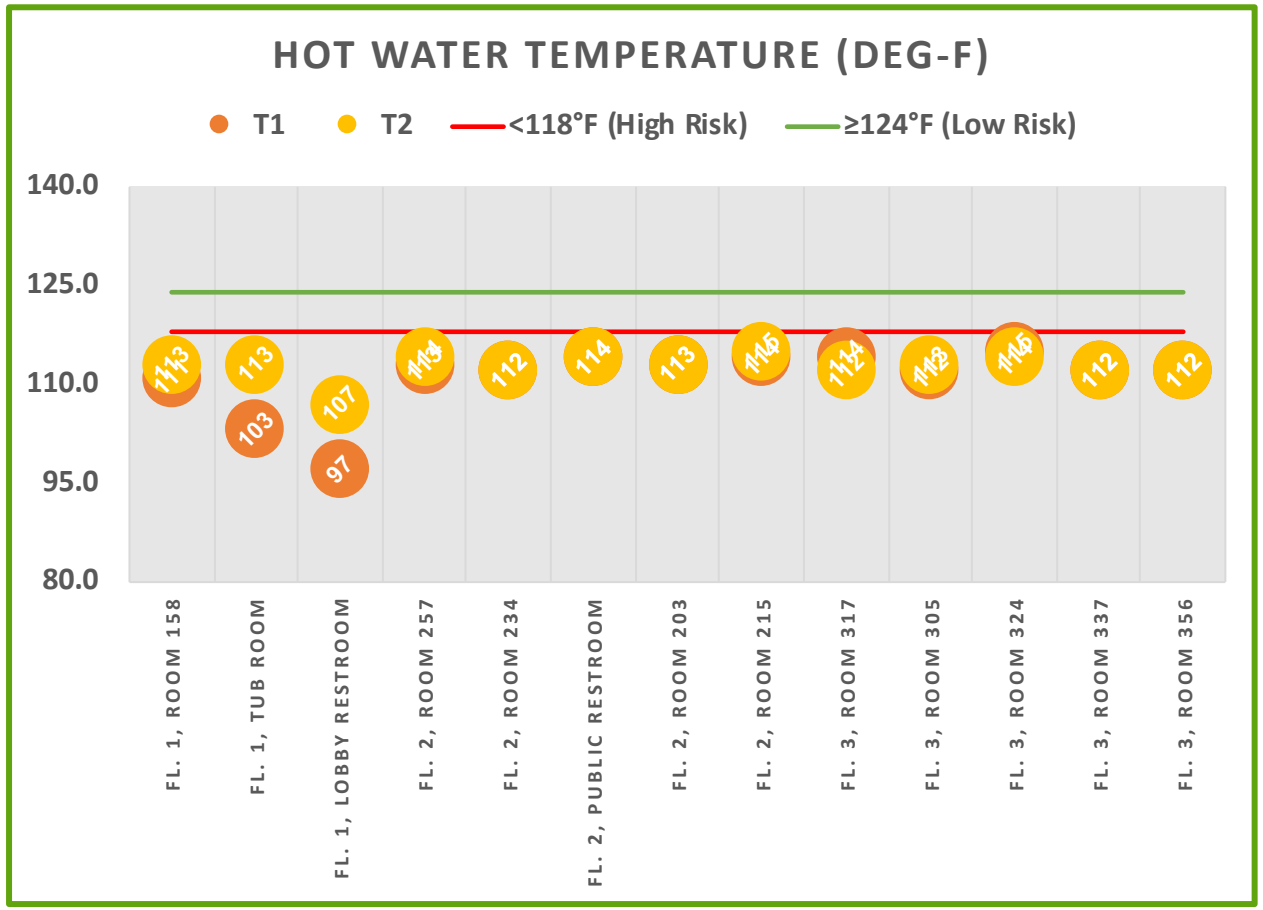
INVESTIGATING SYSTEM PROFILES

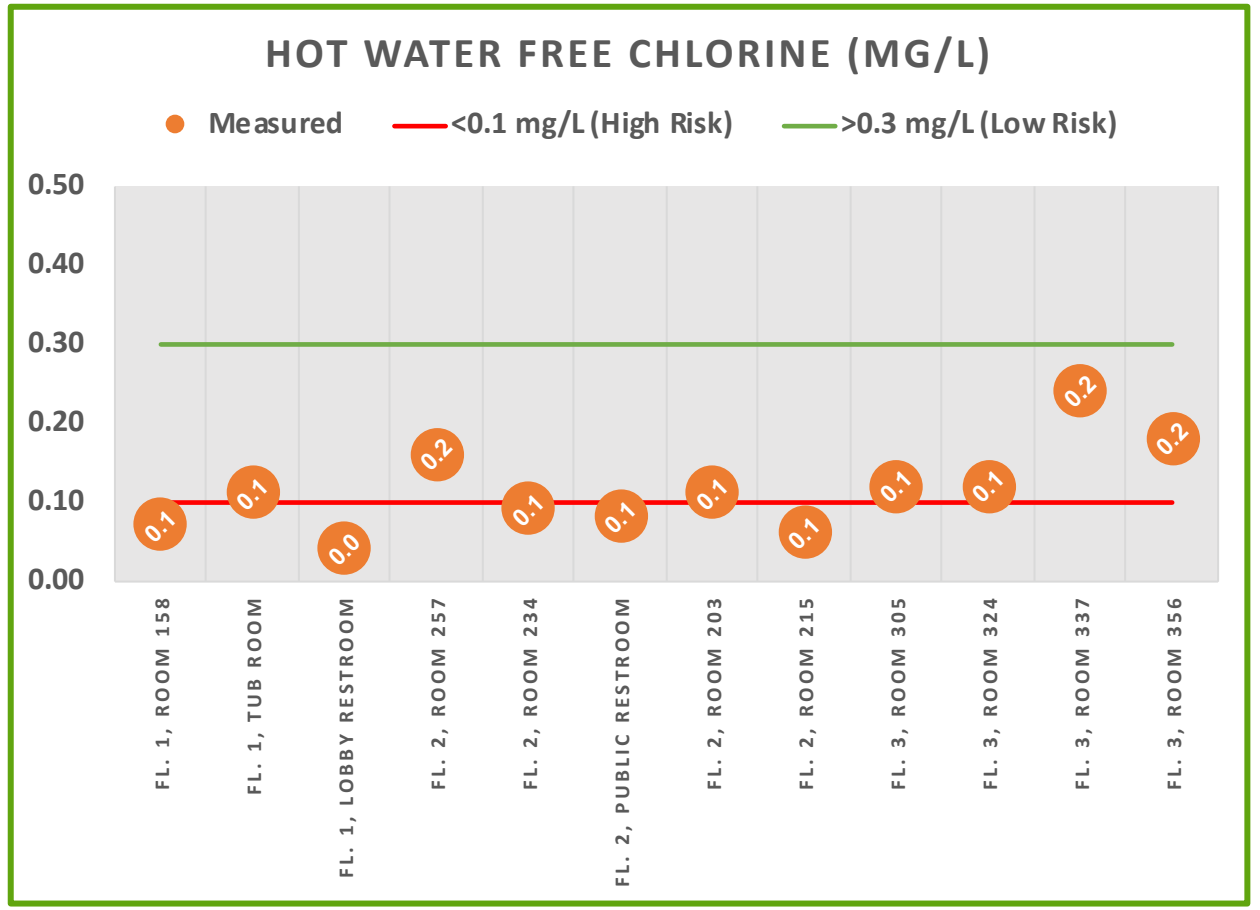
Real-Life Example



INVESTIGATING SYSTEM PROFILES

Real-Life Examples



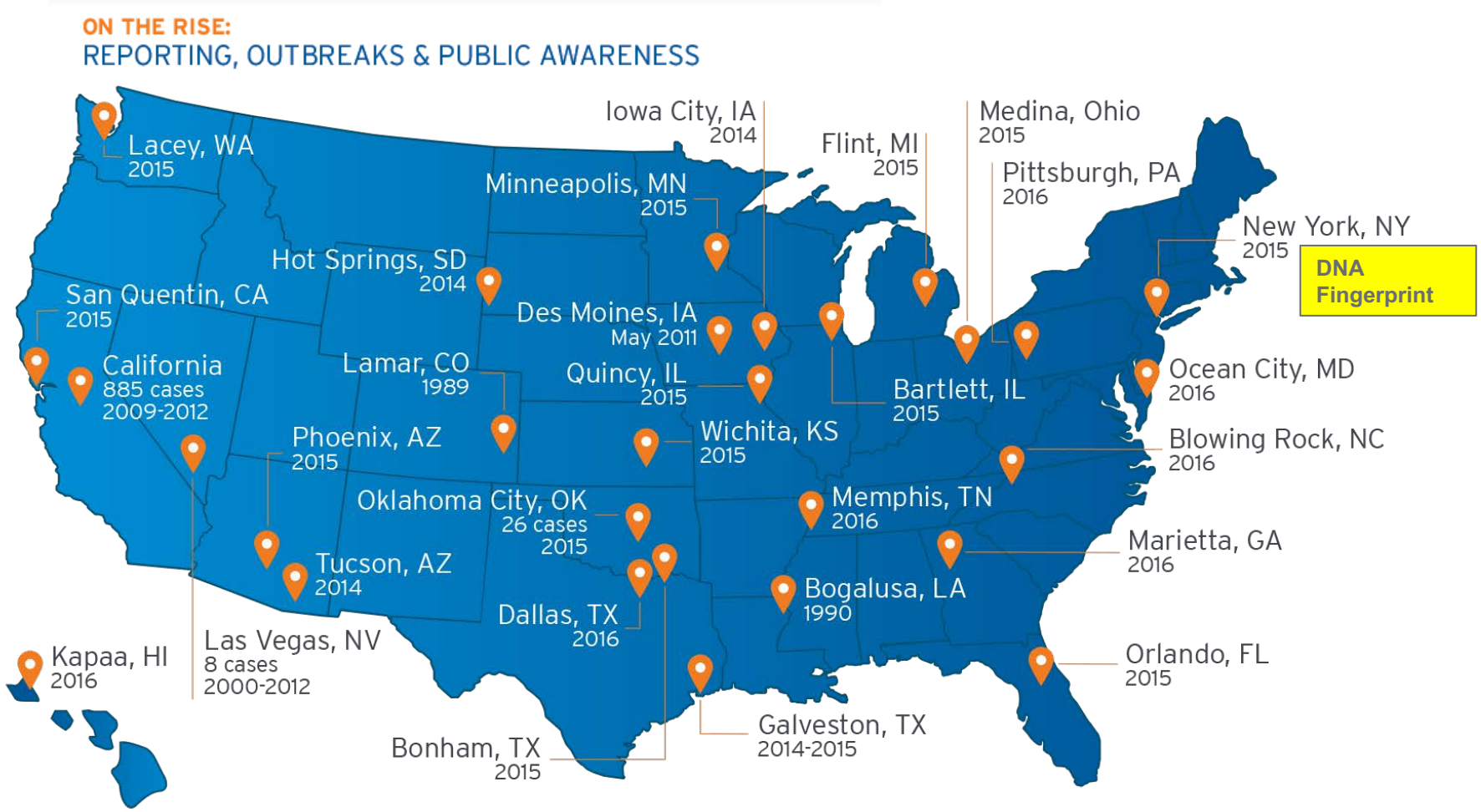


- EMERGENCY -

A *LEGIONELLA* INCIDENT or OUTBREAK

