Legionella
Prevention & Control Symposium

Is Your Building's Water System Safe?

Think Health Act Now!
CITY OF MILWAUKEE
HEALTH DEPARTMENT

WATERTECH
of America, Inc.

Welcome

Paul Biedrzycki, MPH, MBA

Director of Disease Control and Environmental Health

City of Milwaukee Health Department

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
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Notes from the Field: Increase in Reported Legionellosis — Milwaukee, Wisconsin, June–September 2013
***Weekly*- January 24, 2014 / 63(03); 63-63**

Paul A. Biedrzycki, MPH, MBA1, Marisa Stanley, MPH1, Fredrick Radmer, MPH1, Shannon Lauf, MPH1 (Author affiliations at end of text)

In early July 2013, the City of Milwaukee Health Department (MHD) was notified by the Wisconsin Division of Public Health of an increase in reported cases of legionellosis in southeastern Wisconsin. Legionellosis is a reportable disease to state and local public health authorities in Wisconsin. During June 1–September 30, 2013, a total of 58 clinically diagnosed cases of Legionnaires' disease, confirmed by laboratory testing, were reported in Milwaukee County, more than twice the number of total annual case reports in each of the previous 5 years. Forty-five (78%) of these cases were reported in the city of Milwaukee. The median age of county patients was 53 years (range = 29–77 years); all but one was hospitalized, and no deaths were reported. MHD received one report of a death attributed to legionellosis in the county during this period.

Objectives

- Examine the current trends and science of community-acquired legionellosis
- Recognize effective maintenance operations and methods to minimize *Legionella* colonization in water systems and mitigate community exposure
- Improve private and public community stakeholder collaboration, strategic planning, and communications

Agenda

- **Welcome,** *Paul A. Biedrzycki, Director of Disease Control and Environmental Health, City of Milwaukee Health Department*
- **The Origins, Science, and Trends of Legionnaires' Disease,** *Thomas Haupt, M.S., Research Scientist and Epidemiologist, Wisconsin Department of Health Services*
- **Keys to Successfully Managing a Building Water System,** *Joe Russell, CWT, President of WATERTECH of America, Inc.*

15 minute break

- **Legionella: A New Paradigm for Prevention,** *Janet E. Stout, Ph.D., Microbiologist and Director, Special Pathogens Laboratory and Research Associate Professor at University of Pittsburgh Swanson School of Engineering*

5 Minute Stretch

- **Q&A Panel,** *Thomas Haupt, Joe Russell and Dr. Janet Stout*
- **Closing Remarks,** *Paul A. Biedrzycki*

Acknowledgements

Special thanks to:

The Legionella Symposium Working Group

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- Lindor Schmidt
- Scott Olson - Lakeland Chemical Specialties, Inc.

- WATERTECH of America, Inc.
- Wisconsin Division of Public Health
- The Harley-Davidson Museum®

The Origins, Science, and Trends of Legionnaires' Disease

Thomas Haupt, M.S.

Research Scientist-Respiratory Disease Epidemiologist

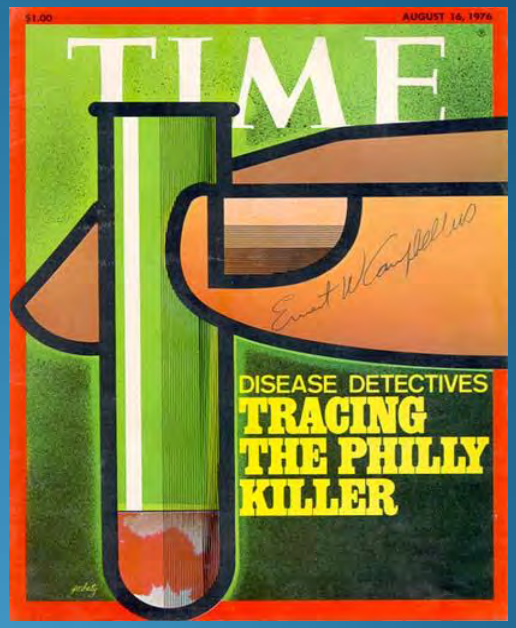
State of Wisconsin Department of Health Services

Emergence

Bellevue-Stratford Hotel
Historic hotel famous for (one of) the first Legionnaires' disease outbreaks in Philadelphia, PA, in 1976.

Emergence (continued)

- The Bellevue-Stratford hosted the 58th state convention of the American Legion Department of Pennsylvania July 21-24, 1976.
- In the days that followed the convention, the mystery disease killed 34 participants and sickened 221, all of whom had spent time at the hotel.
- It was over a year after the outbreak occurred at the Bellevue-Stratford that the Legionella bacteria was identified.



- It is known that legionella bacteria lurked somewhere within the hotel. Researchers still haven't identified the exact source. (Theory: Cooling Tower)

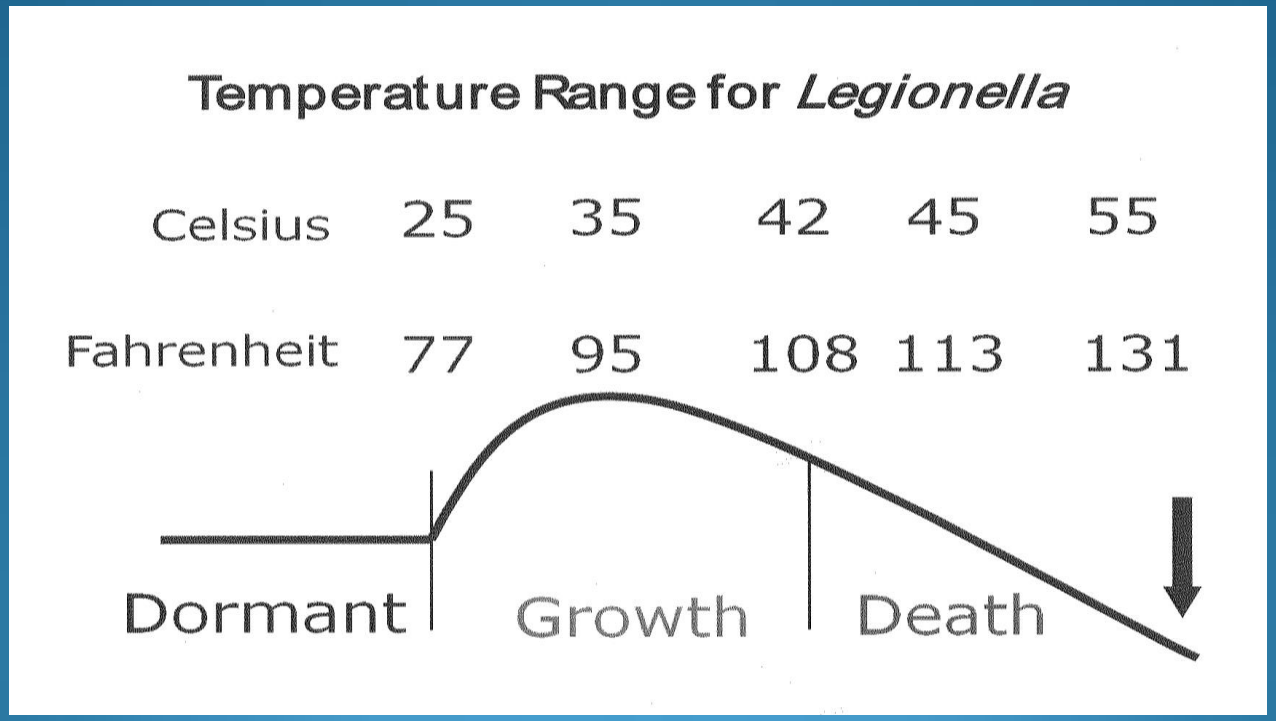
More Outbreaks Follow

- **A large outbreak in the Netherlands, 1999.**
  A total of 188 cases of Legionnaires' disease were reported among visitors and exhibitors of a flower show. A new whirlpool spa was the source of this large outbreak.
- **An explosive community outbreak in Spain, July 2001.**
  More than 800 suspected cases were reported, which made this the world's largest outbreak of the disease reported to date. The epidemiologic investigation implicated the cooling towers at a city hospital as the source.
- **A large community outbreak in Scotland, May 2012.**
  A total of 92 cases were reported. The source was thought to be a cluster of cooling towers in the southwest area of the city.

What is Legionella?

- A naturally occurring bacterium
- Found in water systems, especially warm water
- The bacteria are prevalent in warm stagnant water in:
  - plumbing systems
  - hot water tanks
  - water in cooling towers and evaporative condensers
  - hot tubs

Legionella Environmental Growth?

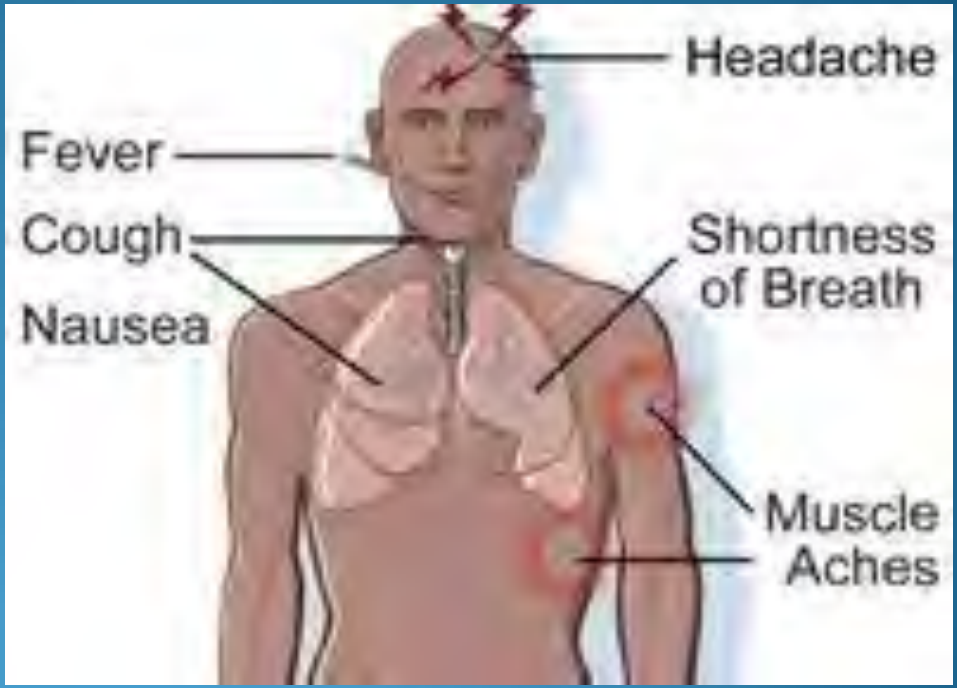


Route of Infection

- Primarily through inhalation of aerosols, fine droplets and mists
- Can be contracted by choking on contaminated water
- Not spread person-to-person
- Statistically those most at risk are:
  - 50 to 70 years old
  - Smokers
  - Those with underlying illnesses

Symptoms of Legionnaires' Disease

- Fatigue
- Loss of appetite
- Diarrhea

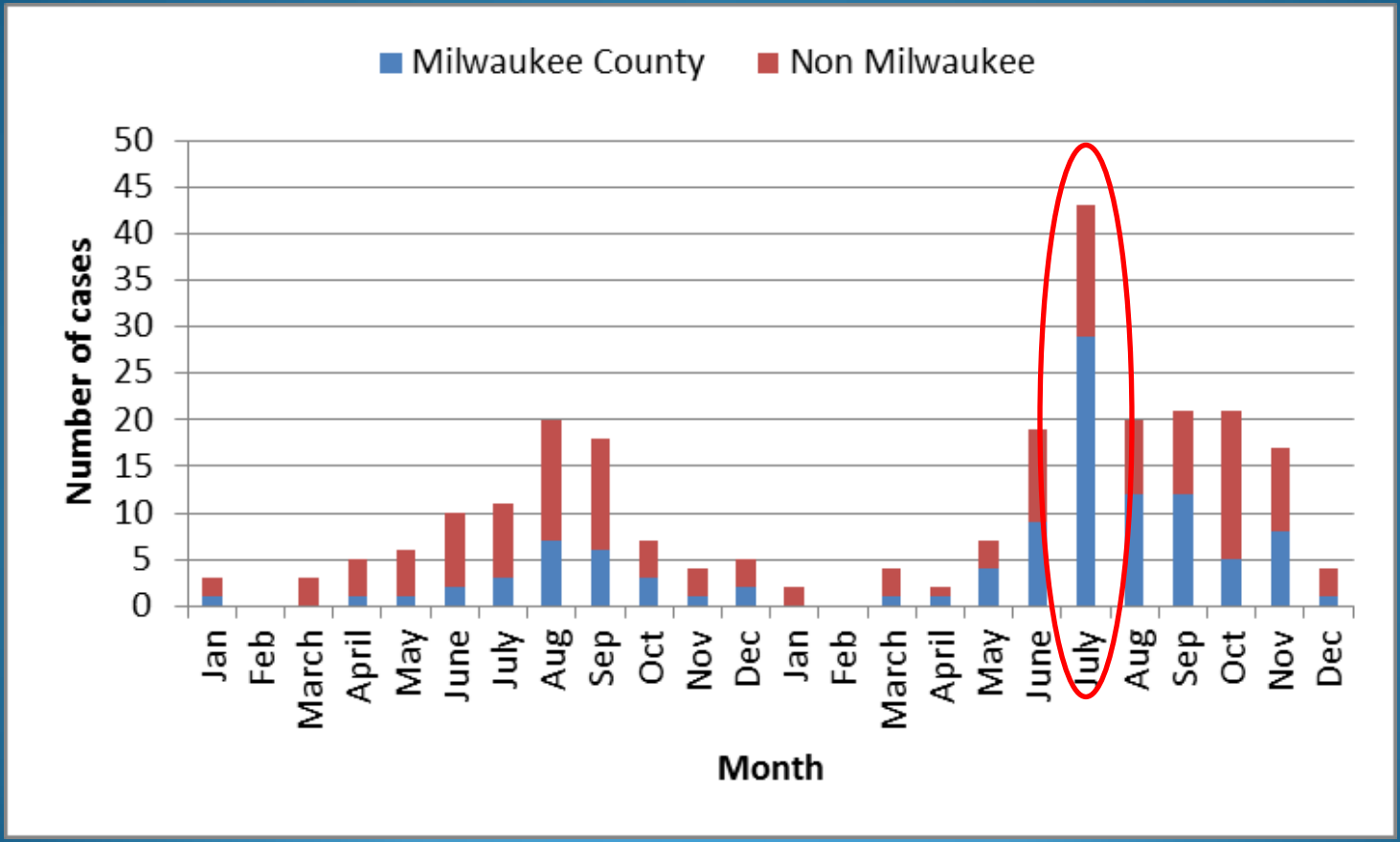


Symptoms of Legionnaires' Disease (continued)

