Waterborne Pathogens

Where They Come From, Why they Matter, & Paradigms to Protect Your Facility

Agenda

- Why Now?
- Waterborne Pathogen Talk
- **Waterborne Pathogen Control**
  - Best Practices
  - Disinfection Technologies
- Copper Silver Ionization
- How Does it Work?
- Q&A

Hospital Water Supply as a Source of Nosocomial Infection: A Plea for Action

“Perhaps the most overlooked, important, and controllable source of nosocomial infections is hospital water.”

-The American Medical Association

An Increasing Epidemic

Legionnaires' Disease in the United States

Increasing Incidence of Legionellosis in the United States, 1990–2005: Changing Epidemiologic Trends

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(See the editorial commentary by Ng et al. on pages 600–2)

Background. An abrupt increase in the incidence of legionellosis in the United States has been noted since 2003. Whether the recent increase is associated with shifting epidemiologic trends has not been well characterized.

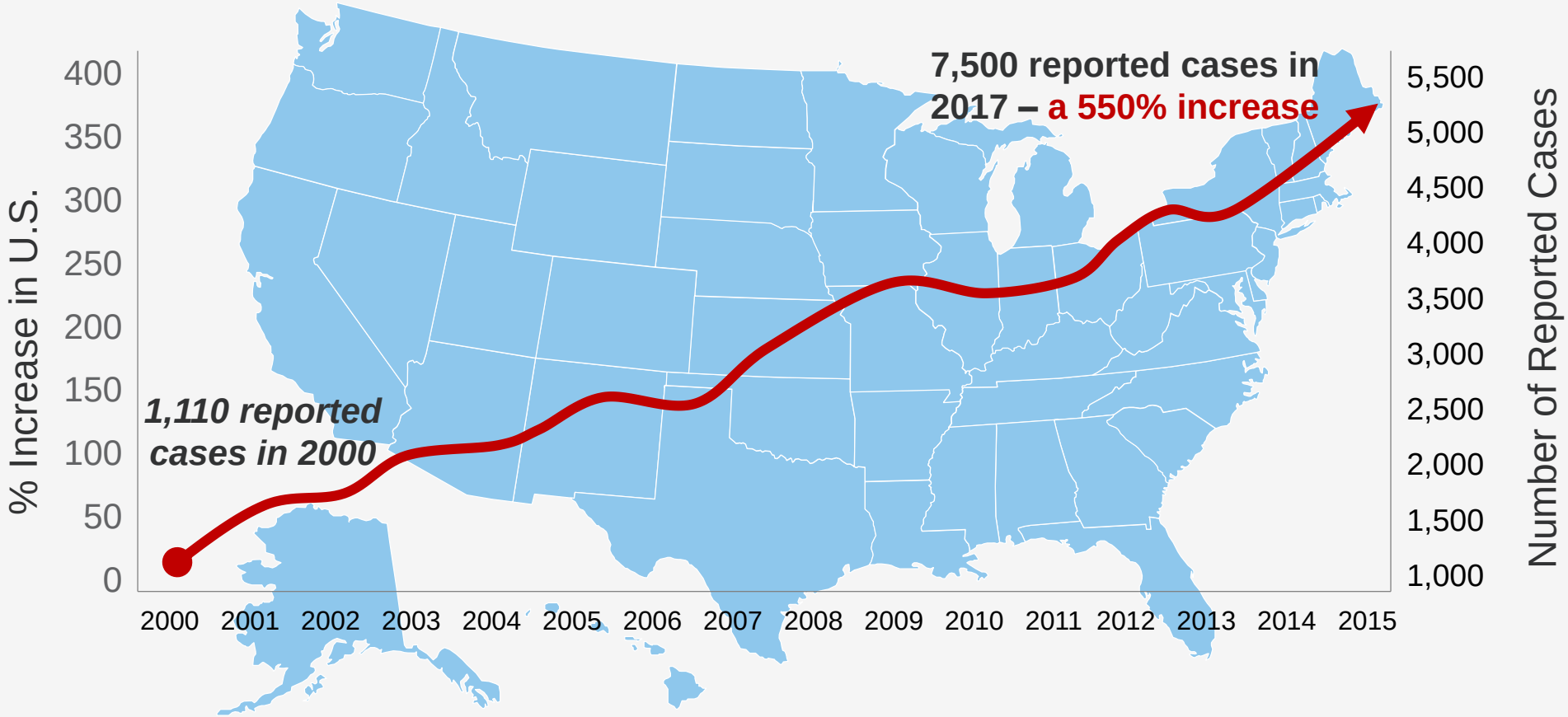
Methods. We analyzed all cases of legionellosis reported to the Centers for Disease Control and Prevention through the National Notifiable Disease Surveillance System from 1990 through 2005.

