Legionnaires' Disease: Steps to Reduce Risk in Aquatic Venues

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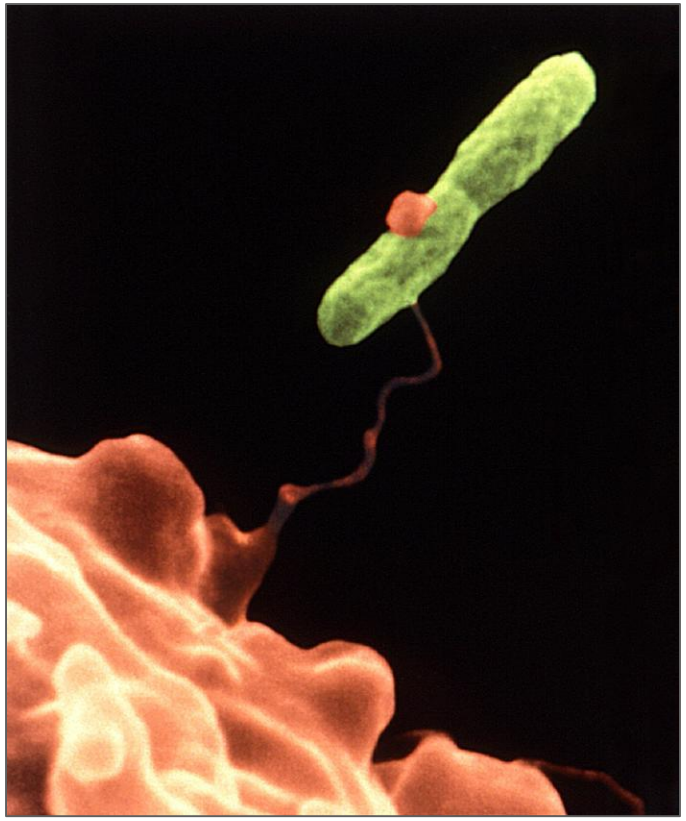
Overview

- Background and epidemiology
- The role of the environment and data to support the need for prevention
- Available prevention guidance

BACKGROUND AND EPIDEMIOLOGY

Legionella

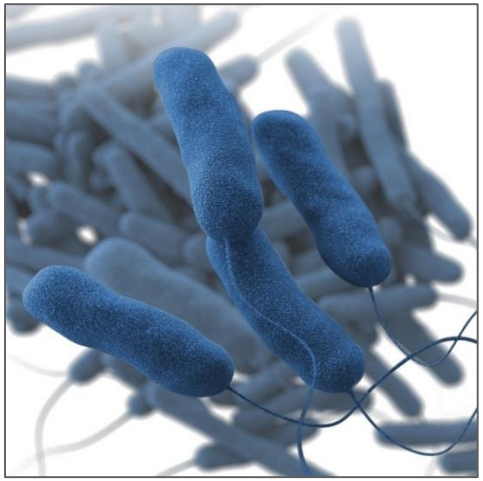
- Atypical gram-negative bacillus
- Intracellular parasite of free-living protozoa primarily found in freshwater environments
- More than 60 species of *Legionella*
- *L. pneumophila* accounts for ~90% of reported cases in the United States[1]



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

Legionnaires' disease

- Causes severe pneumonia that often requires hospitalization
  - Deadly for about 1 in 10 people who get it[1]
- Occurs in people who inhale small droplets of water contaminated with *Legionella*[2]
  - Less frequently due to aspiration
  - One case of probable person-to-person transmission described in the literature[3]



1 Dooling KL et al. *MMWR*. 2015;64(42):1190–3.

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

3 Correia AM et al. N Engl J Med, 2016;374:497-498.

Who Gets Legionnaires' Disease?

Persons at increased risk include those with:

- Recent travel with an overnight stay outside of the home, including stay in a healthcare facility
- Recent exposure to hot tubs/spas
- Recent repairs or maintenance work on domestic plumbing
- Chronic illnesses: renal or hepatic failure, diabetes, chronic lung disease, systemic malignancy
- Smoking (current or historical)
- Immune system disorders
- Age ≥50 years

Hot tubs linked to deadly Hampton Legionnaires outbreak not registered with state

September 05, 2018 3:27PM

Legionnaires' disease bacteria confirmed in hot tub at Playboy Mansion where 200 party guests were struck down with illness