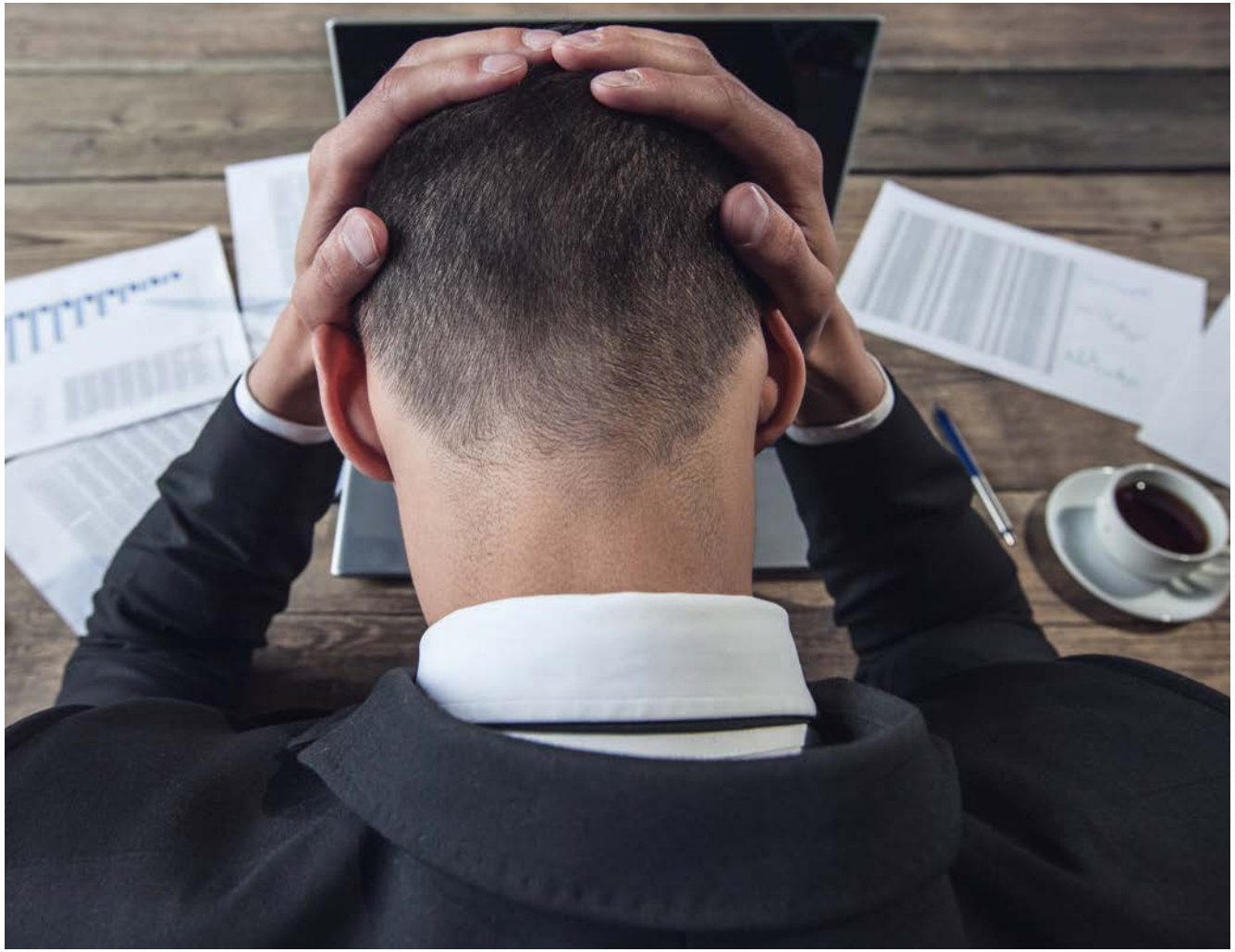
THE INVESTIGATIVE PROCESS

LEGIONELLA: OUTBREAKS



POTENTIAL OUTBREAK CONSEQUENCES

- Outbreak Ensues Chaos
- Investigation & Remediation Costs
- Temporary Shutdown - Production & Revenue Loses
- Litigation, Fines or Civil Lawsuits
- Damage to Brand / Facility Reputation
- Increased Insurance Premium



OUTBREAK INVESTIGATIONS

Defining the Outbreak Case Type

Definite Healthcare-Associated Case

Patient spent entire 10 days before date of symptom onset in a healthcare facility

Possible Healthcare-Associated Case

Patient spent a portion of the 10 days before date of symptom onset in a healthcare facility

A Full Investigation is Conducted if…

- ≥ 1 case of Definite Healthcare-Associated Legionnaires Disease at any time
- ≥ 2 cases of Possible Healthcare-Associated Legionnaires Disease within 12 months