Results. A total of 23,076 cases of legionellosis were reported to the Centers for Disease Control and Prevention from 1990 through 2005. The number of reported cases increased by 70% from 1310 cases in 2002 to 2223 cases in 2003, with a sustained increase to >2000 cases per year from 2003 through 2005. The eastern United States showed most of the increases in age-adjusted incidence rates after 2002, with the mean rate in the Middle Atlantic states during 2003–2005 exceeding that during 1990–2002 by 96%. During 2000–2005, legionellosis cases were most commonly reported in persons aged 45–64 years. Persons aged <65 years comprised 63% of total cases in 2000–2005. Age-adjusted incidence rates in males exceeded those in females for all age groups and years. Legionellosis incidence showed marked seasonality in eastern states, with most cases reported in the summer or fall.

Conclusions. Reported legionellosis cases have increased substantially in recent years, particularly in the eastern United States and among middle-aged adults. *Legionella* infection should be considered in the differential diagnosis of any patient with pneumonia. Public health professionals should focus increased attention on detection and prevention of this important and increasing public health problem.

Growth in Legionnaires Disease

More than 40,500 cases reported over the past 15 years



CDC estimates this only represents 5-10%

Reference: *CDC Weekly MMWR 2000-2015*

Financial Impact of Hospital Acquired Infections

1.8M

People suffer from Hospital Acquired Infections (HAIs) each year

HAIs cost the US Healthcare system **$40 Billion annually**

- 10% of all hospitalized patients may acquire an HAI
- Pneumonia accounts for up to 45% of HAI's and 23,000 deaths in the US each year
- 51,000 Infection attributed to *Pseudomonas*
- The Centers for Medicare and Medicaid Services (CMS) found that the average cost to treat a case is $86,000
- There are 113,000 potential cases of Legionnaires' disease each year

70% of all building water systems contain *Legionella*

San Quentin prison Legionnaires' outbreak tr

By Ham

Legionnaires' cases linked to Disneyland expand to 15

By Danielle Haynes | Nov. 16, 2017 at 8:17 PM Follow @upi

Eleven people apparently contracted Legionnaires' disease after visiting Disneyland, pictured in 2005. File Photo by Marino-Cantrell/UPI | License Photo

Waterborne Pathogens

PRIORITY: CRITICAL	PRIORITY 2: HIGH	PRIORITY 3: MEDIUM
Acinetobacter baumannii carbapenem-resistant	**Enterococcus faecium** vancomycin-resistant	**Streptococcus pneumoniae** penicillin-non-susceptible
Pseudomonas aeruginosa carbapenem-resistant	**Staphylococcus aureus** methicillin-resistant vancomycin-intermediate and resistant	**Haemophilus influenzae** ampicillin-resistant
Enterobacteriaceae carbapenem-resistant, ESBL-producing	**Helicobacter pylori** clarithromycin-resistant	**Shigella spp.** fluoroquinolone-resistant
	Campylobacter spp. fluoroquinolone-resistant	
	Salmonellae fluoroquinolone-resistant	
	Neisseria gonorrhoeae cephalosporin-resistant fluoroquinolone-resistant	

Source: WHO

Waterborne Pathogens

The World Health Organization states that 10 out the 12 bacteria that pose the greatest risk to human health are attributable to water.