- Symptoms are variable ranging from:
  - No symptoms
  - Respiratory disease (pneumonia)
  - Death
- Symptom onset after exposure 2-14 days (usually 5-7 days)
- Symptoms are similar to other respiratory diseases (influenza for example), and require a unique test (urine antigen or culture)
- Treated with antibiotics

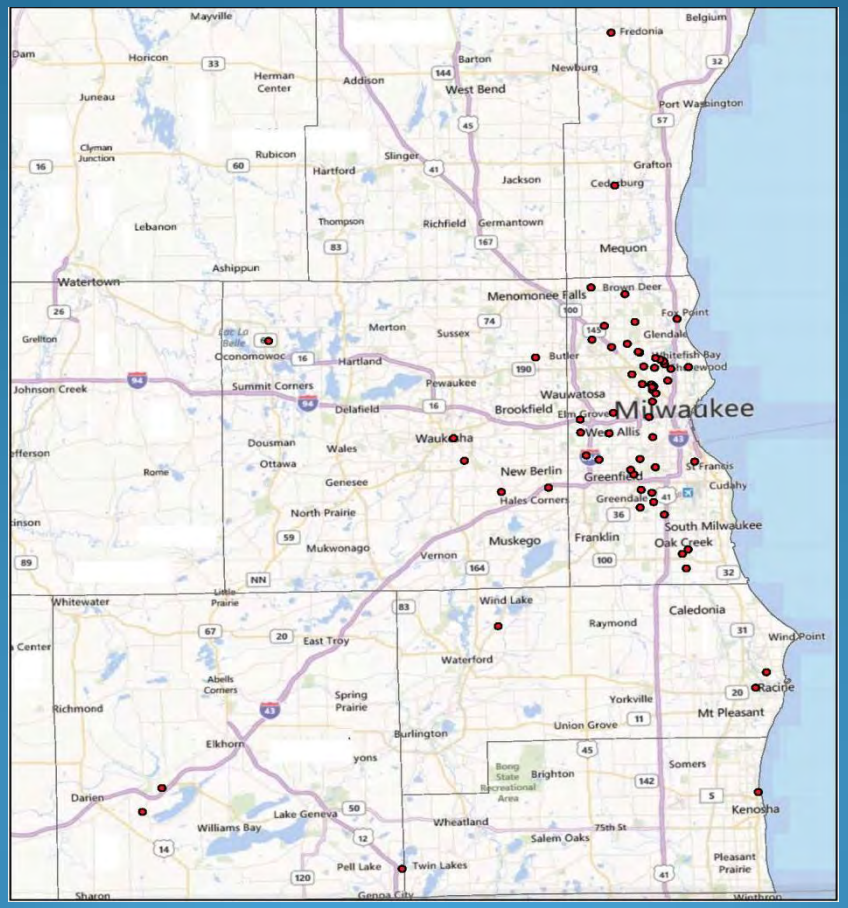
Cases of Legionnaires' disease

Wisconsin and Milwaukee County, 2012-2013



Cases of Legionnaires' disease

Southeastern Region, June 1- August 26, 2013 (N=63)

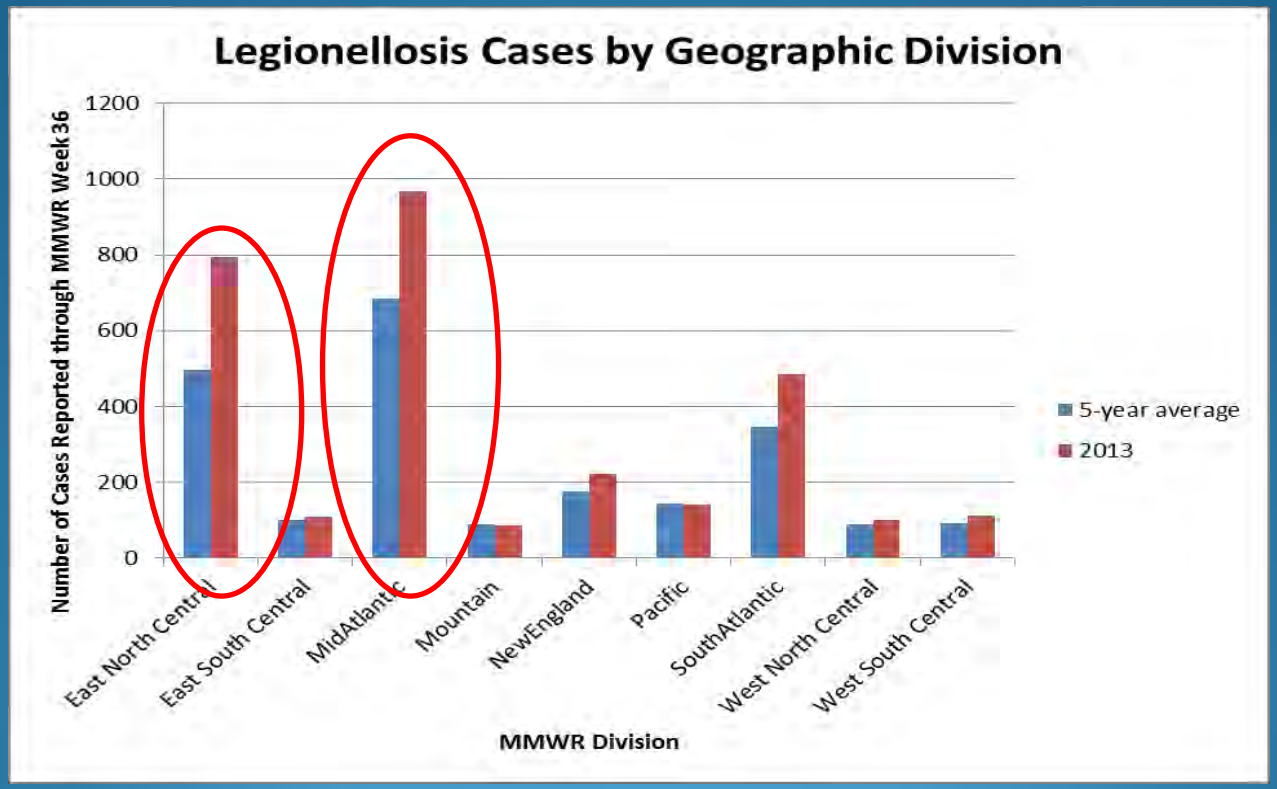


Public Health Response

- Multiple clinician alerts
  - State and Local Health Departments
- Expanded questionnaires on each patient
  - Common places of exposure in 10 days prior to illness
  - Known sources of exposure to water droplets/mists
  - Travel outside of home area
- Increased testing of clinical and environmental samples
  - Culture of respiratory specimens at the State Lab
  - Genetic testing for common patterns

Increased Cases

Nationwide, January-September, 2013

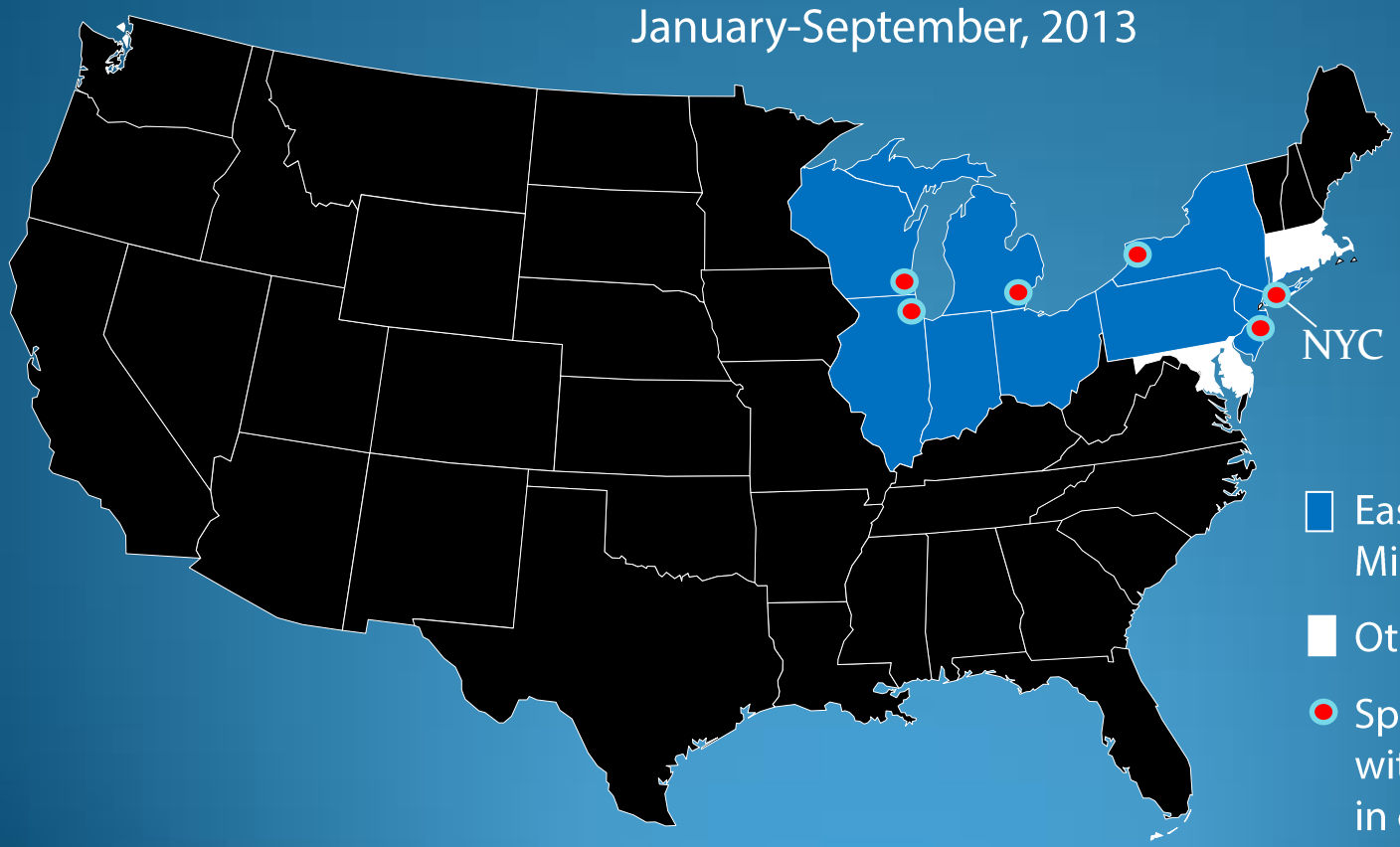


The geographic divisions seeing the largest increase over the 5-year average are:

- East North Central (Illinois, Indiana, Michigan, Wisconsin, and Ohio)
- Mid Atlantic (New Jersey, New York, and Pennsylvania)

Notable Increase

States with a notable increase of Legionnaires' disease cases, January-September, 2013



- East North Central and Mid Atlantic Regions
- Other Regions
- Specific cities/counties with notable increase in cases

Key Points

- In the last two years a there has been a significant increase in identified cases of Legionnaires' disease, especially in the Southeastern region of the state.
- A similar trend has been seen in other states
- Despite a major effort no source of the illnesses was identified

Key Points (continued)

- Prevention and control is a multifaceted, multi-agency task
  - Clinicians
  - National, state and local public health
  - Manufacturers and other public and private agencies
- Many theories need further research
  - Climate (humidity, cloud cover , heat)
  - New, previously unknown sources

Keys to Successfully Managing a Building Water System

Joe Russell, CWT

President

WATERTECH of America, Inc.