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK INVESTIGATION

Communication Considerations

- Be prepared – consider establishing a communications plan for outbreaks ahead of time
- Develop key messages and coordinate early and often
- Do not speculate – only provide information
- Gauge public concern and address accordingly
- Discuss with staff how to notify employees, visitors & patients
- Encourage anyone who has symptoms to see a healthcare provider

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK FULL INVESTIGATION

Part 1 • Retrospective Review of Cases

- Search Health Department surveillance database for other reported cases
- Review of Facility routine surveillance for healthcare-associated pneumonia
- Create line list defining past 12 months pneumonia cases to determine if they were healthcare-associated
- Review of Facility *Legionella* testing protocol and any positive results
- Identify all new and recent patients with healthcare-associated pneumonia and test them for *Legionella*

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK FULL INVESTIGATION

Part 2 • Active Clinical Surveillance

- Review protocol for active clinical surveillance with public health official
- Identify all new and recent patients with healthcare-associated pneumonia and test them for *Legionella*
  - Daily review of chest radiographs and CT scans to diagnose pneumonia
  - Daily review of new pneumonia diagnoses in intensive care units
  - Daily review of laboratory testing ordered to diagnose pneumonia
- Obtain post-mortem specimens, when applicable

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK FULL INVESTIGATION

Part 3 • Implementation of Immediate Control Measures

- Water Restrictions
  - Restricting Showers
  - Avoiding exposure to hydrotherapy tubs
  - Avoiding use of water from sink/tub faucets
  - Using bottled or sterile water
  - Avoiding consumption of non-sterile ice
  - Halting new admissions or temporarily closing the affected area(s)

NOTE: Periodic flushing may be necessary to avoid stagnation in facility systems due to water restrictions.

- Point-of-Use Filters
  - At a minimum, 0.2 micron biological filters on any showerheads or sink/tub faucets intended for use
  - May need to be removed during remediation procedures

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK FULL INVESTIGATION

Part 4 • Perform an Environmental Assessment

- Used to gain thorough understanding of a facility's water systems and identify possible environmental sources of *Legionella*
- Monitoring of Water Quality Parameters
  - Temperature
  - pH
  - Residual Disinfectant
- Determine sampling plan for *Legionella* environmental testing

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK FULL INVESTIGATION

Part 5 • Perform Environmental Sampling

- Used to characterize extent of *Legionella* colonization within water system
- Sampling Plans based upon
  - Environmental Assessment
  - Building Characteristics
  - Possible exposure sites
  - Available resources/supplies to support sampling
- Important for verifying remedial actions are working

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

TYPES OF ENVIRONMENTAL SAMPLING

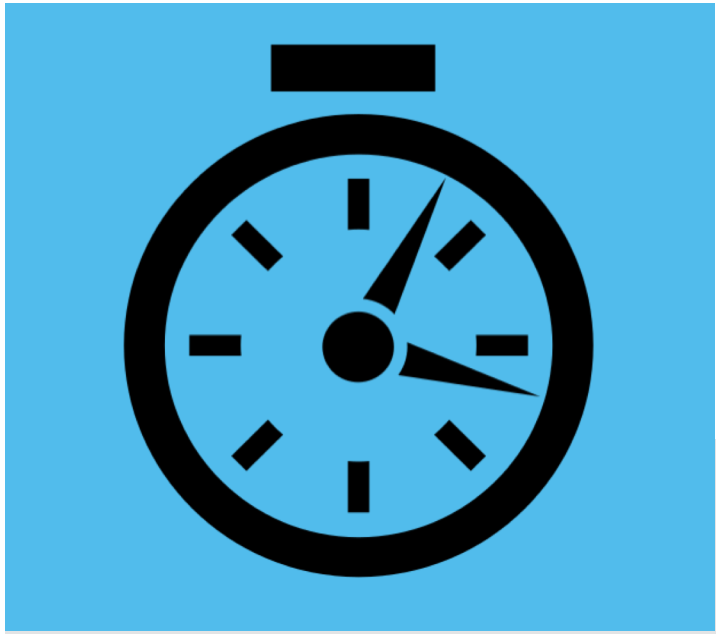
CULTURE TEST ISO 11731

Industry accepted “Gold Standard”

qPCR

(QUANTITATIVE POLYMERASE CHAIN REACTION)