By DAILY MAIL REPORTER
UPDATED: 11:49 EDT, 17 April 2011

Legionnaires bacteria found at luxury Auckland tower block's spa pool

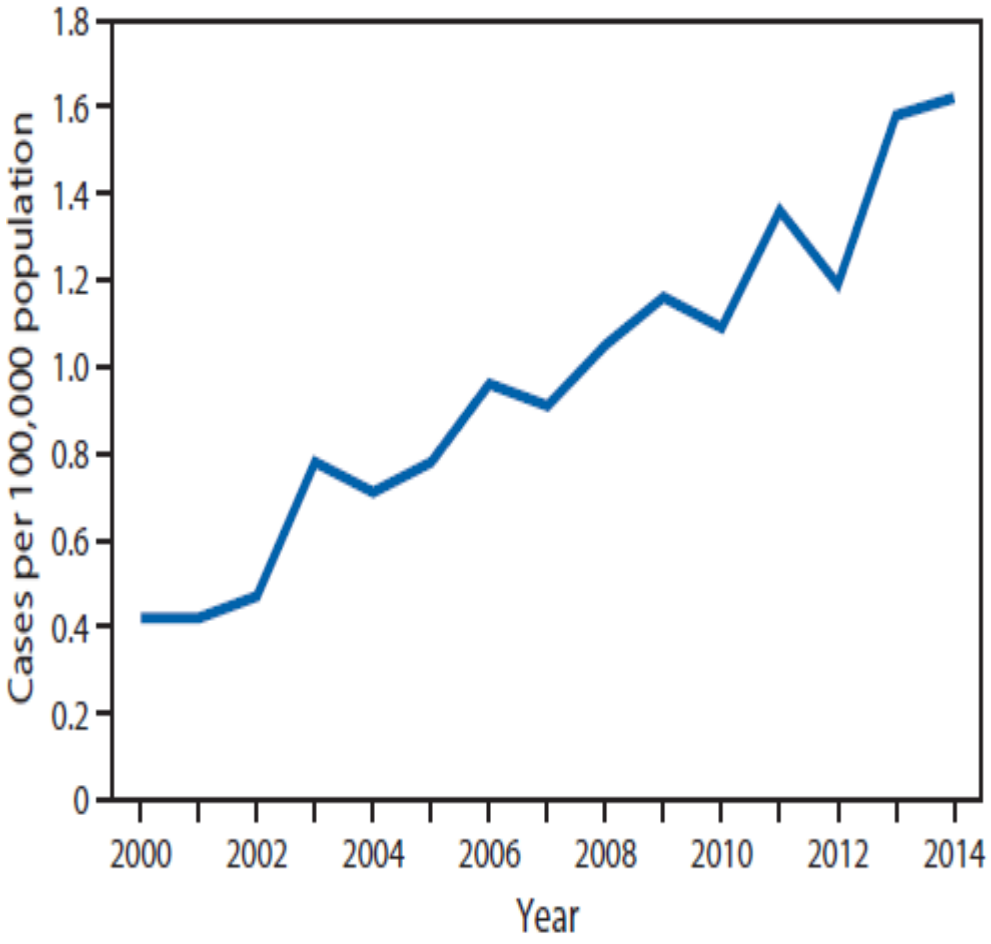
Last updated 20:03, September 13 2018

Two confirmed cases of Legionnaires' Disease linked to hot tub at Water Oak

By Staff Report - April 21, 2018

Legionnaires' disease is on the rise

- Incidence nearly quadrupled from 2000 through 2014[1]
- 5,000 diagnosed cases each year
- Hospitalization cost estimates >$433 million per year[2]
- At least 20 outbreaks reported each year
- Legionnaires' disease outbreaks comprise two-thirds of all reported drinking water outbreaks[3]



1. Garrison LE et al. *MMWR*. 2016;65(22):557–61.
2. Collier SA et al. *Epidemiol Infect*. 2012;140: 2003–13.
3. Beer KD et al. *MMWR*. 2015;64(31):842-848.

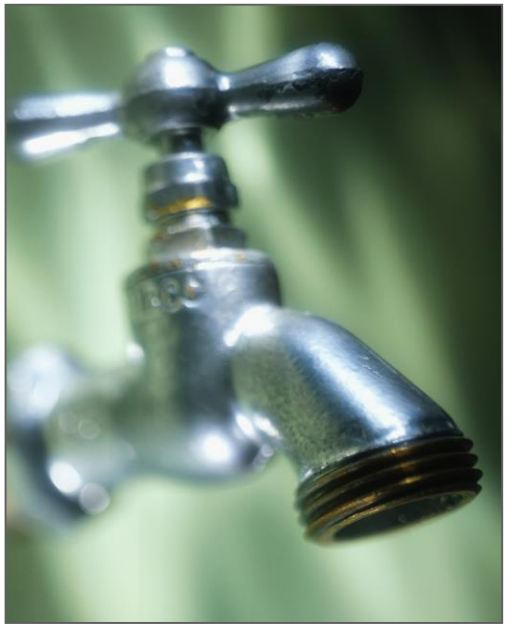
www.cdc.gov/vitalsigns/legionnaires

Increasing number of reported cases: possible reasons

- **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

THE ROLE OF THE ENVIRONMENT AND DATA TO SUPPORT THE NEED FOR PREVENTION

Legionella is found naturally in fresh water



- Exposure to *Legionella* in freshwater environments such as lakes and rivers does not lead to disease
- In human-made water systems, *Legionella* can grow and be transmitted to susceptible hosts

Events leading to Legionnaires' disease

Supply Water

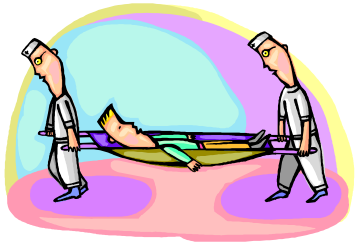
Amplification

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

Aerosolization

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

Transmission



Susceptible Host

Why are Hot Tubs/Spas at Risk for *Legionella* Growth and Transmission?

- Operate at temperatures in the ideal growth range for *Legionella* **(**77°F–108°F)
- Smaller volumes of water are more susceptible to changes in disinfectant and pH due to bather loads
- Operating temperature of ~104°F causes disinfectant to rapidly dissipate
- Jets cause aerosols to be generated in the breathing zone of bathers and those nearby the hot tub/spa
- Biofilms that harbor *Legionella* can build up on hot tub/spa surfaces, piping and filter media/housing

Properly operating and maintaining hot tubs/spas is critical to reducing the risk of Legionnaires' disease

What About Other Aquatic Venues?