BONUS
BusinessWeek
China
Cisco
Inside Story
DaimlerChrysler
IS YOUR OFFICE KILLING YOU?
The dangers of sick buildings

Does This Apply to You??

- A building water system may be simple or complex.
- It may contain any or all these
  - Cooling tower
  - Showerheads/ Faucets
  - Ice Machines
  - Spa/ Whirlpool
  - Water Feature
  - Humidifier
  - Respiratory Therapy Equipment
  - Misting Machines/ Systems

- If your building contains any of these, then you need a plan!!!

This Sounds Complicated – How Do I Start?

Several Agencies / Associations have developed guidelines to assist the building owner/ facility manager:

- Association of Water Technologies (AWT)
  - Legionella 2003 – An Update and Statement by AWT
- ASHRAE
  - 2000 Legionella Guideline
  - Standard SP188P – 2014???

- Cooling Technology Institute
  - Legionellosis: Guideline: Best Practices for Control of Legionella
- OSHA

Have a Plan!!

Water Safety Plan

System Assessment

Monitoring

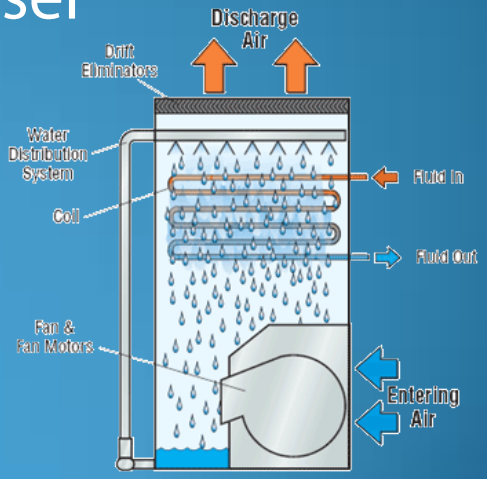
Management/ Communication

Surveillance (Validation)

Evaporative Cooling Systems

- Cooling Towers

- Fluid Cooler/Evaporative Condenser



Cooling Tower Water Management Solutions

- Pay close attention during start up and after extended shut downs.
  - For best results, circulate off-line cooling towers daily for 1 – 2 hours during which time a biocide feed should occur
    - Improves microbiological control
    - Minimizes corrosion
- Cooling Tower Start Up/Shut Down Checklist blog.watertechusa.com

Start Up Checklist

- The following checklist is a review guide for your personnel:
  - Review the purpose of each cooling water treatment chemical used in the system with the operating personnel.
  - Review chemical treatment dosage rates.
  - Review safe handling procedures for all chemicals used in the system.
  - Review testing and recording procedures.
  - Make sure that there are adequate reagents for testing.
  - Check the shelf life of the testing reagents.

Cooling Tower Water Management Solutions

- Provide adequate chemical treatment
  - Continuous feed of oxidizing biocide at low levels provides best results (0.5 – 1.0 ppm Free Chlorine)
  - Alternate with Non Oxidizing biocide as a best practice.
  - Test for residual treatment levels and other critical parameters (conductivity, pH)
    - Frequency depends on level of automation.
    - Log results and any corrective actions.
  - Document, document, document

Cooling Tower Water Management Solutions

Common Oxidizing Biocides

	* Effectiveness Against:			
Microbiocide	**Bacteria**	**Fungi**	**Algae**	**Comments**
Chlorine	E	S	S	Reacts with $-NH_2$ groups; effective at neutral pH; may be less effective at high pH. Use concentration: 0.1 to 0.2 mg/L continuous free residual; 0.5 to 1.0 mg/L intermittent free residual.
Chlorine dioxide (ClO_2)	E	G	G	pH insensitive; can be used in presence of $-NH_2$ groups. Use concentration: 0.1 to 1.0 mg/L intermittent free residual.
Bromine	E	S	S	substitute for Cl_2; effective over broad pH range. Use concentration: 0.05 to 0.1 mg/L continuous free residual; 0.2 to 0.4 mg/L intermittent free residual.
Ozone	E	G	G	Effective over broad pH range, 7 - 9. Continuous or intermittent feed of .2 to .5 mg/L

* E = Excellent G = Good S = Slight

Cooling Tower Water Management Solutions (cont.)

Common Non-Oxidizing Biocides

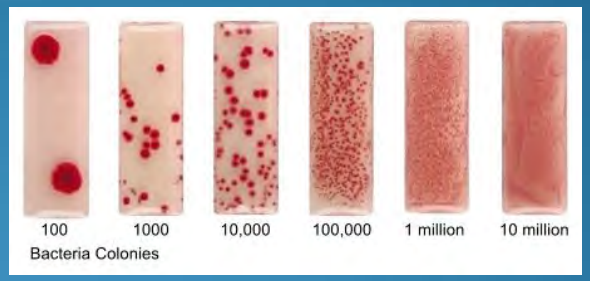
	* Effectiveness Against:			
Microbiocide	**Bacteria**	**Fungi**	**Algae**	**Comments**
Organo-bromide (DBNPA)	E	S	S	pH range 6 to 8.5. Use concentration: 0.5 to 24 mg/L, intermittent feed
Methylenebis-thiocyanate (MBT)	E	S	S	Hydrolyzes above pH 8. Use concentration: 1.5 to 8 mg/ L, intermittent feed
Isothiazoline	E	G	G	pH insensitive; deactivated by HS and - NH2 groups. Use concentration: 0.9 to 13 mg/L, intermittent feed
Quaternary ammonium salts	E	G	G	Tendency to foam; surface active; ineffective in highly oil or organic-fouled systems. Use concentration: 8 to 35 mg/L, intermittent feed
Organo-tin/ quaternary ammonium salts	E	G	E	Tendency to foam; functions best in alkaline pH. Use concentration: 7 to 50 mg/L, intermittent feed.
Glutaraldehyde	E	E	G	Deactivated by $-NH_2$ groups; effective over broad pH range. Use concentration: 10 to 75 mg/L, intermittent feed
Carbamates	E	E	G	Broad spectrum activity; pH range 5 to 9. Good in high suspended solids systems; not compatible with chromate treatment programs. Use concentration: 15 to 100 mg/L
Dodecylguanidine (DGH)	E	E	G	Broad spectrum activity; pH range 6 to 9. Use concentration 25 to 100 mg/L
Triazine	NA	NA	E	Specific for algal control; must be used with other biocides. pH range 6 to 9. Use concentration: 2 to 7 mg/L

* E = Excellent G = Good S = Slight NA = Not Applicable

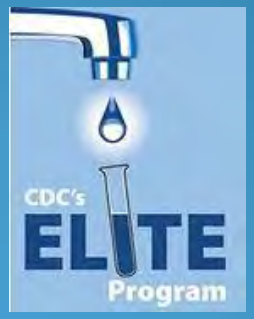
Bacteria Testing

Validate

- Test weekly for total aerobic bacteria.



- Monitor as needed for the presence of Legionella Pneumophila by sending samples to a CDC Elite Certified Lab for culturing. "Gold Standard"



Cooling Tower Water Management Solutions

Provide proper maintenance.

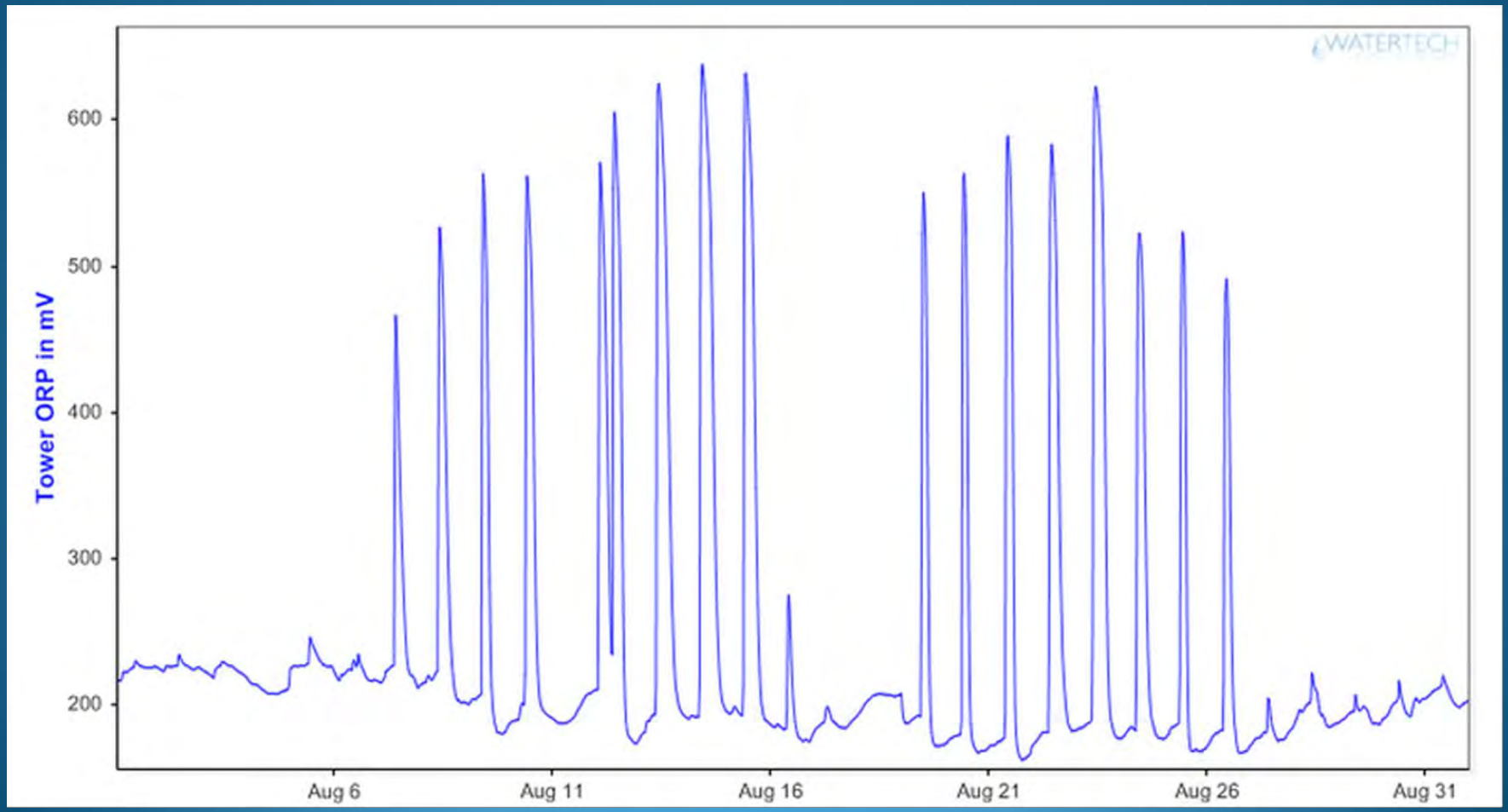
- Maintain drift eliminators.
- Clean system at lease twice annually to remove accumulated dirt and debris.– disinfect system before and after cleaning with oxidizing biocide. This is especially critical if side stream filtration is not in use.

- Maintain chemical feed systems in proper working order.
- Establish a maintenance plan and log all activities
- When not in use system should be drained and kept dry.

Cooling Tower Water Management Technology

- SMART System
- Controls
  - Conductivity
  - pH/ORP
  - Inhibitor Feed
  - Biocide Feed
- Tracks
  - Water Usage
  - Chemical Usage
  - Chemical Concentration
- Remote Monitoring
  - Alarms
  - Low Chemical Levels

ORP Validation of Oxidizing Biocide Feed



Cooling Tower Water Management Technology

Filtration System

- Keep dirt and debris out of the system.
- Breeding grounds for bacteria and biofilm.

Domestic Water Systems

Should be given equal importance to cooling towers in regards to sources of Legionella Transmission

- Provides Legionella with favorable growth and amplification conditions.
- Many outlets to disseminate aerosols that could transmit Legionnaires Disease (showerheads, faucets, hot water tanks etc.)
- Deadlegs that create stagnant conditions.

Have a Plan!!

Water Safety Plan

System Assessment

Monitoring

Management/ Communication

Surveillance (Validation)

Domestic Water Management Solutions

- Reduce deadlegs (stagnant lines and stubs) in the system.
- Clean and inspect hot water tanks regularly – annually as a minimum.
- Continually run hot water circulation pumps – avoid recycling to mixing valves.
- Store hot water at a minimum temperature of 140F and deliver to the taps a minimum temperature of 122F.

Domestic Water Management Solutions (continued)

- Store and distribute the cold domestic water below 68F – if not possible then consider monitoring Legionella and using a disinfection system if Legionella are not under control.
- Flush the entire water system on a regular basis.
- Consider routine potable water treatments – including the use of approved secondary disinfectants.

Disinfection Technologies

- Thermal Eradication
  Legionella control using heat
- Non-EPA SDWA-listed treatments
  Technologies employed for Legionella control but ***NOT*** *listed for potable water by the EPA*
- EPA-listed disinfectants
  Technologies effective in controlling Legionella and approved for potable water by the EPA

Thermal Eradication

- Superheat & Flush
- "Temporary Systemic Disinfection Modality"[3]
- Must generate and maintain 160°F (70°C) in the DHW system during the entire procedure
- Must maintain 140°F (60°C) for 30 minutes at the distal site (sink, shower, water fixture)
- Recolonization of Legionella will occur

Thermal Eradication

Why not rely on Thermal Eradication?