Water is the Causal Factor of 33% of HAIs

-The Centers for Disease Control & Prevention (CDC)

LEGIONELLA

Sources of Infection:

Hot water system

Site of Infection:

Lung (pneumonia) wound infection, high mortality

PSEUDOMONAS

Sources of Infection:

Potable water, contaminated liquid solutions & disinfectants

Site of Infection:

Blood, catheter site, lungs, urinary, *high mortality*

S. MALTOPHILIA

Sources of Infection:

Potable & distilled water, contaminated liquid solutions, & disinfectants

Site of Infection:

Blood, pneumonia, UTI, wound infections, skin, stools, throat

MYCOBACTERIA

Sources of Infection:

Hot water system, shower

Site of Infection:

Abscesses and wound infections

How do Waterborne Pathogens Enter My Facility?

The Municipality

- Does not claim to disinfect to the end user
- May not properly maintain lines from municipality to facility

Water Source

Legionella & Pseudomonas are naturally occurring rivers, lakes and streams from the cold water

Municipal Treatment

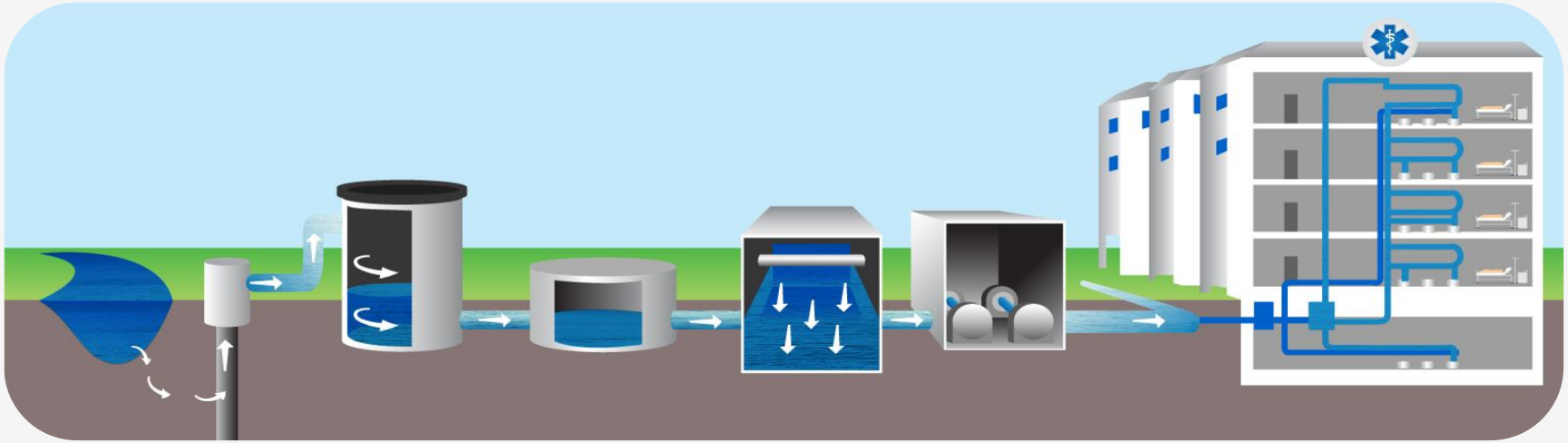
Water gets pulled into your city water municipality distribution system and goes through a process of disinfection and filtration

Facility

Water enters facility line after a majority of municipally-added chemicals dissipate, rendering them ineffective

Naturally-Occurring Waterborne Pathogens

How do Waterborne Pathogens Enter My Facility?