- Swimming pools and spray features are:
  - Typically cooler in temperature than hot tubs/spas
  - More *likely* to have a disinfectant residual due to cooler water temperatures
  - Spray features and swimming pools can aerosolize water due to splashing and spray feature design
  - Flow through spray features that do not recirculate water are at reduced risk (provided a disinfectant residual exists)
  - UV or Ozone secondary disinfection systems possibly installed on these venues

- **Bottom line: follow the epidemiology coupled with environmental assessment data to determine which aquatic venues to investigate/sample for *Legionella***

Improper Operation and Maintenance of Public Hot Tubs/Spas is Common

- CDC's Network for Aquatic Facility Inspection Surveillance (NFAIS) reported:
  - 15% (2,217 of 12,637) of hot tub/spa inspections reported to NFAIS resulted in immediate closure
  - Most frequent hot tub/spa violations from inspections were problems with:
    - pH (27.5%)
    - Disinfectant concentration (19.2%)
    - Pool chemical safety (9.9%)
    - Excess water temperature (7.5%)

Review of Building-Associated Outbreaks

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

Centers for Disease Control and Prevention

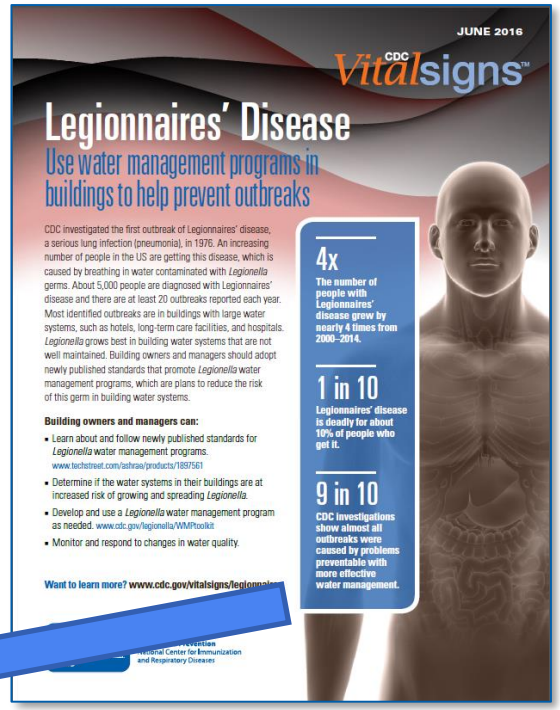
MMWR

Morbidity and Mortality Weekly Report

Early Release / Vol. 65 June 7, 2016

Vital Signs: Deficiencies in Environmental Control Identified in Outbreaks of Legionnaires' Disease — North America, 2000–2014

Laurel E. Garrison, MPH[1]; Jasen M. Kunz, MPH[2]; Laura A. Cooley, MD[1]; Matthew R. Moore, MD[1]; Claressa Lucas, PhD[1]; Stephanie Schrag, DPhil[1]; John Sarisky, MPH[2]; Cynthia G. Whitney, MD[1]



JUNE 2016

CDC Vitalsigns™

Legionnaires' Disease

Use water management programs in buildings to help prevent outbreaks

CDC investigated the first outbreak of Legionnaires' disease, a serious lung infection (pneumonia), in 1976. An increasing number of people in the US are getting this disease, which is caused by breathing in water contaminated with *Legionella* germs. About 5,000 people are diagnosed with Legionnaires' disease and there are at least 20 outbreaks reported each year. Most identified outbreaks are in buildings with large water systems, such as hotels, long-term care facilities, and hospitals. *Legionella* grows best in building water systems that are not well maintained. Building owners and managers should adopt newly published standards that promote *Legionella* water management programs, which are plans to reduce the risk of this germ in building water systems.

Building owners and managers can:

- Learn about and follow newly published standards for *Legionella* water management programs. www.techstreet.com/ashrae/products/1897561
- Determine if the water systems in their buildings are at increased risk of growing and spreading *Legionella*.
- Develop and use a *Legionella* water management program as needed. www.cdc.gov/legionella/WMPtoolkit
- Monitor and respond to changes in water quality.

Want to learn more? www.cdc.gov/vitalsigns/legionnaires

4x

The number of people with Legionnaires' disease grew by nearly 4 times from 2000–2014.

1 in 10

Legionnaires' disease is deadly for about 10% of people who get it.