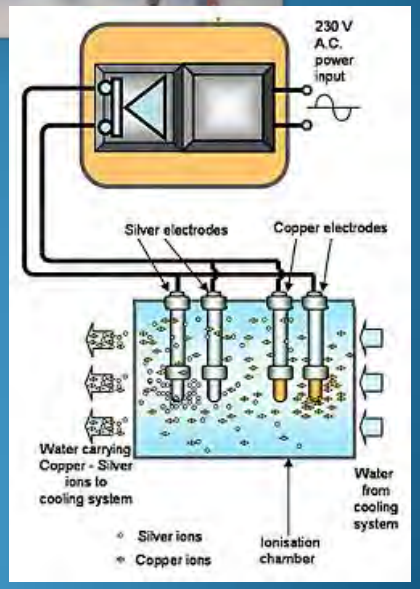
- Building how water system unable to reach or maintain temperature
- Scalding risk to patients and staff
- Manpower required to execute and monitor procedure
- High cost of procedure
- Temporary solution- Recolonization of Legionella will occur

Non-EPA Technologies

- Several Non-EPA approved methods have been recently employed for Legionella control.
- Copper Silver Ionization
- Mixed Oxidants

Copper/Silver Ionization

- Studies show adequate control in some cases
- Numerous systems required for site
- Not EPA approved disinfectant
- Treat only hot water
- High capital cost
- High maintenance
- High corrosion potential
- Not effective long-term

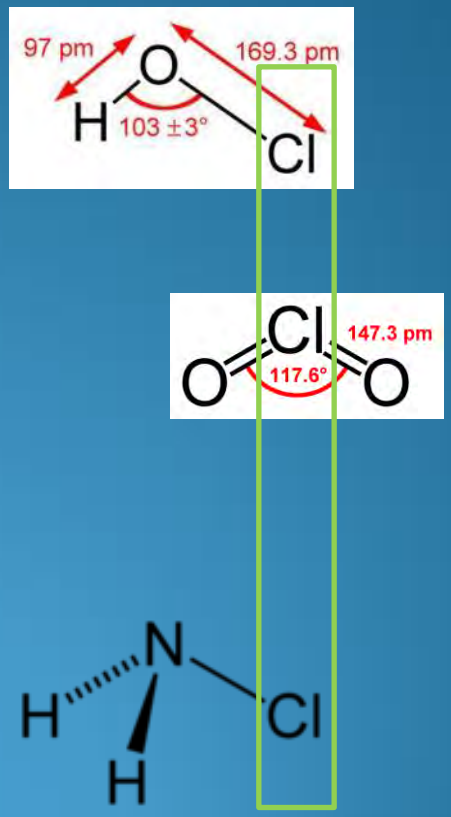


Mixed Oxidant

- No peer-reviewed potable water Legionella control studies
- Unproven for potable water Legionella Control
- Unknown mixed oxidants produced
- Not listed for potable water use

EPA Listed Disinfectants

- **Hypochlorite** → cheap, simple to use, less effective, toxic by-products, high residuals required
- **Chlorine dioxide** → very good disinfectant, used in drinking water
- **Monochloramine** → very good disinfectant, used in drinking water, used for Legionella remediation with success



Chlorination

- Long established technology
- Legionella control may be achieved if free chlorine is continually maintained at **2.0-6.0** PPM,
- Most incoming city water contains below 1.0 PPM
- Multitude of chemical feed and monitoring equipment available

Chlorination System

Chlorination

Why Not Chlorination?

- Residual required for Legionella control may violate the Safe Drinking Water Act (SDWA)
  - MRDL for chlorine is 4.0 PPM
  - Some States set MRDL at 2.0 PPM
- Disinfection byproducts formed
  - Trihalomethane (THM)- Known Carcinogen
  - Haloacetic Acids (HAA5)

Chlorination (continued)

Why Not Chlorination?

- Chlorine attacks metal pipes; leaks and corrosion failures likely to occur
- Corrosion must be minimized by using a secondary corrosion inhibitor chemical

Chlorination (continued)

Why Not Chlorination?

- Chlorine may not kill Legionella, it may only suppress Legionella bacteria growth in bulk water
- If Chlorination system fails, Legionella can experience rapid growth and recolonization in the system
- Chlorine does not penetrate biofilm
- Chlorine taste and odor complaints

Chlorine Dioxide

- 8 times the efficacy of chlorine
- Legionella control achieved at 0.5 PPM of ClO_2
- Most effective choice for complex plumbing systems with multiple hot water recirculation loops
- No THM or HAA5 Formation
- Penetrates and destroys biofilm
- Some generation equipment is NSF/ ANSI Standard 61 Approved
- No taste & odor

Chlorine Dioxide System

Chlorine Dioxide

Why Not Chlorine Dioxide?

- Varying generation technologies
- Some generators require strong acids or chlorine gas be stored onsite
- Some manufactures generate chlorine dioxide at unstable levels (> 3000 mg/l)
- High cost of some generators
- Not all offerings are NSF/ ANSI Stds. 60 or 61 certified
- Damage to plastic piping systems. ClO 2 permeates into pipe and causes embritlement and failure.
- Can be difficult to maintain residual in hot water without supplemental feed.

Monochloramine

- Proven to be the most effective disinfectant against Legionella and many other Waterborne pathogens.
- Higher efficacy than chlorine dioxide
- Penetrates and destroys biofilm
- No listed DBP's formed
- NSF/ ANSI Std. 60 certified reagents
- New technology successfully delivered controlled doses of Monochloramine
- Rapid reduction of distal site positivity

Monochloramine System

Monochloramine

Why Not Monochloramine?

- Best applied to hot water recirculation loop
- New technology in the US, established in widespread applications in Europe
- Dosing control must maintain proper reagents ratio

Which EPA Approved Disinfection Technology is Appropriate?

Chlorine Dioxide

- High Legionella Efficacy
- Best Applied to Cold Water Mains
- Best Choice for Complex Facility with multiple Domestic Hot Water Recirculation Loops or Multi-Building Campus fed by Single Onsite drinking Water Treatment Plant.

Monochloramine

- High Legionella Efficacy
- Best Applied Directly to Domestic Hot Water Recirculation Loop
- Best Choice for Less Complex Healthcare Facility with few Domestic Hot Water Recirculation Loops

Which EPA Approved Disinfection Technology is Appropriate? (cont.)

- Proper technology selection is site specific
- Technology should be determined through a risk assessment

BREAK – 15 Minutes

- Help yourself to refreshments
- Restrooms – Located one stair level down and to the left

Legionella: A New Paradigm for Prevention

Janet E. Stout, Ph.D.

Director, President & CEO
Special Pathogens Laboratory

Research Associate Professor
University of Pittsburgh

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Preventing Legionellosis

By Janet Stout, Ph.D., Associate Member ASHRAE

Hospital engineers often go to guidance documents for help in preventing Legionnaires' disease. While advisory documents from health authorities and professional societies provide guidelines for approaches to prevention (*Table 1*),[1] a consensus opinion for

- Recommendations be prospectively validated through controlled studies;
- Studies should include a prolonged observational period (greater than one year) to evaluate the efficacy of recommended actions; and
- Recommended approaches/actions achieve the expected result, prevention of the disease through environmental

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Legionella

- Lots of Anxiety
- Legionella in Building Water Systems
- New Approaches to Control & Prevention
- My Favorite: New Research

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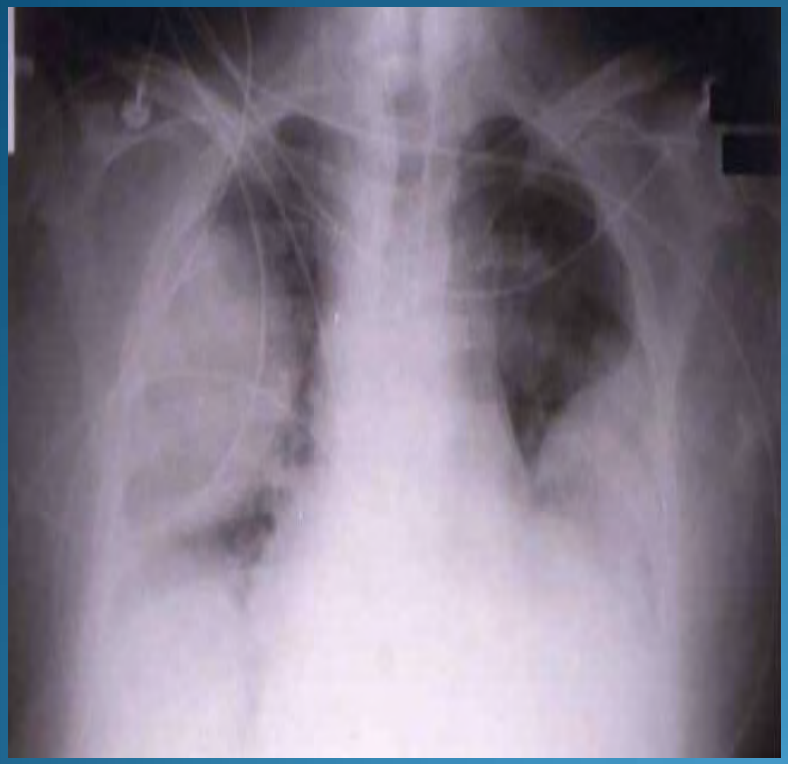

The Challenge of Legionnaires' Disease

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Preventing Legionnaires' Disease

How are we doing?

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Legionella Is Winning

- Legionnaires' disease is increasing
- Legionella control poses new challenges

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July Health Alert

PENNSYLVANIA DEPARTMENT OF HEALTH
2013-PAHAN-261-07-10-ALT
Increased Legionella Infections in Pennsylvania

pennsylvania
DEPARTMENT OF HEALTH

DATE:	7/10/2013
TO:	Health Alert Network
FROM:	Michael Wolf, Secretary of Health
SUBJECT:	**Increased Legionella Infections in Pennsylvania**
DISTRIBUTION:	Statewide

Report available: https://han.pa.gov

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Why Increase in Reported Cases?

- Better reporting?
- Increase in diagnostic testing? It's not an outbreak, it's an "outbreak of diagnosis"
- Environmental factors?

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Wet Weather and Legionnaires' Disease?

Rain, flooding likely led to spike in Legionnaires' disease

Reports of Legionnaires' disease follow heavy rains.

Comments 0 Recommend 4 Share 1 0

By Tim Darragh, Of The Morning Call
11:42 P.M. EDT, OCTOBER 17, 2011

All that rainfall in September may have left more than wet basements here and flood-wracked communities in northeast Pennsylvania.

It also appears it was at least partly responsible for a record spike in Legionnaires' disease, a water-borne bacterial pneumonia that can be fatal to some people.

© Special Pathogens Laboratory

Estimated Number of Cases

- In the U.S. approximately 600,000 adults are diagnosed with community-acquired pneumonia requiring hospitalization
- 2-5% are caused by Legionella, as many as 30,000 cases/year

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Legionnaires' Disease in Hospitals

- 35% of reported cases met the case definition for hospital-acquired infection (range 45% - 25%)
- Case fatality rate was 28% (range 46%-14%)

From Benin A.L., Benson R.F., Besser R.E. Clin Infect Dis 2002; 35:1039-46.
Data reported to the CDC from 1980-1998.

© Special Pathogens Laboratory

Many Cases Still Missed

- Diagnostic tests for Legionella not routine – often not done
- Many studies have demonstrated under reporting/missed diagnosis

© Special Pathogens Laboratory

Under Reporting Due to Missed Diagnosis

Hollenbeck *et al. BMC Infectious Diseases* 2011, **11**:237
http://www.biomedcentral.com/1471-2334/11/237

BMC Infectious Diseases

RESEARCH ARTICLE Open Access

How often is a work-up for *Legionella* pursued in patients with pneumonia? A retrospective study

Brian Hollenbeck[1], Irene Dupont[2] and Leonard A Mermel[2,3*]

Abstract

Background: It is unclear how often patients with pneumonia are assessed for *Legionella* in endemic areas. Additionally, the sensitivity of the IDSA/ATS criteria for recommended *Legionella* testing is undefined.

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Results for 37 Cases

41% of *Legionella* cases were missed following current IDSA-ATS recommendations for *Legionella* testing.

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Update on Diagnostic Methods

- Urine antigen tests were used to confirm 97% of U.S. resident cases reported during 2005–2009
- Only 5% of cases were confirmed by culture during this period
- <1% were confirmed by either serologic or direct fluorescent antigen testing

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How does *Legionella* get into our water?

© Special Pathogens Laboratory

Legionella in Drinking Water

© Special Pathogens Laboratory

"Public water supplies may contaminate the plumbing systems of hospitals and other large buildings."

States, SJ, Conley LF, Kuchta JM, et al. Survival and multiplication of L. pneumophila in municipal drinking water systems. Appl. Environ. Microbiol. 1987; 53: 979-986.

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"Legionella …
is the single most common etiologic agent associated with outbreaks involving drinking water."