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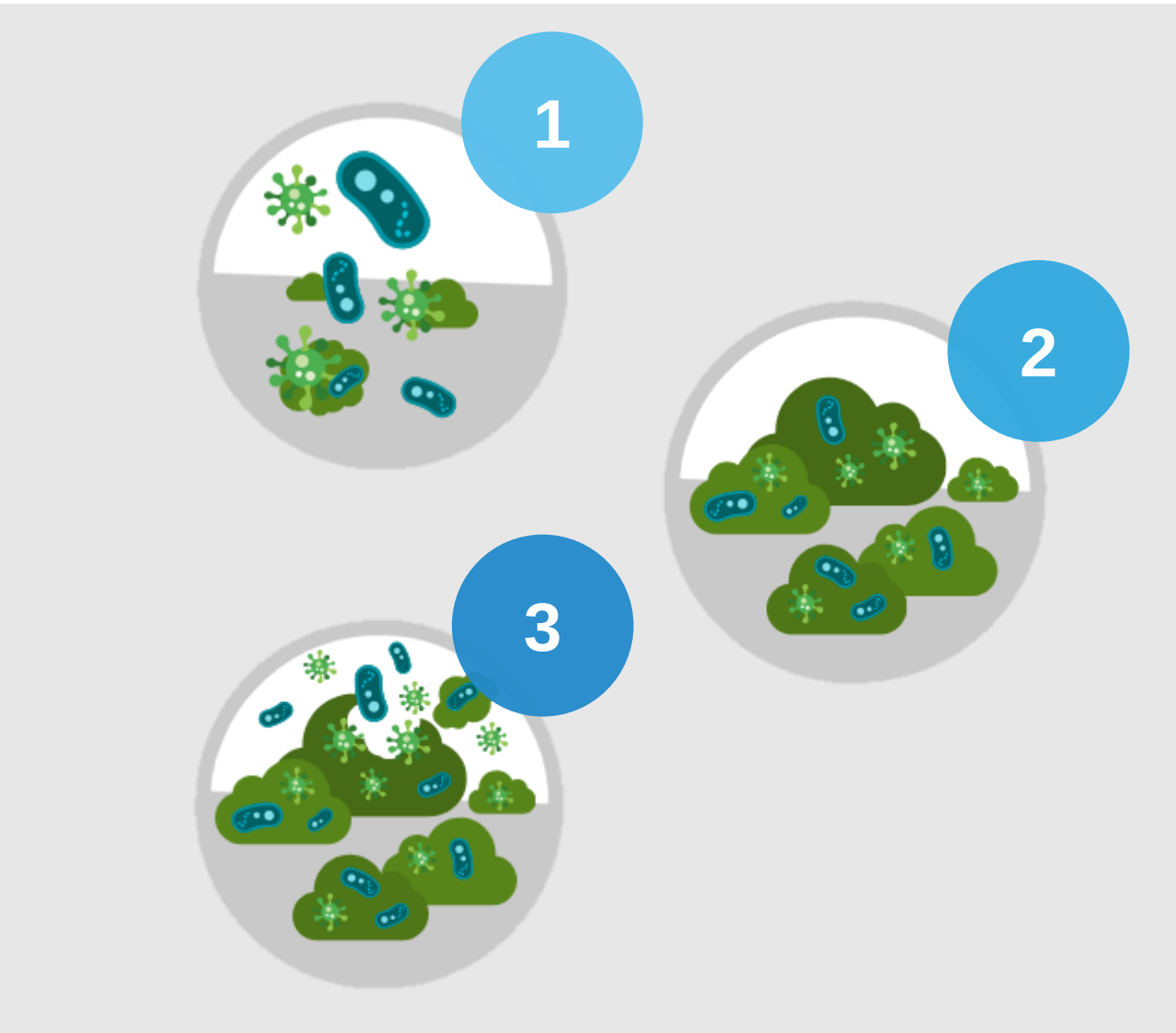
Naturally-Occurring Waterborne Pathogens