Rapid method used to detect & quantitate bacteria, used as a positive or negative screen



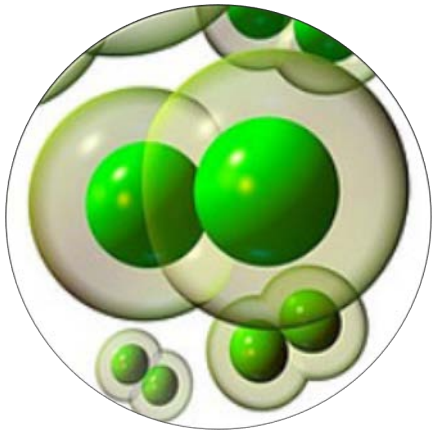
OTHER RAPID METHODS

Emerging methods that may have limitations to detect low levels and limited to one or a few species.

OUTBREAK FULL INVESTIGATION

Part 6 • Remedial Procedures – Potable Water Systems

- Outlet Cleaning Procedure
- Outlet Flushing Procedure
- Superheating & Flushing Procedure
- Hyperchlorination



OUTBREAK FULL INVESTIGATION

Part 7 • Determining the End of the Outbreak

- No new cases of Legionnaires' Disease
- No detection of *Legionella* in post-remediation environmental samples

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

OUTBREAK FULL INVESTIGATION

Part 8 • Environmental Sampling Following an Outbreak

- *Legionella* can regrow following remediation events if conditions are right
- Follow up sampling approach, as described in HICPAC Guidance
  - Collect Environmental Samples for culture at 2-week intervals for 3 months
  - If *Legionella* is not detected after 3-months, collect cultures monthly for another 3 months
  - If *Legionella* is detected
    - Review & modify Water Management Program
    - Perform additional remediation
    - Implement new 6-month post-remediation environmental monitoring follow-up sampling

SOURCE: CDC, https://www.cdc.gov/legionella/health-deps/epi-resources/outbreak-investigations.html#remediation

AFTER AN OUTBREAK

Future Preventive Measures

- Have an effective Water Management Program in place
- Implement a continuous Environmental Sampling Plan

WATER MANAGEMENT PROGRAM

Risk Management

WATER MANAGEMENT PROGRAM

Pathogen Analytical

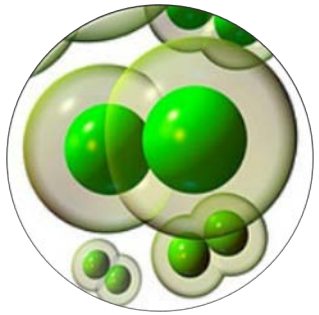
- Testing plans are a method to validate the Water Management Program is working to control the hazard
- Proactive measure to
  - Identify potential growth & transmission sources
  - Confirm efficacy of remedial procedures
  - Manage and reduce risk

WATER MANAGEMENT PROGRAM

Short-Term Remediation Strategies

- Contingencies to regain control
- Reactionary measures ¬ Does not resolve root cause!

Remedial Cleaning & Disinfection



Hyper-chlorination

Thermal Disinfection

Point-of-Use Water Filters

WATER MANAGEMENT PROGRAM

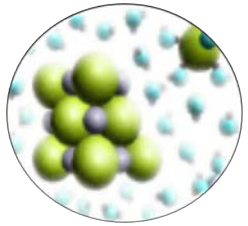
Long-Term Control Strategies

- Supplemental Disinfection

Chlorine Dioxide

Chlorine

Chloramine



Cu-Ag Ions

- Point-of-Use Filters

SUPPLEMENTAL DISINFECTION STRATEGIES

CHLORINE DIOXIDE

- EPA approved
- On-site generation using sodium chlorite + chlorine + acid
- On-site generation from sodium chlorite

CHLORINE

- EPA approved
- Liquid Chlorine
- On-site generation (higher stability)

CHLORAMINE

- EPA approved
- On-site generation using liquid chlorine + liquid ammonia

COPPER-SILVER

- Regulated as a contaminate by US-EPA under FIFRA*
- Cu-Ag ions from Cu-Ag electrodes