National Academy of Sciences Report, Report by the U.S. Environmental Protection Agency (EPA) and the Committee on Public Water Supply Distribution Systems

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"One third of drinking water-associated outbreaks occurred in building premise plumbing systems outside the jurisdiction of water utility management and EPA regulations; Legionella spp. accounted for >90% of these outbreaks."

MMWR Surveill Summ. 2011 Sep 23;60(12):38-68.Surveillance for waterborne disease outbreaks associated with drinking water---United States, 2007--2008.

Brunkard JM1, Ailes E, Roberts VA, Hill V, Hilborn ED, Craun GF, Rajasingham A, Kahler A, Garrison L, Hicks L, Carpenter J, Wade TJ, Beach MJ, Yoder Msw JS; CDC.

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Drinking water ~~can be~~ is the prime Legionnaires' disease carrier

CHICAGO (AP) – Seven kinds of bacteria have been found to cause

drinking more water. The evidence, however, was not conclusive.

At that time, it was difficult to test for

bacteria are causing the disease.

Legionnaires' disease remained undiscovered until 1976 because it was

© Special Pathogens Laboratory

DRINKING WATER

What Ben Franklin had to say

© Special Pathogens Laboratory

"With wine comes wisdom,

with beer comes freedom,

with water comes *Legionella*."

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Legionella in Our Water

- New at-risk populations: long-term care facilities (nursing homes) and rehabilitation centers
- Increase number of younger patients with no typical risk factors
- Potable water is the source
- Showering over-emphasized
- Immuno-compromised children at risk

© Special Pathogens Laboratory

Another High Risk Group

INVITED COMMENTARY

Neonatal Legionellosis

The Tip of the Iceberg for Pediatric Hospital-Acquired Pneumonia?

Victor L. Yu, MD, and Tzielan C. Lee, MD

The Pediatric Infectious Disease Journal • Volume 29, Number 3, March 2010

© Special Pathogens Laboratory

Water Is a Source of Infection for Neonates And Exposure Occurs in Healthcare Facilities

Epidemiology of Pediatric LD

- CDC study showed 72% pediatric cases had healthcare exposure
- Mortality rate 22% *(Alexander NT, et al 2008 ICAAC)*

Lots of ...

Legionella Anxiety

© Special Pathogens Laboratory

Coping with Legionella

- Denial
- Bargaining
- Depression
- Acceptance
- Medication

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Denial

© Special Pathogens Laboratory

Denial

Most wait to address the problem until

after

a case of Legionnaires' disease is diagnosed.

© Special Pathogens Laboratory

Bargaining

- Legionella is everywhere
- It is too costly to control/monitor
- If I don't know, I'm not responsible

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Is Legionella Everywhere?

- 12 – 70% of hospitals are colonized, depending on the study
- 10 - 20% of homes are colonized
- Legionella is not ubiquitous

© Special Pathogens Laboratory

Is Legionella Too Costly to Control and Monitor?

© Special Pathogens Laboratory

CDC Estimates

- Cost per patient $34,000
- Average hospital stay 10 days
- Total hospitalization costs per year between $101 and $321 million dollars

Collier, SA. 07. Presented at: 2010 International Conference on Emerging Infectious Diseases; July 11-14, 2010; Atlanta.

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Legionella Outbreaks Are Costly

© Special Pathogens Laboratory

Costly Outbreaks

- Legionella in the water systems of buildings is a serious health risk
- Even a single case can dramatically affect an organization

Floors likely to reopen at Grady today

Hospital makes changes in wake of Legionnaires'

By CRAIG SCHNEIDER
cschneider@ajc.com

Grady Memorial Hospital expects to reopen some areas today that were contami- ...ted ... while ... $700,000 ... to prev... hospital officials said.

Hospital officials said

for a person to contract the potentially deadly disease. Legionnaires' is a form of pneumonia.

Today, if tests determine the areas are safe, the hospi- ... cl...ed because the space isn't needed.

$700,000

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Outbreak Response: Pittsburgh VA Hospital

$10 Million

$10M in safety upgrades planned for 2 campuses, testing, mapping of pipes

BY ADAM SMELTZ

Despite allegations from Congress, a labor union and military families in mourning, a top official with the VA Pittsburgh Healthcare System said on Wednesday that he does not know of any attempt to conceal the [illegible] Legionella [illegible] and [illegible] deaths.

"As the overseer, I'm not aware of any effort to provide any kind of cover-up," VA regional Director Michael Moreland said in a controlled interview provided to the Tribune-Review four months after the outbreak was publicly revealed.

Moreland rejected concerns from Congress that VA leaders withheld critical information [illegible] O'Hara campuses. "The first time Congress heard about this was when we notified them," he said.

VA administrators used the interview to announce more than $10 million in safety improvements at the 224-bed Oakland hospital and the 262-bed Heinz campus in O'Hara. Testing for Legionella and Legionnaires'

VA · A4

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Depression

© Special Pathogens Laboratory

Is Legionella Too Costly to Control & Monitor?

Lessons learned:

- Costs of the disease in millions
- Outbreaks cost way more than proactive prevention
- Ounce of prevention…

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Acceptance

© Special Pathogens Laboratory

New Paradigm for Prevention

© Special Pathogens Laboratory

Proposed ASHRAE Standard 188P

Engineers' codes target Legionella

Group proposes new rules for building operators to prevent waterborne bacteria

BY ADAM SMELTZ

An engineering group that influences building codes nationwide is drafting tough new standards to prevent Legionella, the waterborne bacteria blamed in a deadly Legionnaires' disease outbreak in Pittsburgh.

Federal estimates show Legionnaires', a form of pneumonia, kills more than 4,000 people and sickens about 21,000 others each year, three decades after researchers figured out how to control the bacteria in tap water.

The proposed standards would require building operators to verify they are monitoring the Legionella threat in commercial, residential and medical facilities with established risk factors, such as multiple whirlpools and spas. It also outlines methods to prevent the growth of the bacteria.

The cost of implementing these standards is unknown. Single-family homes would not be included in the proposed changes.

"It's not the science or the engineering lacking here. It's the lack of a management system that can be applied in a practical and defensible way," said William McCoy, Standards Committee chairman at the American Society of Heating, Refrigerating and Air-Conditioning Engineers in Atlanta.

McCoy's international committee, part of the 55,000-member engineering society, worked for the past six years to craft the first unified and enforceable domestic rules for Legionella control in the plumbing of large buildings, where the bacteria can fester and grow. The proposed plan could be voted on by the society's board this year.

The International Code Council in Washington generally adopts ASHRAE recommendations in building code guidelines that are used by state and local code enforcement agencies across the country.

Current ICC recommendations do not mention Legionnaires' disease, spokesman Steve Daggers said. The little-known council drew national attention in 2008 for advocating stringent fire sprinkler standards for single-family homes that met with heavy resistance from builders and consumers.

ASHRAE will not perform a cost-

VA · B7

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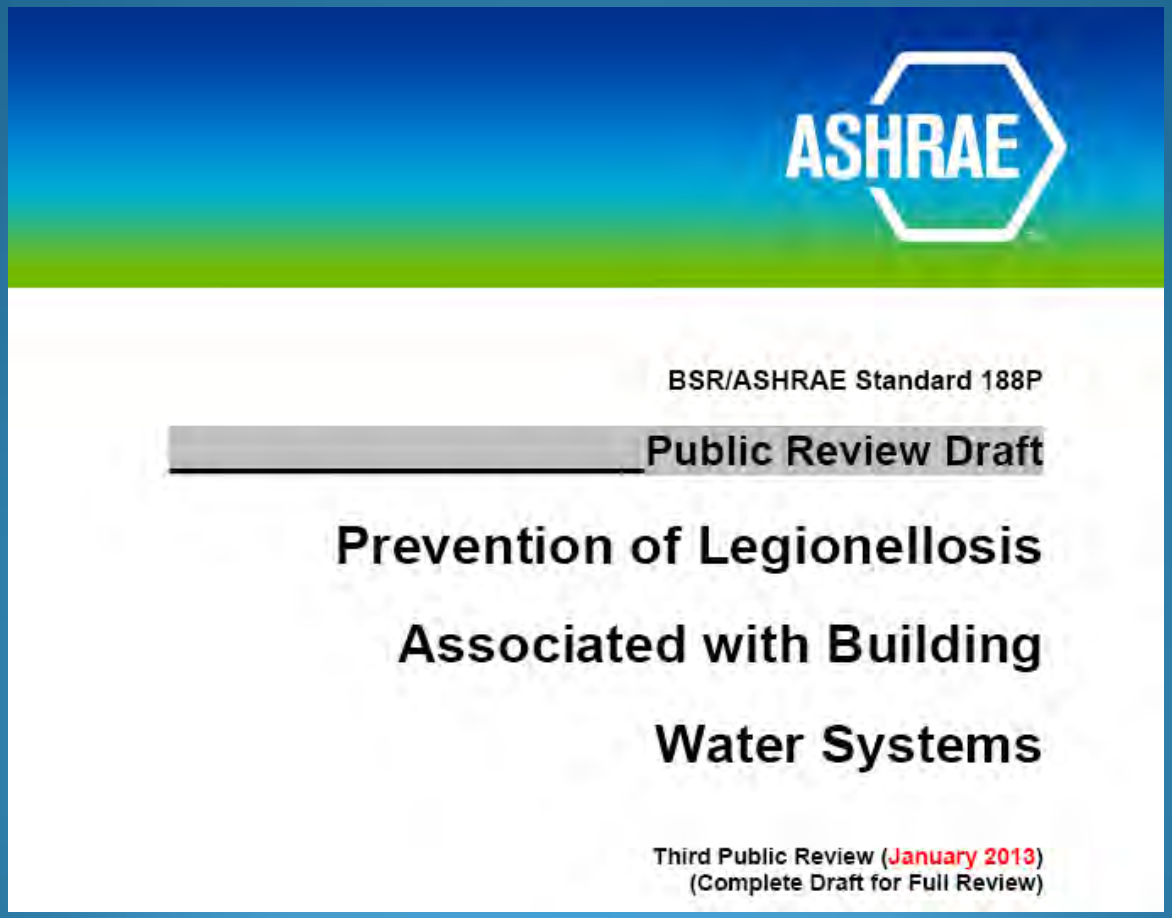
Acceptance



ASHRAE

BSR/ASHRAE Standard 188P

Public Review Draft

Prevention of Legionellosis Associated with Building Water Systems

Third Public Review (January 2013)
(Complete Draft for Full Review)

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DISCLAIMER

The opinions expressed are those of the author and do not represent those of ASHRAE or other cited organizations.

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ASHRAE Guideline vs. Standard

Standard

- Eventually ends up in codes
- Specific direction for management
- "You shall," "You must" language

Guideline

- Nonbinding
- Provides suggestions for management
- Should's and Could's

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What Is ASHRAE Standard 188P?

Risk management approach for the prevention of legionellosis associated with centralized industrial and commercial building water systems

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Risk Management Approaches

- Water Safety Approach (WHO)
- Hazard Analysis

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Assessing Risk

Facility owners and managers survey buildings to determine risk characteristics such as water system characteristics and building occupants.

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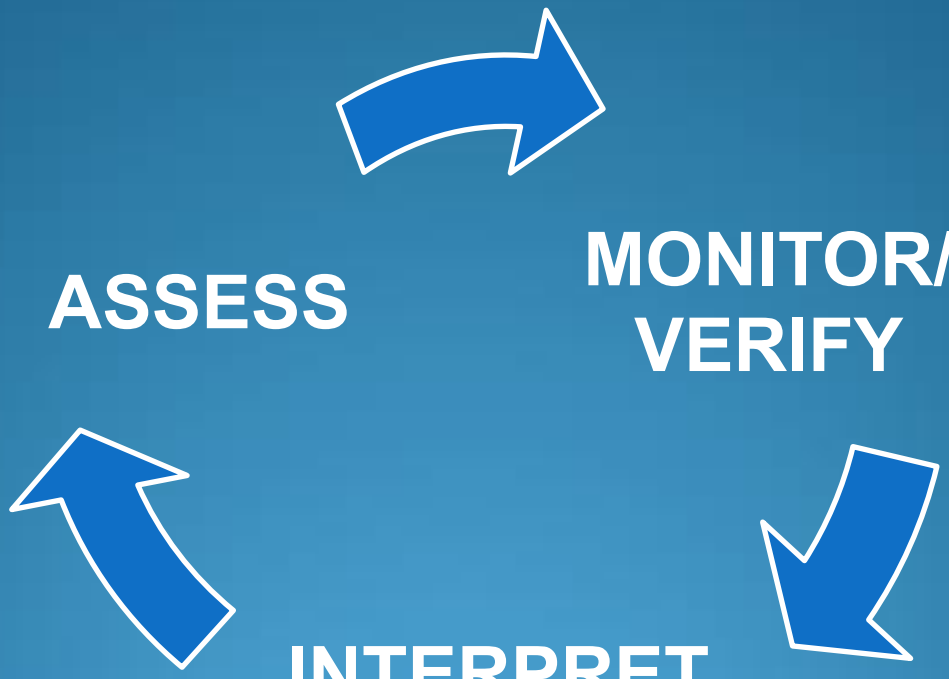
Who Is Responsible?

Facility managers on front line of water safety.