9 in 10

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

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

www.cdc.gov/vitalsigns/legionnaires

Building-associated Outbreaks: Root Causes

- About **2 in 3 (65%)** were due to **process failures**
- About **1 in 2 (52%)** were due to **human error**
- About **1 in 3 (35%)** were due to **equipment failures**
- About **1 in 3 (35%)** were due to **unmanaged external change**
- About **1 in 2 (48%)** were due to **more than one** of the above problems

Water management problems can lead to Legionnaires' disease outbreaks

www.cdc.gov/vitalsigns/legionnaires

Deficiencies in water system maintenance contributing to growth and transmission of *Legionella* among outbreaks of Legionnaires' disease investigated by CDC—North America, 2000–2014 (n = 23)

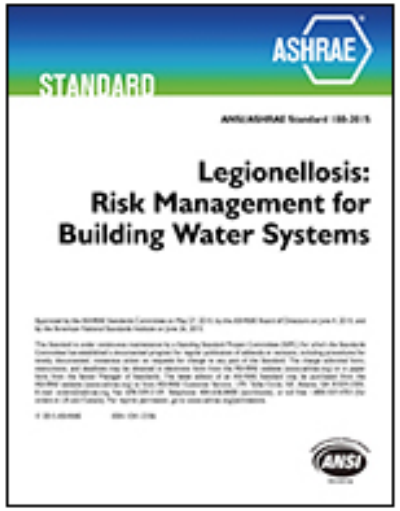
Setting	Source	Deficiency	Category[1]			
			Process failure	Human error	Equipment failure	Unmanaged external change
Hotel/Resort	Potable water (and possibly also hot tub)	Temperatures in optimal range for *Legionella* growth[2] in potable water	✓	✓	✓	✓
		Lack of disinfectant in potable water (resort served by well water, disinfectant not required by state law)				
		Lack of potable water distribution mapping plans (staff unable to describe system)				
		Poor access to filters and disinfectant feeder because of hot tub placement and equipment design				
		Broken water main[4] (not followed by appropriate flushing of the distribution system)				
Hotel/Resort	Hot tub	Inadequate maintenance of hot tub		✓		
		Lack of knowledge by contracted pool operator				
Hotel/Resort	Hot tub	Inadequate disinfectant in hot tub water because of inaccurate disinfectant feeding equipment, resulting in inadequate disinfectant delivery (unrecognized by hot tub operator)		✓	✓	
		Inadequate hot tub maintenance and disinfectant monitoring				

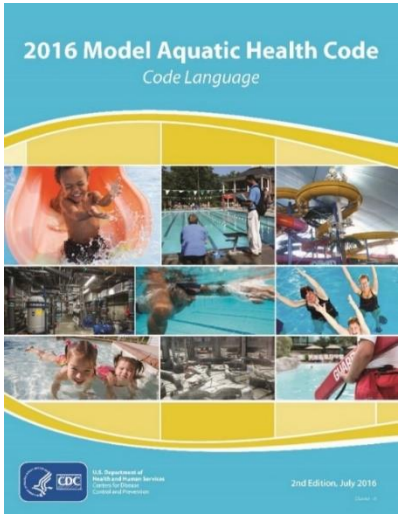
Garrison LE et al. *MMWR*. 2016;65(22):557–61.

AVAILABLE PREVENTION GUIDANCE

Primary prevention of Legionnaires' disease

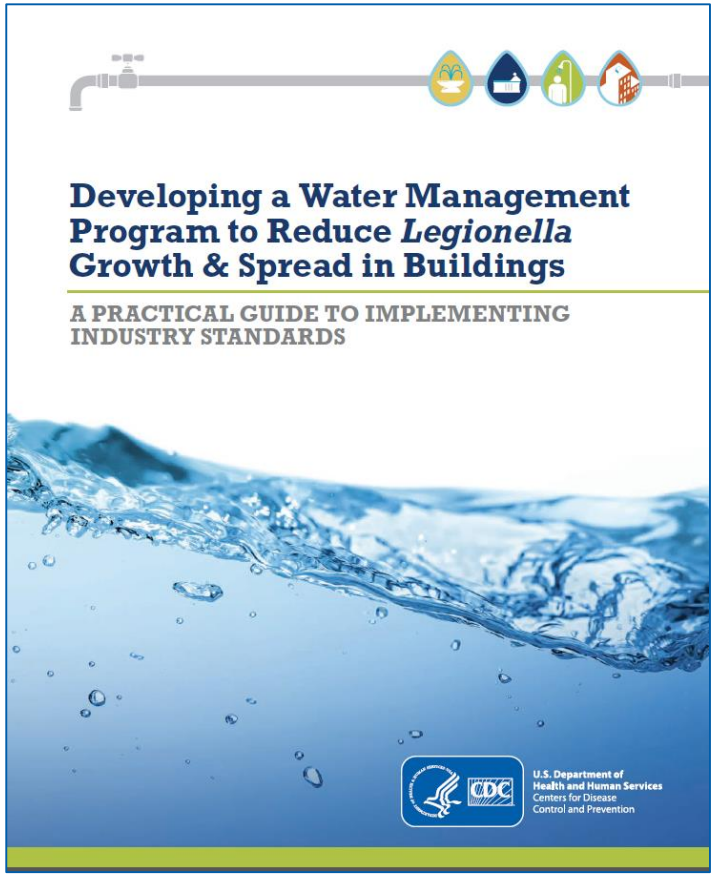
- Ensuring proper maintenance of building water systems and aerosol-generating devices is key
- Current guidelines, and standards
  - ASHRAE Standard 188 (2015)
  - CDC's Model Aquatic Health Code
  - ASHRAE Guideline 12 (2000)
  - Others in development (ASHRAE 12 revision, others)