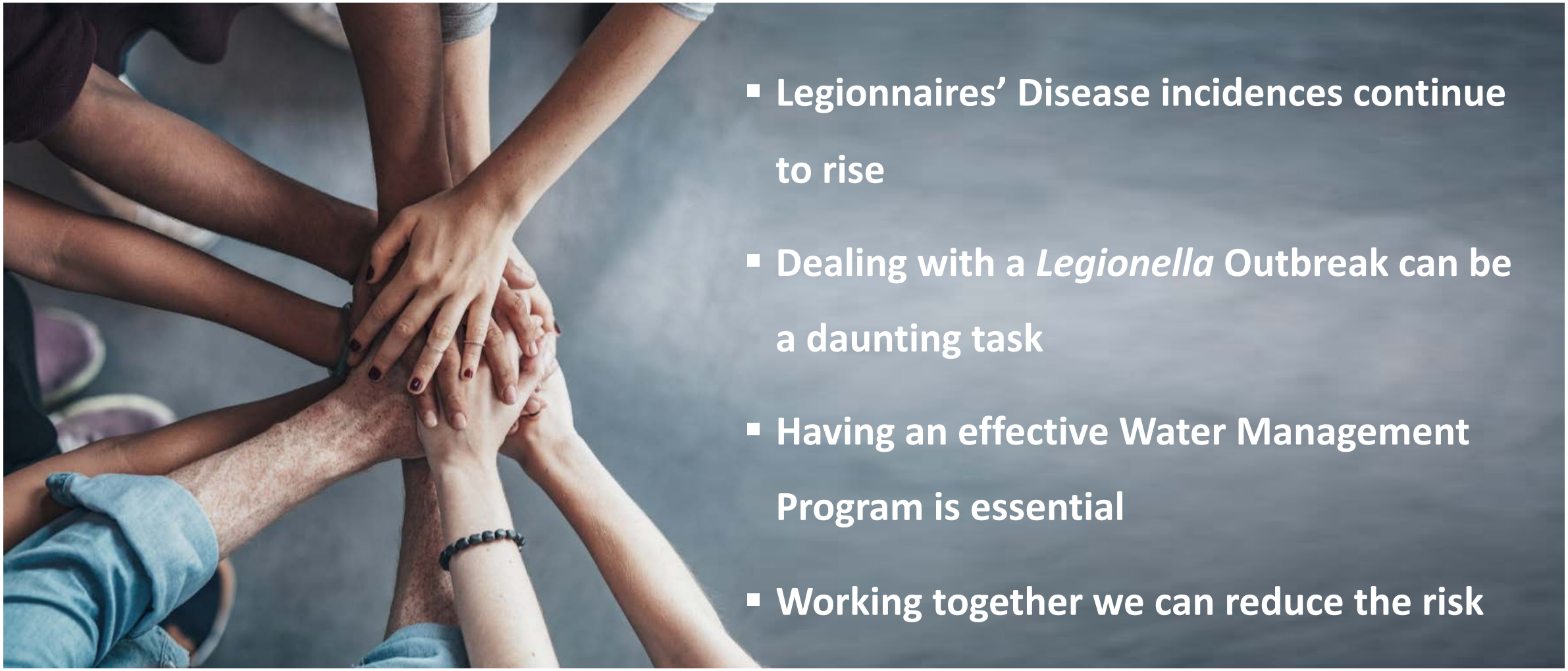
* Federal Fungicide, Insecticide, & Rodenticide Act

WATER MANAGEMENT PROGRAM

Supplemental Disinfection Permitting

- Safe Drinking Water Act
- Each State may have their own requirements
- The permit & permitting process is owned by the building owner

IN CONCLUSION…



- Legionnaires' Disease incidences continue to rise
- Dealing with a *Legionella* Outbreak can be a daunting task
- Having an effective Water Management Program is essential
- Working together we can reduce the risk

ECOLAB | NALCO Water

We have boots on the ground everywhere.

Local service delivered worldwide.

Global Experts in Water Safety

25+ years

Our *Legionella* lab is a charter member of the CDC-ELITE proficiency program, ELAP Certified and follows ISO 11731 procedures.