Responsibility

Facility managers will soon be required to implement stronger safeguards to protect against Legionellosis.

Legionella Water Safety



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Legionella and the Law

Legionnaire's disease victim sues Md. retirement home

Charlotte man is suing Baltimore developers and others for $225 million.

By Tricia Bishop
Baltimore Sun
Posted: Friday, Aug. 13, 2010

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Impact on Legionella Litigation

New Mandates for Building Water Systems Affect Legal Liability in Legionnaires' Disease Cases

By Garry R. Boehlert and Janet E. Stout

Legionella bacteria are commonly present in man-made aquatic environments and contaminate up to 70% of all plumbing systems. The Centers for Disease Control and Prevention (CDC) estimate that *Legionella* bacteria annually cause as many as 18,000 cases of Legionnaires' disease in the United States. CDC, *Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water—United States*, 2007–2008, available at www.cdc.gov/mmwr/preview/mmwrhtml/ss6012a4.htm?s_cid=ss6012a4_w. More than 10% of those cases are fatal. *Legionella* bacteria also cause Pontiac Fever, a serious influenza-like illness. Together, these two water-borne illnesses are called Legionellosis. With increasing frequency the designers, owners, and managers of facilities believed to be the source of Legionellosis outbreaks find themselves defending claims and litigation demanding significant damages.

Change to the Status Quo Will Affect Legal Liability

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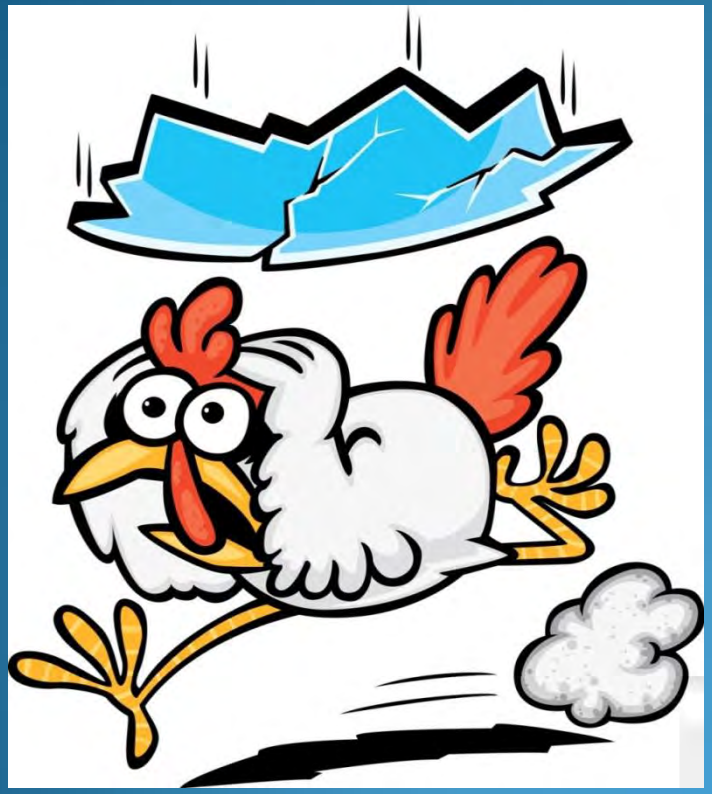
Property & Probate, Jan/Feb 2012

Is the Sky Falling . . .



. . . If I Find Some Legionella?

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What is an acceptable amount of a contaminant?

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IS ZERO NECESSARY?

© Special Pathogens Laboratory

Legionella

Zero is the goal, but
NOT NECESSARY
to avoid outbreaks.

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Establish Targets

- Action Levels
- Minimum Levels
- Goals

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Food and Drug Agency (FDA)

Product	Type of insect contamination	Action Level
Canned fruit juice	Insects and insect eggs	5 or more fly eggs per 250 ml or 1 or more maggots per 250 ml

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EPA Maximum Contaminant Regulatory Levels

- Maximum
- Contaminant
- Level
- Goal

- Maximum
- Contaminant
- Level

© Special Pathogens Laboratory

Environmental Protection Agency

Regulated	MCL (mg/L)	MCL Goal
Arsenic	0.010 milligrams per Liter	zero
Cyanide	0.2 milligrams per Liter	0.2 mg/L

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Defining Risk

- Concentration-based thresholds that establish target values in CFU per litre or millilitre
- OK for cooling towers
- Colonization rate or proportion of distal sites in the water system that are positive for Legionella
- Best for hospitals and building water systems

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Cooling Towers

Testing as a Performance-based Measure

© Special Pathogens Laboratory

Legionnaires' Cases in Quebec City

TOTAL NOW=180

A 13th death from legionnaires' disease in Quebec City

THE CANADIAN PRESS Thursday, September 13, 2012 4:1 PM

Recommend Be the first of your friends to recommend this.

QUEBEC - A 13th person has died from legionnaires' disease in Quebec City, while authorities are confident that the outbreak has been brought under control.

© Special Pathogens Laboratory

Outbreak = Guidance Failed

- Outbreak Canada's biggest, deadliest in 25 years
- 89 cooling towers disinfected
- Source=Cooling Tower

© Special Pathogens Laboratory

Review of *Legionella* Guidance

Journal of Occupational and Environmental Hygiene, 8: 249–265
ISSN: 1545-9624 print / 1545-9632 online
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DOI: 10.1080/15459624.2011.565409

Assessing Maintenance of Evaporative Cooling Systems in Legionellosis Outbreaks

Kelly M. Rangel, George Delclos, Robert Emery, and Elaine Symanski

Division of Epidemiology, Human Genetics and Environmental Sciences, University of Texas School of Public Health, Houston, Texas

Rangel, K. Delcos G, Emery R, Symanski E. 2011. Assessing maintenance of evaporative cooling systems in Legionellosis outbreaks. J Occup Environ Hyg. 8(4): 249-265

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Review

- Guidelines from 1990 to 2009; reported outbreaks 1979-2009
- Results – 38 outbreaks:
  - Lack of or improper use of biocides
  - Infrequent testing for microbiological contamination
  - Lack of system cleaning within 6 months of outbreak

© Special Pathogens Laboratory

A review of guidelines for evaporative cooling systems revealed that guidelines failed to contain detailed procedures to prevent problems seen in outbreaks.

Rangel, K. Delcos G, Emery R, Symanski E. 2011.Assessing maintenance of evaporative cooling systems in Legionellosis outbreaks. J Occup Environ Hyg. 8(4): 249-265.

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Controlling Legionella: What Works in Cooling Towers?

Legionella species colonization in cooling towers: Risk factors and assessment of control measures

Varvara A. Mouchtouri, BSc, PhD,[a,b] Georgia Goutziana, MD,[a] Jenny Kremastinou, MD, PhD,[b] and Christos Hadjichristodoulou, MD, PhD[a]
Larissa and Athens, Greece

Mouchtouri et al. American Journal of Infection Control, 2009

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Study

- Examined 96 cooling towers
- Results – 130 samples tested
  - 49% colonized with Legionella species
  - What were the elements of the effective water treatment and management programs (negative for Legionella)?

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Study Results

Effective programs included the following:

- Chemical disinfection with biocides known to be effective (p=0.0003)
- Periodic Legionella testing (p=0.002)
- Presence of a risk assessment plan (p=0005)

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Testing Significantly Associated with Negative Towers

Table 3. Association of cooling towers system and operational characteristics with *Legionella* spp contamination (univariate analysis)

Characteristics	Number of positive cooling towers for *Legionella* spp			
	With characteristic (%)	Without characteristic (%)	RR (95% CI)	*P*
Algaecide water treatment	3 (60.0)	14 (58.3)	1.02 (0.46-2.26)	.60
Antiscale water treatment	19 (51.4)	8 (57.1)	0.89 (0.51-1.55)	.40
Chemical disinfection	4 (16.7)	23 (63.9)	0.2 (0.10-0.65)	.0003
Cleaning every > 6 months	3 (75.0)	35 (46.7)	1.60 (0.86-2.97)	.20
Heterotrophic colony count tests not conducted	26 (60.5)	32 (42.1)	1.43 (1.00-2.05)	.04
Legionella spp. tests every 3 months not conducted	25 (65.8)	13 (31.7)	2.07 (1.25-3.43)	.002
Sprinklers not properly operated	0 (0.0)	38 (48.1)	—	—
System components damaged	2 (50.0)	36 (48.0)	1.04 (0.38-2.85)	.60
Responsible person not trained	16 (66.7)	22 (40.0)	1.66 (1.08-2.56)	.02
Free-residual chlorine < 0.5 mg/L	33 (55.9)	5 (25.0)	2.23 (1.01-4.94)	.01
Presence of risk assessment and management plan	1 (7.1)	26 (59.1)	0.12 (0.01-0.81)	.0005
Chlorine disinfection	6 (28.6)	41 (56.2)	0.50 (0.25-1.03)	.02
Cooling tower not protected from sunlight	18 (64.3)	20 (39.2)	1.63 (1.05-2.54)	.02

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A "Well-Maintained" Cooling Tower

Automated dosing of chemical biocides and clean

>3000 CFU/ml Legionella pneumophila serogroup 1

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Water Distribution Systems

Legionella testing

© Special Pathogens Laboratory

Outbreaks in Nursing Homes & Assisted Living Facilities

The Columbus Dispatch

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Number of Legionnaires' cases rises to 39

LOCAL

» Westbound I-270 closed at Sawmill

» $10,000 reward offered in North Linden homicide

» Handcuffed-kids

By Misti Crane

The Columbus Dispatch · Friday August 2, 2013 4:34 PM

Comments: 1 | Recommend 4 | Tweet 6

Health officials said today that the number of people sicke
Legionnaires' disease outbreak at a Reynoldsburg retirem
is now up to 39.

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PUBLIC HEALTH

Legionnaires' death toll at Reynoldsburg retirement center hits 6

By Misti Crane

The Columbus Dispatch · Wednesday August 7, 2013 4:37 AM

Comments: 0 | Recommend 35 | Tweet 20 | ShareThis

A sixth Wesley Ridge Retirement Community resident has died in the state's largest and deadliest Legionnaires' disease outbreak on record.

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Legionella in Hospital Water Systems: Link to Disease

1994 – Alary & Joly

20 hospital study: "hospitals with a water system contaminated by Legionella were more likely to have cases of legionellosis (p=0.054)

Joly J and Alary M. Occurrence of nonsocomial Legionnaires' disease in contaminated potable water supply. In: Barbaree JM, Breiman RF, Dufour AP. eds. Legionella: Current Status and Emerging Perspectives. Washington, DC. ASM Press

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Multi-Center Study of 20 Healthcare Facilities

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JULY 2007, VOL. 28, NO. 7

ORIGINAL ARTICLE

Role of Environmental Surveillance in Determining the Risk of Hospital-Acquired Legionellosis: A National Surveillance Study With Clinical Correlations

Janet E. Stout, PhD; Robert R. Muder, MD; Sue Mietzner, MS; Marilyn M. Wagener, MS; Mary Beth Perri, BS; Kathleen DeRoos, MSN; Dona Goodrich, BS; William Arnold, MS; Theresa Williamson, MS; Ola Ruark, MSN; Christine Treadway, MSN; Elizabeth C. Eckstein, MSN; Debra Marshall, RN; Mary Ellen Rafferty, MS; Kathleen Sarro, RN; Joann Page, MS; Robert Jenkins, BA; Gina Oda, MS; Kathleen J. Shimoda, RN, BS; Marcus J. Zervos, MD; Marvin Bittner, MD; Sharon L. Camhi, MD; Anand P. Panwalker, MD; Curtis J. Donskey, MD; Minh-Hong Nguyen, MD; Mark Holodniy, MD; Victor L. Yu, MD; and the Legionella Study Group

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Findings

- 20 Hospital prospective study
- 43% positive for Legionella spp.
- 6/14 had extensive colonization (>30% outlets positive)
- 4 of these 6 hospitals identified cases of hospital-acquired Legionnaires' disease

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Legionella Testing

- Increased Awareness
- Triggered Control Measures

AJIC practice forum

A proactive approach to prevention of health care–acquired Legionnaires' disease: The Allegheny County (Pittsburgh) experience

Cheryl L. Squier, RN, CIC,[b,c] Janet E. Stout, PhD,[c,d] Sharon Krsytofiak, MS, MT(ASCP), CIC,[b] Joan McMahon, RN, M
Marilyn M. Wagener, MS,[d] Bruce Dixon, MD,[a] and Victor L. Yu, MD[c,d]
Pittsburgh, Pennsylvania