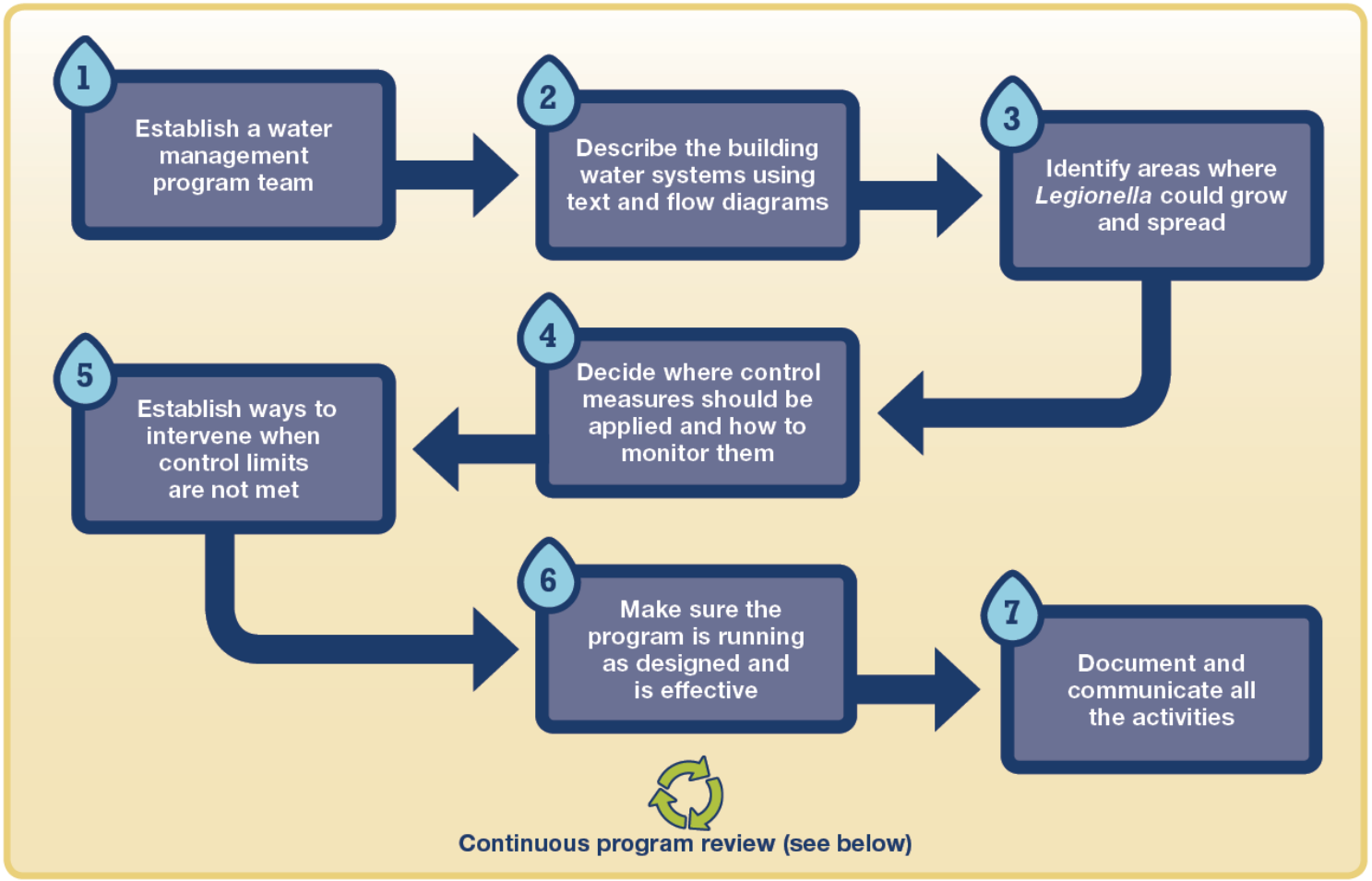
CDC *Legionella* Water Management Program Toolkit

- Translates ASHRAE 188 into plain language for wider audiences
  - Public health professionals
  - Building managers
  - Healthcare facilities
- Step-by-step guide to creating a water management program
  - Control measures and corrective actions
  - Healthcare-specific guidance