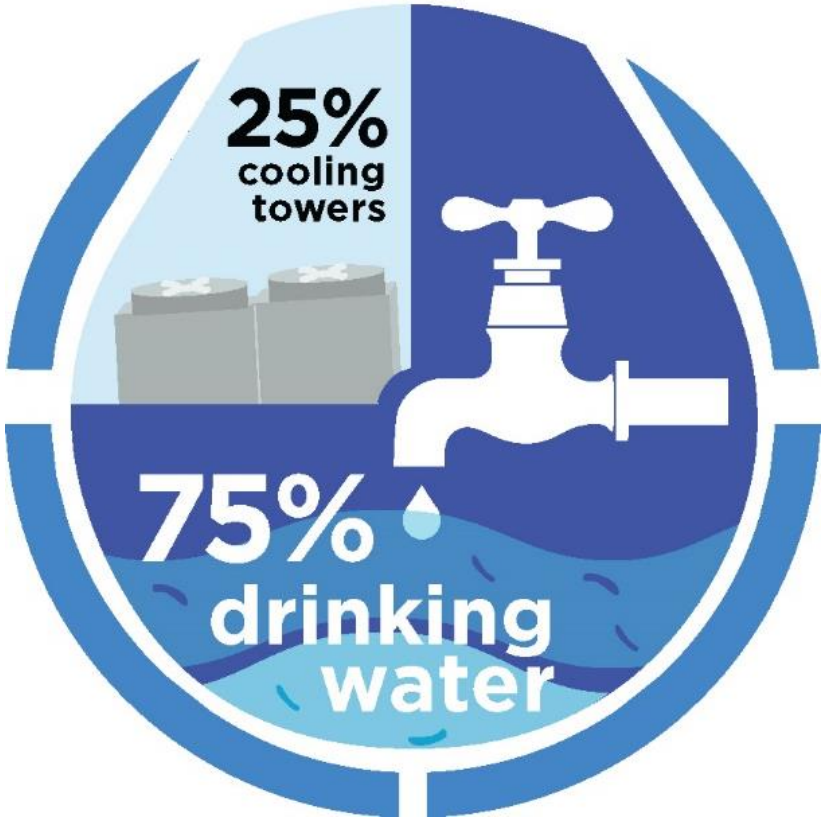
Like Blood Vessels, Pipes Can Develop Plaque, Which Can Harbor Bacteria



Legionella Outbreak Sources

Drinking/potable water is the main source of *Legionella*

- Shower Heads
- Faucets
- Ice Machines
- Water Fountains
- Hot tubs
- Decorative fountains



Legionella can live & proliferate in a facility's water system at a wide range of temperatures

158-176 °F	• Disinfection Range
151 °F	• 99% die in 2 minutes of direct contact
140 °F	• 99% die in 32 minutes of direct contact
131 °F	• 99% die in 5 – 6 hours of direct contact
68 - 122 °F	• Ideal growth range for Legionella
Below 68 °F	• Legionella survive, but are dormant

Chemical Treatment

(ClO2, Chlorine, & Monochloramine)