Am. J. Infection Control 2005; 33(6):360-367

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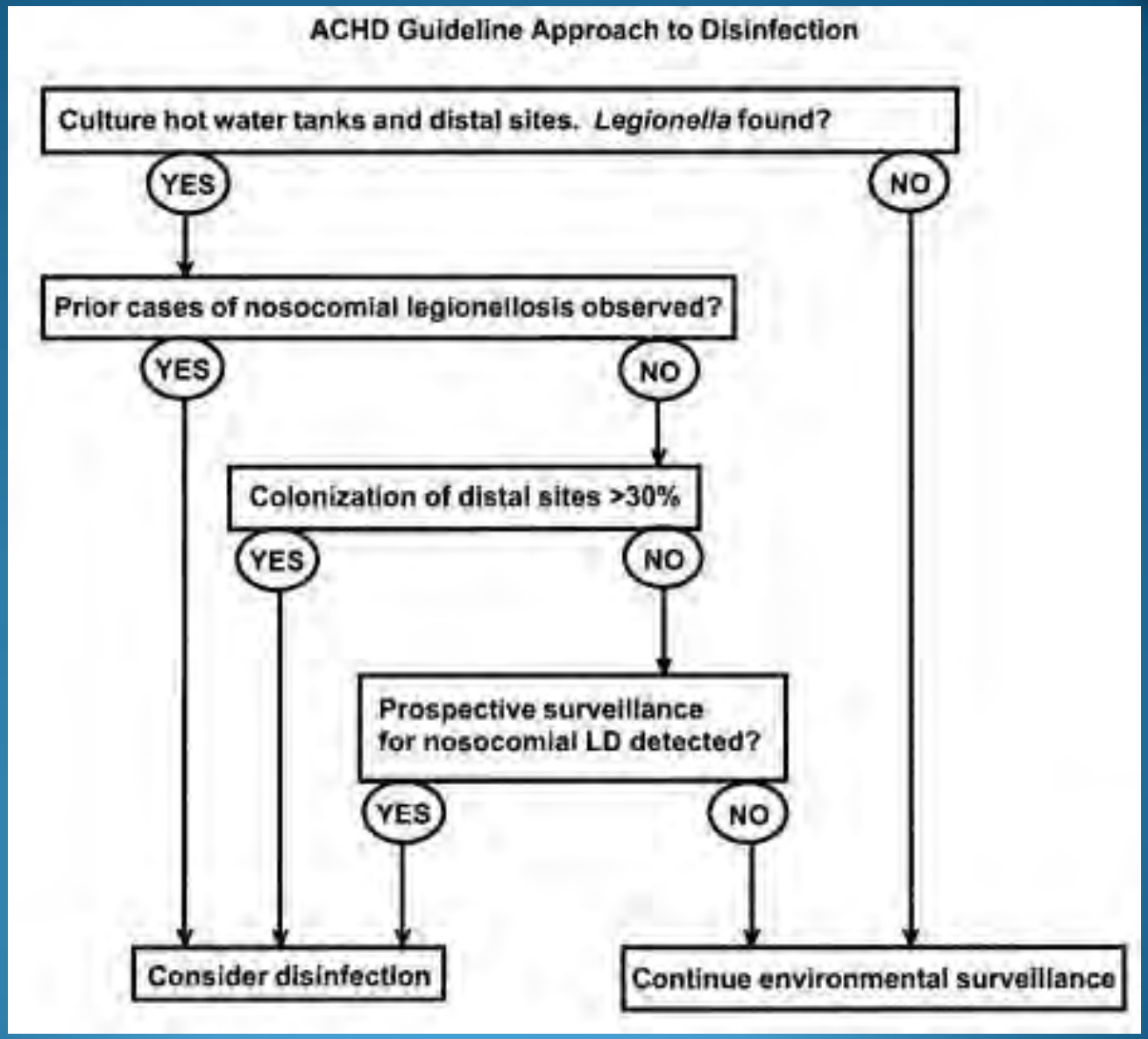
Allegheny County Approach to Prevention of Hospital-Acquired Legionnaires' Disease 1993



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Study Findings

- Reviewed 487 reported cases from 1991 - 2001 (Pre- and-post guideline)
- Significant decrease in healthcare-acquired cases observed in the post guideline period ($p<0.0001$)
- Control Measures = 44% of hospitals initiated disinfection of the water system

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World Health Organization

Legionella and the Prevention of Legionellosis, Geneva. 2007

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WHO – Legionella Testing

- Legionella testing can be a useful component of monitoring to verify the performance of water safety plans
- Is recommended for cooling towers, hot tubs and water distribution systems where people are at high risk (healthcare facilities)

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WHO – Legionella Testing (cont.)

- Legionella testing is not suitable for operational monitoring
- Legionella testing cannot be considered a control measure
- Legionella testing can be used in validation to provide some evidence that the plan is effective

World Health Organization. Legionella and the prevention of legionellosis. Geneva. 2007

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Legionella Testing

- Legionella testing can be a useful component of monitoring to verify the performance of water safety plans
- Use Legionella testing for establishing performance-based targets **NOT** health-based targets

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Set Performance-Based Targets

- Goal
- Alert
- Maximum

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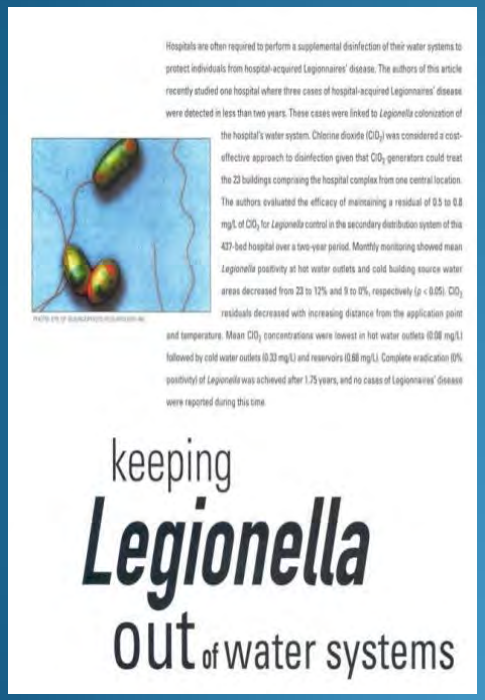
DISINFECTION OPTIONS



Hospitals are often required to perform a supplemental disinfection of their water systems to protect individuals from hospital-acquired Legionnaires' disease. The authors of this article recently studied one hospital where three cases of hospital-acquired Legionnaires' disease were detected in less than two years. These cases were linked to *Legionella* colonization of the hospital's water system. Chlorine dioxide (ClO_2) was considered a cost-effective approach to disinfection given that ClO_2 generators could treat the 23 buildings comprising the hospital complex from one central location. The authors evaluated the efficacy of maintaining a residual of 0.5 to 0.8 mg/L of ClO_2 for *Legionella* control in the secondary distribution system of this 437-bed hospital over a two-year period. Monthly monitoring showed mean *Legionella* positivity at hot water outlets and cold building source water areas decreased from 23 to 12% and 9 to 0%, respectively ($p < 0.05$). ClO_2 residuals decreased with increasing distance from the application point and temperature. Mean ClO_2 concentrations were lowest in hot water outlets (0.08 mg/L) followed by cold water outlets (0.33 mg/L) and reservoirs (0.68 mg/L). Complete eradication (0% positivity) of *Legionella* was achieved after 1.75 years, and no cases of Legionnaires' disease were reported during this time.

keeping
Legionella
out of water systems

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HOSPITAL WATER SYSTEMS

What's New Disinfection Methods

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Disinfection Methods

- Thermal shock treatment (heat & flush)
- Shock chlorination (>10 mg/L residual), may require water tanks to be 20-50 mg/L
- Continuous supplemental chlorination (2-4 mg/L)
- Copper-silver ionization (continuous)
- Chlorine Dioxide (ClO2)
- Point-of-use filtration

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Chlorine

Legionella

- Legionella more tolerant of chlorine – survives up to 50 ppm
- E. coli - 99% kill < 1.0 min. vs. 40 min.for Legionella
- 0.5 mg/L will not control Legionella

Plumbing

- Continuous chlorination caused extensive corrosion and facilities switched to other modalities

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Disinfection Methods Review

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY FEBRUARY 2011, VOL. 32, NO. 2

REVIEW ARTICLE

Controlling *Legionella* in Hospital Drinking Water: An Evidence-Based Review of Disinfection Methods

Yusen E. Lin, PhD, MBA;[1] Janet E. Stout, PhD;[2,3] Victor L. Yu, MD[3]

© Special Pathogens Laboratory

UPDATE

New Approach for Legionella Control in Hospital Water Systems

Monochloramine

© Special Pathogens Laboratory

Monochloramine

Vol. 24 No. 8 INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY 569

RISK OF HOSPITAL-ACQUIRED LEGIONNAIRES' DISEASE IN CITIES USING MONOCHLORAMINE VERSUS OTHER WATER DISINFECTANTS

James D. Heffelfinger, MD, MPH; Jacob L. Kool, MD, PhD; Scott Fridkin, MD; Victoria J. Fraser, MD; Jeffrey Hageman, MHS; Joseph Carpenter, PE; Cynthia G. Whitney, MD, MPH; Society for Healthcare Epidemiology of America

Infect Control Hosp Epidemiol 2003;24:569-574

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New Monochloramine System

Sanipur, Italy

© Special Pathogens Laboratory

First Study in United States

OBJECTIVE

Determine the efficacy of this new system for on-site generation of monochloramine for controlling Legionella in a hospital water system.

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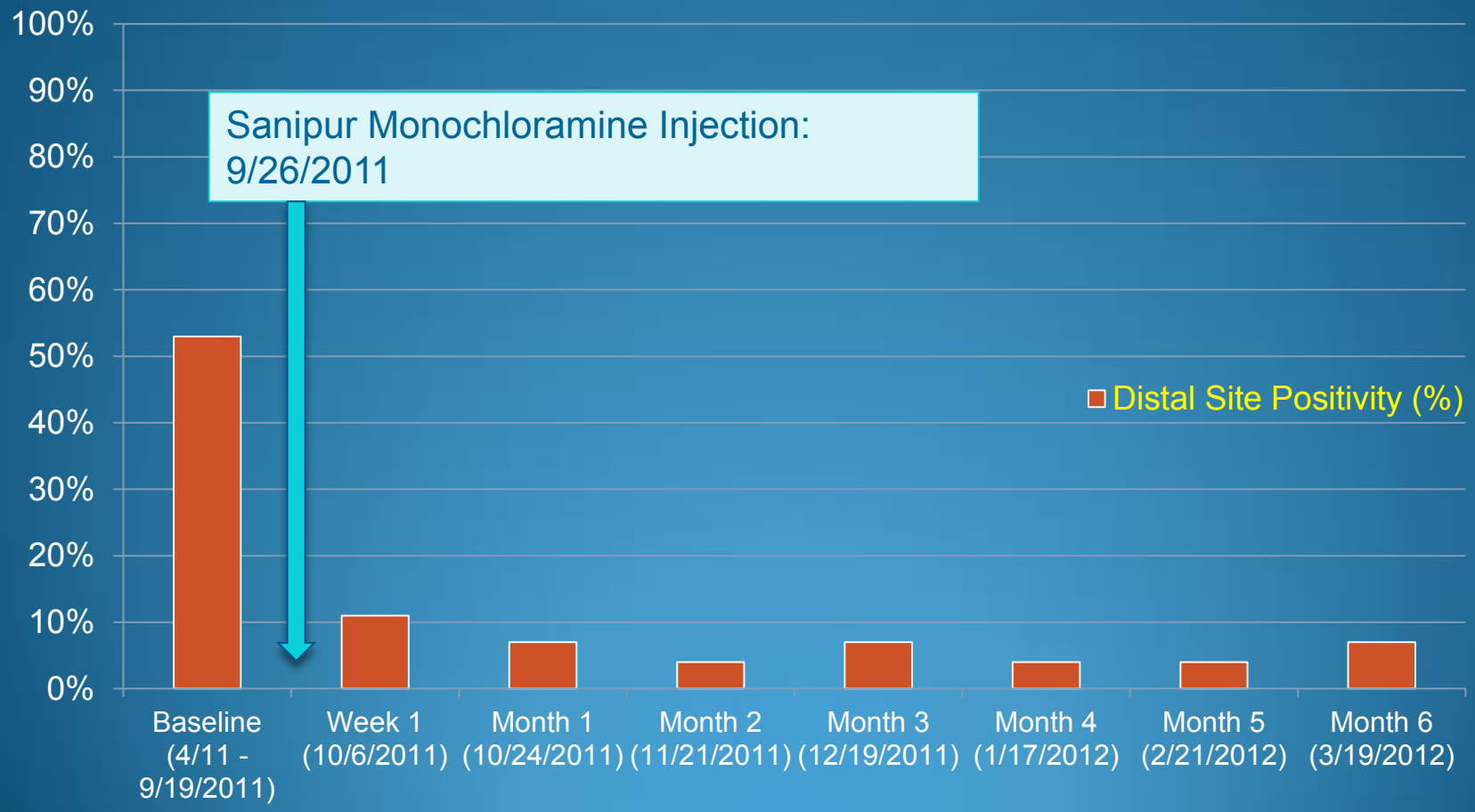
Dramatic Reduction in Legionella after Treatment