www.cdc.gov/legionella/WMPtoolkit

Create a Water Management Program



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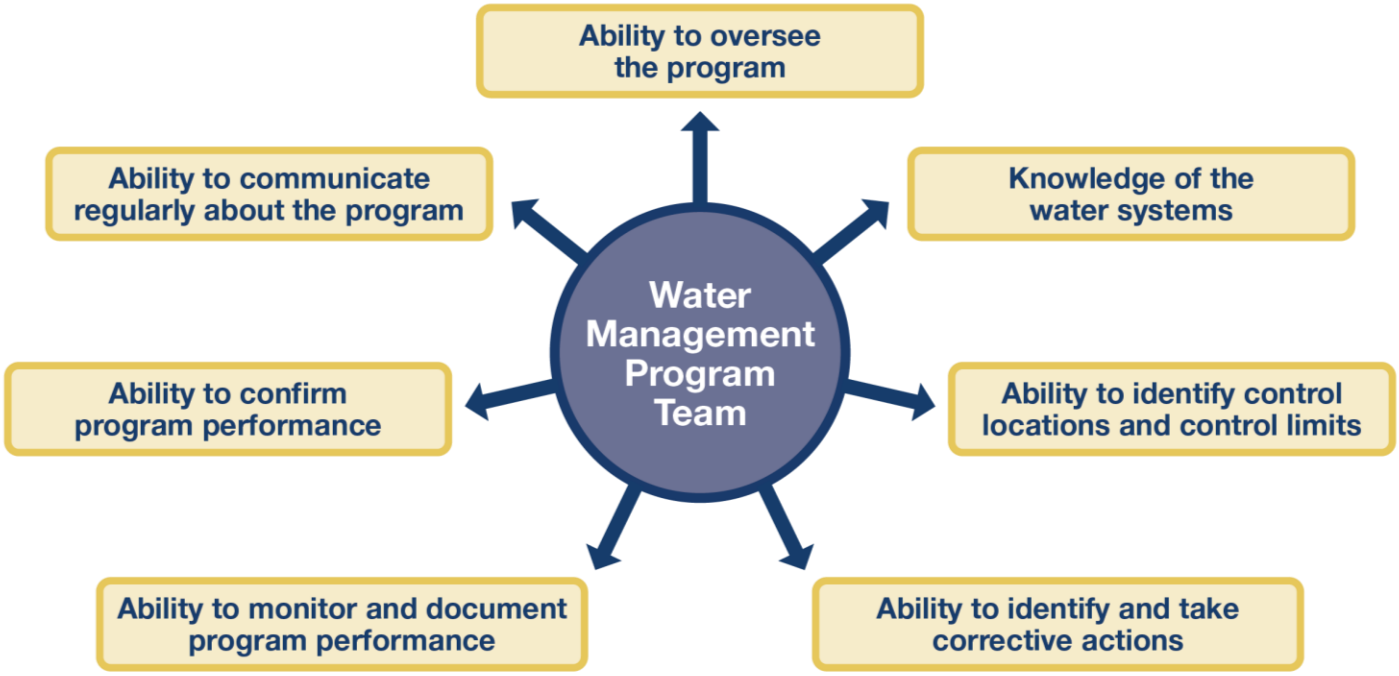
Establish a Water Management Team



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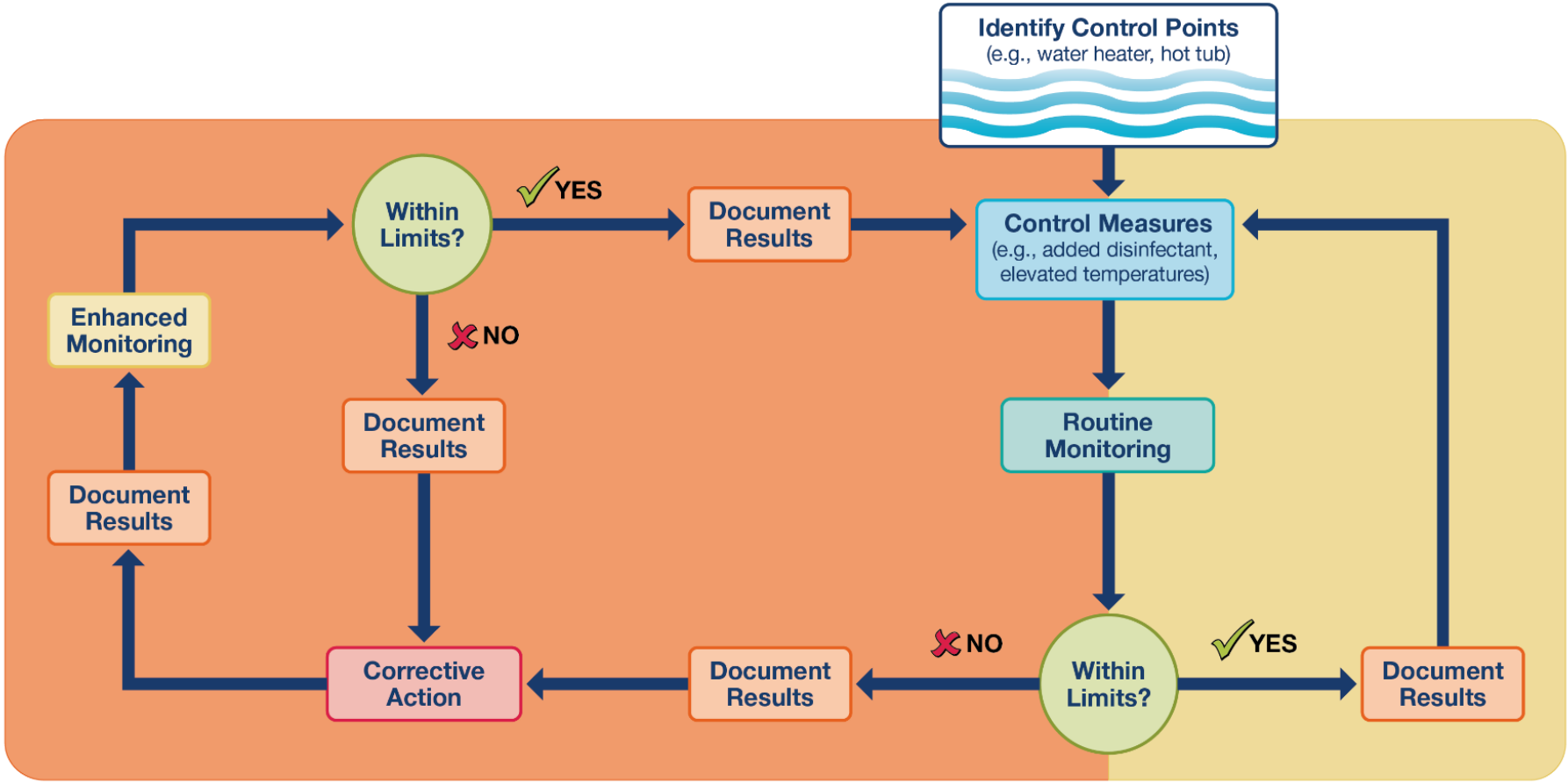
Control Measures and Corrective Actions



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Verification and Validation

- Verification
  - Are we doing what we said we would do?
- Validation
  - Is our program actually working?
    - Testing for *Legionella* is an optional validation strategy

www.cdc.gov/legionella/WMPtoolkit

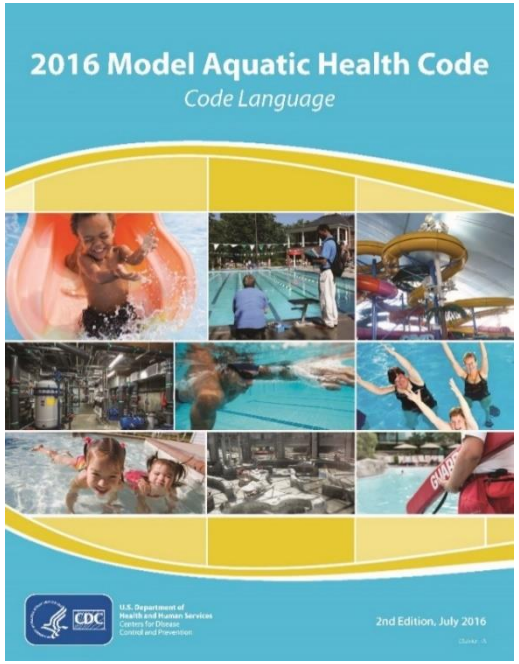
Continuous Program Review

- Review program elements at least once per year, or when any of the following events occur:
  - Data review shows control measures persistently outside control limits
  - Major maintenance or water service change (e.g., new construction or change in disinfectant) occurs
  - One or more cases of disease are thought to be associated with your system(s)

www.cdc.gov/legionella/WMPtoolkit

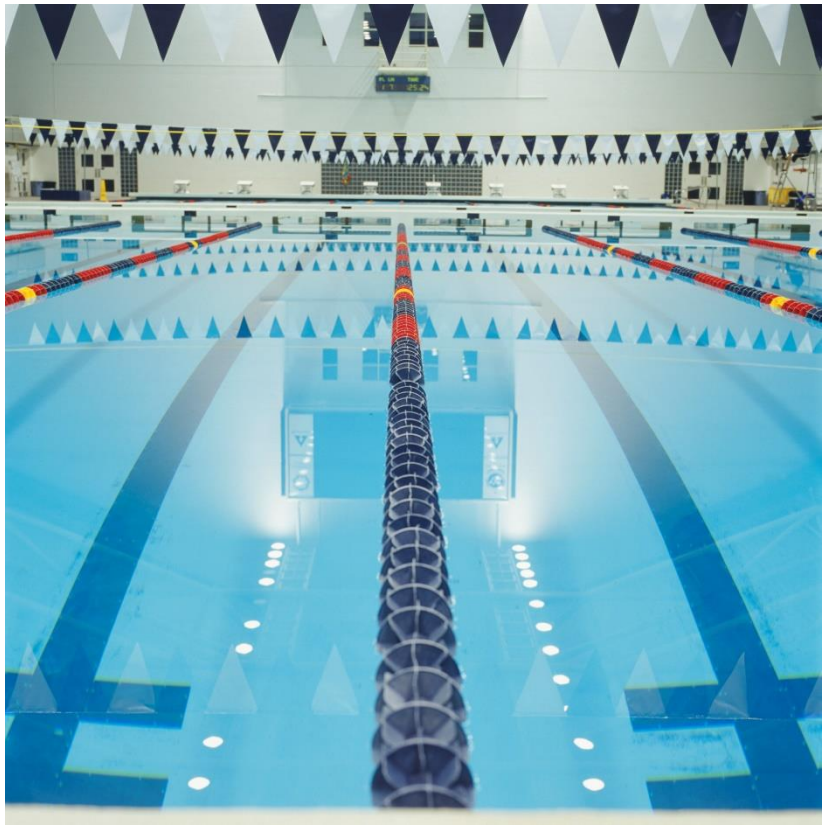
What is the Model Aquatic Health Code (MAHC)?

- Based on science and best practices
  - Code / Annex
- Resource for creating or updating pool codes
- Goals
  - Reduce risk for outbreaks, drowning, and pool-chemical injuries
  - Outline uniform safety and operation standards
- Review and update cycle
  - Council for the Model Aquatic Health Code (CMAHC)