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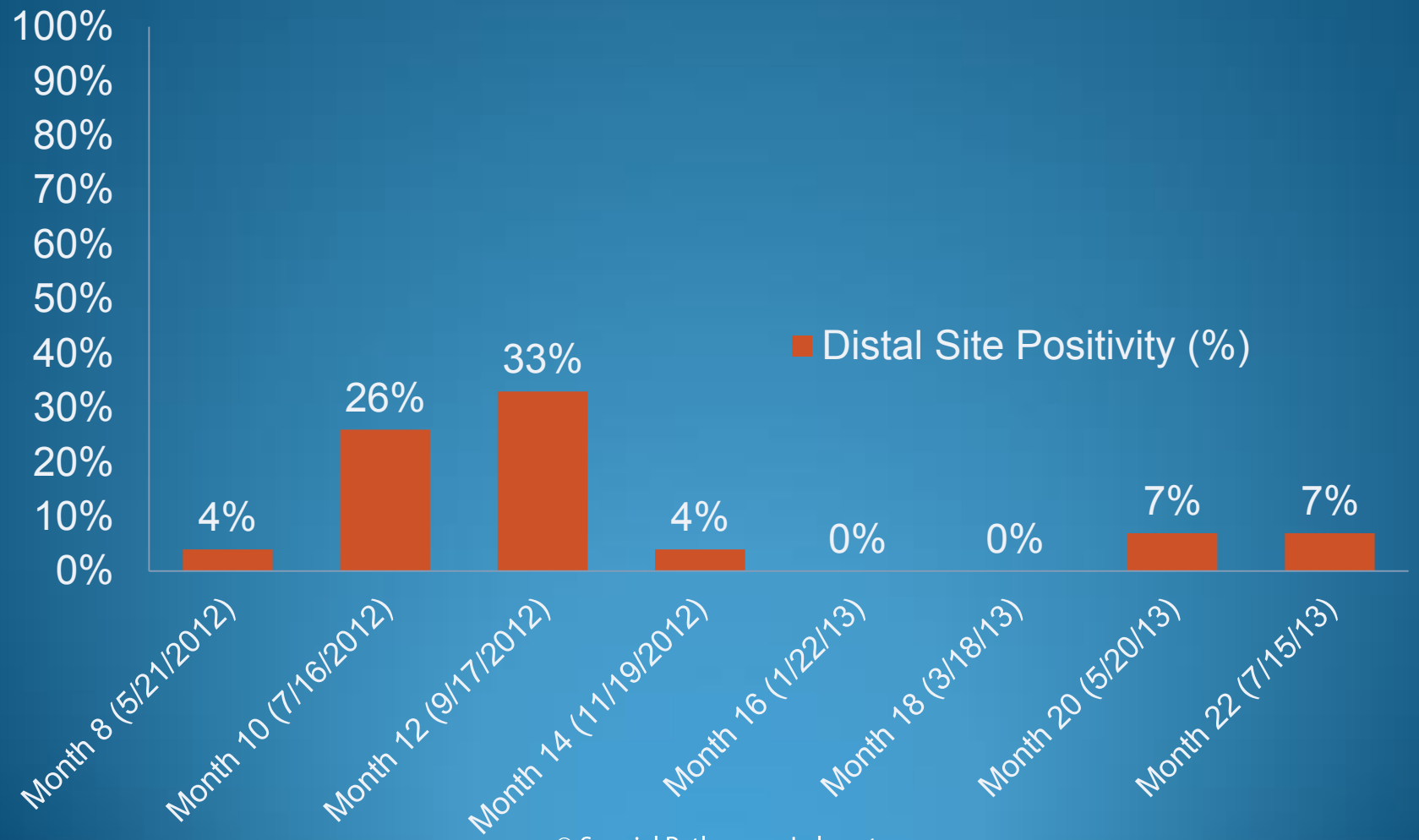
Dramatic Reduction in Legionella after Treatment



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Chemicals Degrade with Storage

Injection Reaction Chamber

Chemical Reagents

Buffered Ammonium Salt

Stabilized Chlorine

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Conclusions

- On-site generation of monochloramine significantly reduced Legionella positivity
- Monitor Legionella, monochloramine and ammonia
- Pay attention to reagent levels, storage and shelf life

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Protecting Transplant / High Risk Patients/Neonates

We Filter the Air…But Let Them Drink Tap Water?

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Barrier Against Exposure to Waterborne Pathogens

Efficacy of new point-of-use water filter for preventing exposure to *Legionella* and waterborne bacteria

Patricia J. Sheffer, MPM,[a] Janet E. Stout, PhD,[a,b] Marilyn M. Wagener, MPH,[b] and Robert R. Muder, MD[a,b]
Pittsburgh, Pennsylvania

American Journal of Infection Control 2005; 33:S20-25.

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Point of Use Filtration

- High Risk Patients
- Bone marrow and solid organ transplant units
- Hematology/oncology units
- NICU

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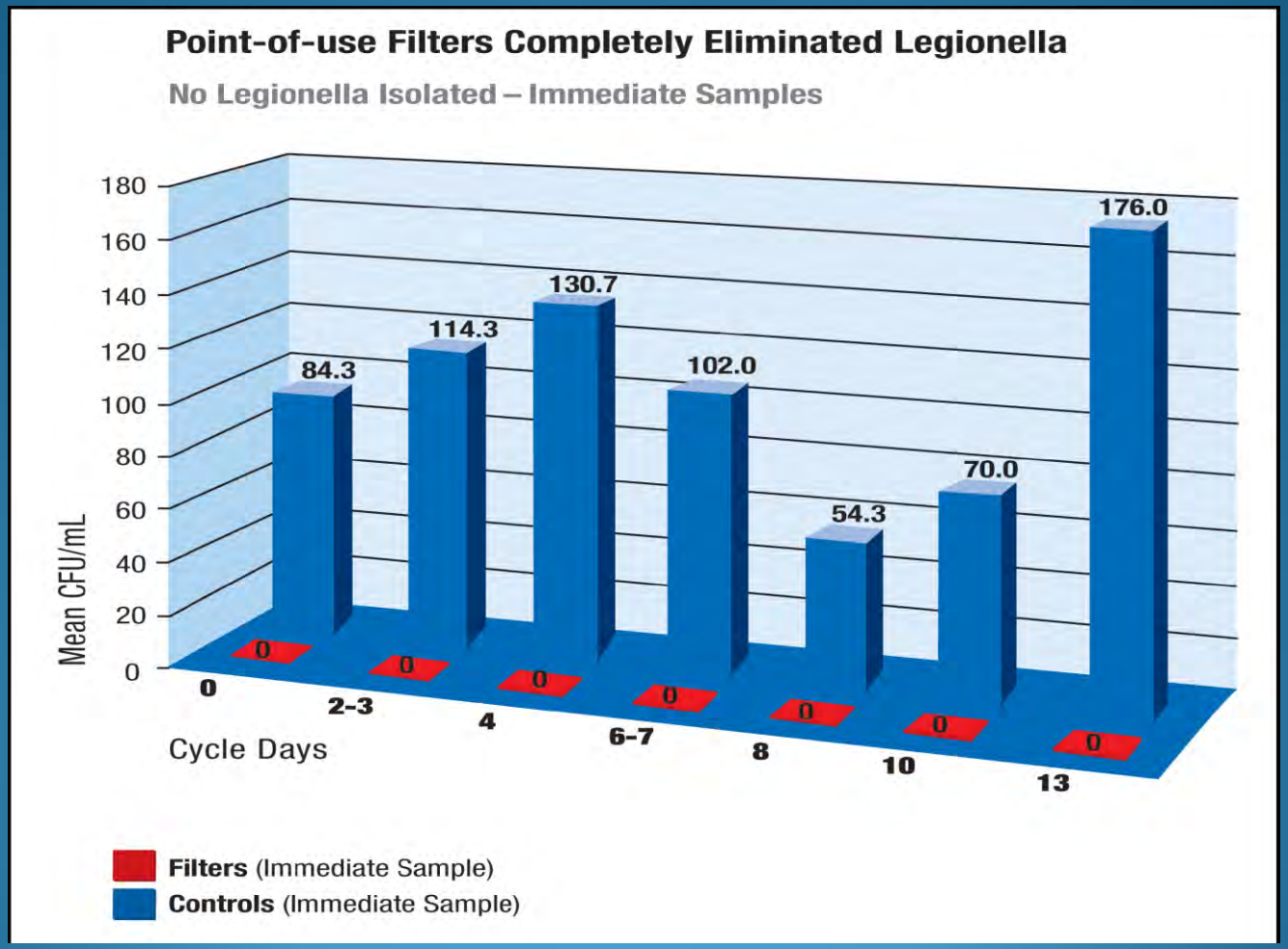
First Field Trial – 14 Days



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History of Point-of-Use Filters

Bacterial exclusion at 0.2 micro

- Use duration approximately 30 days
- Depending on water quality (particulates), filters may clog
- Need for improvement

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Field Evaluation of New Filter

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Study Using New POU Filters

- New Product – product label states 62 days of use
- Test Location – Cancer Center
- Sampling – 5 control faucets (no filter) and and 5 test faucets (with filters)
- Sampling Frequency– Weekly
- Duration – 14 weeks

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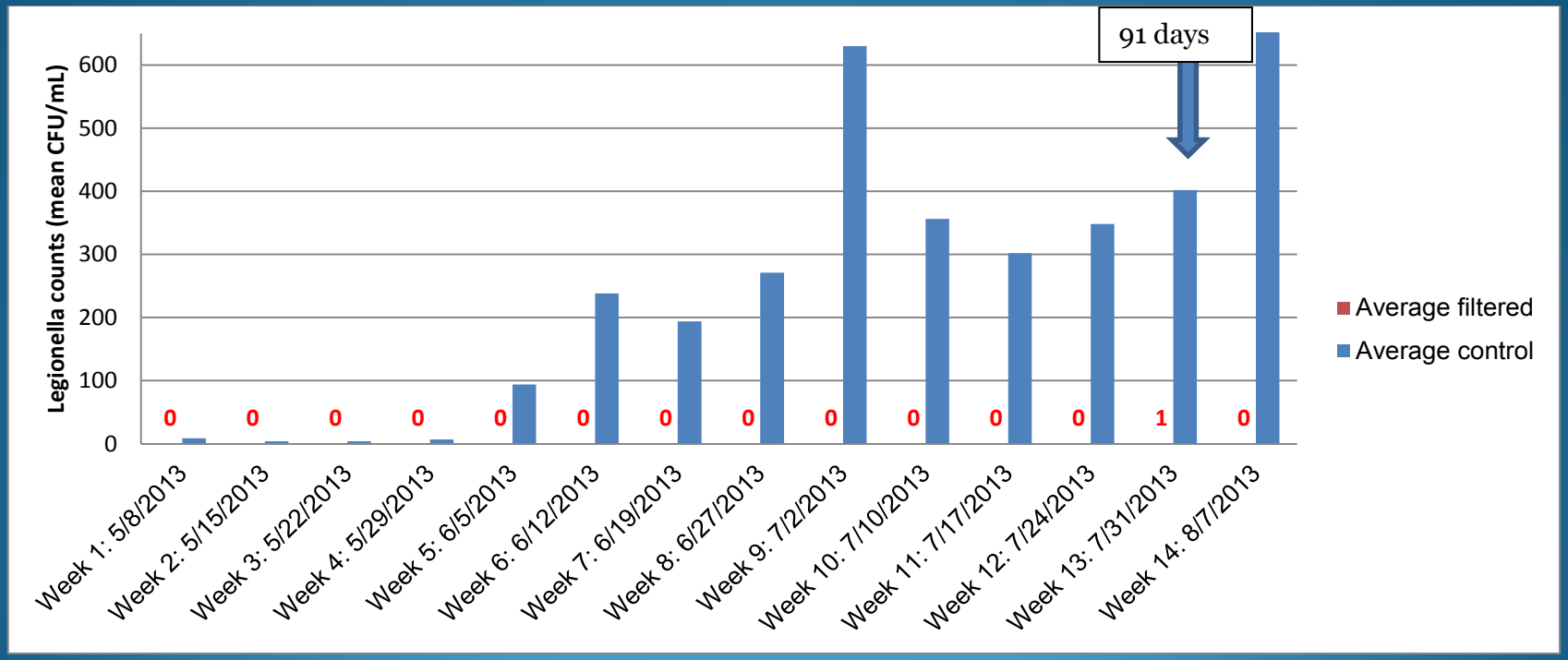
No Recovery of Legionella for 12 weeks



Results are the average of 5 sites.

Blue bars = Control Faucets/no filter

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INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY FEBRUARY 2011, VOL. 32, NO. 2

REVIEW ARTICLE

Controlling *Legionella* in Hospital Drinking Water: An Evidence-Based Review of Disinfection Methods

Yusen E. Lin, PhD, MBA;[1] Janet E. Stout, PhD;[2,3] Victor L. Yu, MD[3]

Choice of method must include infection control in addition to engineering

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Lots of …

Legionella

Anxiety

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Sometimes we could use a little professional help.

Dr. Ruth

© Special Pathogens Laboratory

Sometimes we could use a little professional help.

Dr. Janet Stout

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Medication

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Dr. Stout's Legionella Chill Pills

- For treatment of Legionella-related anxiety.
- Take 2 tablets 1 hour before Legionella testing or as needed.

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THE LEGIONELLA EXPERTS®

THANK YOU

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5 Minute Stretch

Question & Answer Panel

Think Health Act Now!
CITY OF MILWAUKEE
HEALTH DEPARTMENT

WATERTECH of America, Inc.

Thank You for Attending

Legionella

Prevention & Control Symposium

April 9th, 2014

Harley-Davidson Museum
Rumble Conference Room

400 W. Canal St., Milwaukee WI 53203

Think Health Act Now!
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