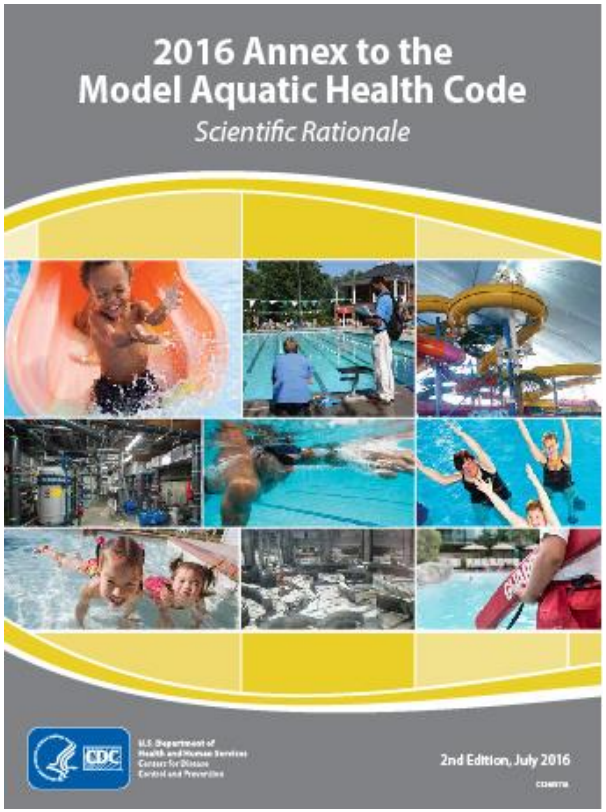
MAHC Layout and Contents

- Code Language
  - **3.0** Glossary of Acronyms, Initials, and Terms
  - **4.0** Aquatic Facility Design Standards and Construction
  - **5.0** Facility Operation and Maintenance
  - **6.0** Policies and Management



MAHC Layout and Contents

- Annex
  - Scientific rationale for Code Language
  - Suggested best practices
  - Regularly updated
  - Superscript “A” – Annex available



Using the MAHC as a Legionnaires' Disease Risk Reduction Tool

- **MAHC Design and Construction:**

  - Includes requirements for automated disinfection and pH control
  - Defines flow rates and turnover times
  - Outlines inlet spacing to ensure adequate mixing
  - Requires a means to easily drain and clean a hot tub/spa
  - Specifies that hot tub/spas have proper ventilation with and air handling system that complies with ASHRAE Standard 62.1 – 2013*

*ASHRAE Standard 62.1 – 2013, Ventilation for Acceptable Indoor Air Quality

Using the MAHC as a Legionnaires' Disease Risk Reduction Tool

- **MAHC Operation and Maintenance:**

  - Requires facilities to have a preventive maintenance program
  - Requires continuous operation of the recirculation system and filters
  - Requires filters/media to be listed and labeled to conform with NSF/ANSI 50*
  - Establishes filtration and filter backwashing rates
  - Establishes minimum and maximum disinfectant/pH concentrations
  - Establishes water quality chemical testing frequency
  - Requires regular draining and cleaning of hot tubs/spas

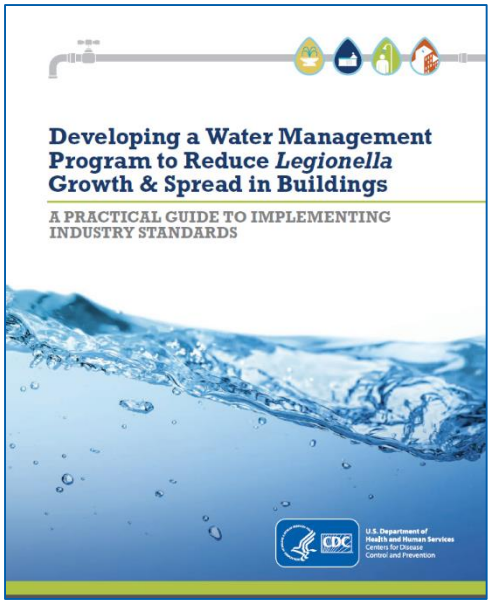
*NSF/ANSI 50, Equipment for Swimming Pools, Spas, Hot Tubs and Other Recreational Water Facilities

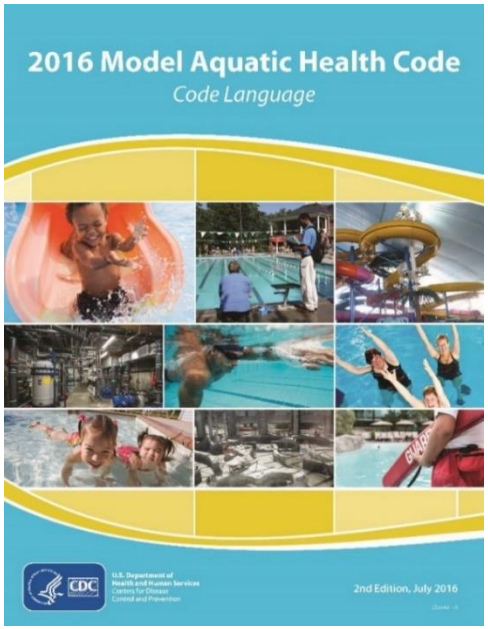
Using the MAHC as a Legionnaires' Disease Risk Reduction Tool

- **MAHC Policies and Procedures:**
  - Requires all operators to have appropriate state or local certified pool and spa operator and chemical handling training
  - Outlines essential topics in qualified operator training courses and staff training requirements
  - Requires trained staff be available during peak hours and seasons that venues are used most frequently

Summary

- Improper operation and maintenance of public hot tubs/spas is common
- Improperly maintained hot tubs/spas are at risk for *Legionella* growth and transmission
- Pool and hot tub/spa operators and regulatory programs should have a working knowledge of ASHRAE and MAHC guidance
- **Incorporating MAHC and ASHRAE principles into water management programs and pool codes can reduce the risk of Legionnaires' disease in public hot tubs/spas**





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