- Effective in cold water
- Cheaper up front cost

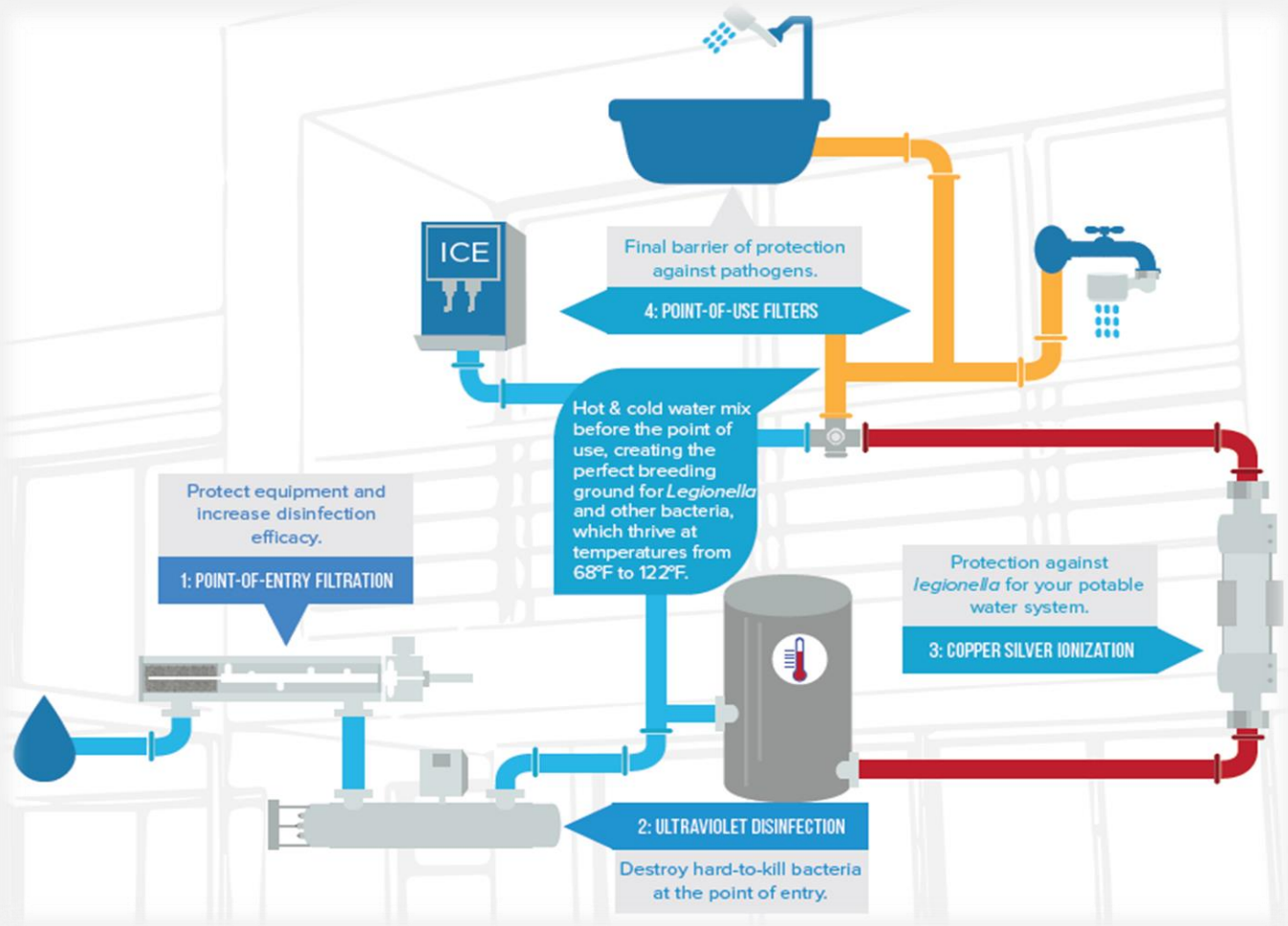
- 70% of ClO2 decomposes in warm water environments
- Often creates aesthetic complaints, corrosive and rarely effective on chlorine resistant bacteria
- Not a sustainable technology
- Creates harmful disinfection byproducts
- Can be damaging to plumbing infrastructure over time
- Studies have shown Clo2 to increase biofilm growth (Shemesh, Kolter, Losick, et al.)
- Dangerous handling concerns/explosive

Superheat & Flush

- Impossible to maintain constant temperature throughout whole infrastructure due to stratification and heat loss
- Can not deliver water at scalding temperatures so location of water mixing becomes point of contamination
- No residual protection
- Energy and maintenance intensive
- High capital cost on implementation
- Does not penetrate biofilm

Multi Barrier Approach

- Specialized mix of technology and service
- Protect the facility from point of entry to point of use
- Analytical approach to water management



Point of Entry Filtration

Improve incoming water quality while extending the life of equipment by 9-12% and boosting disinfection efficacy

Improvement

- Remove the ‘Food Source’ for microorganisms
- Eliminates Sediment and Corrosion Particulate
- Improves Secondary Disinfection

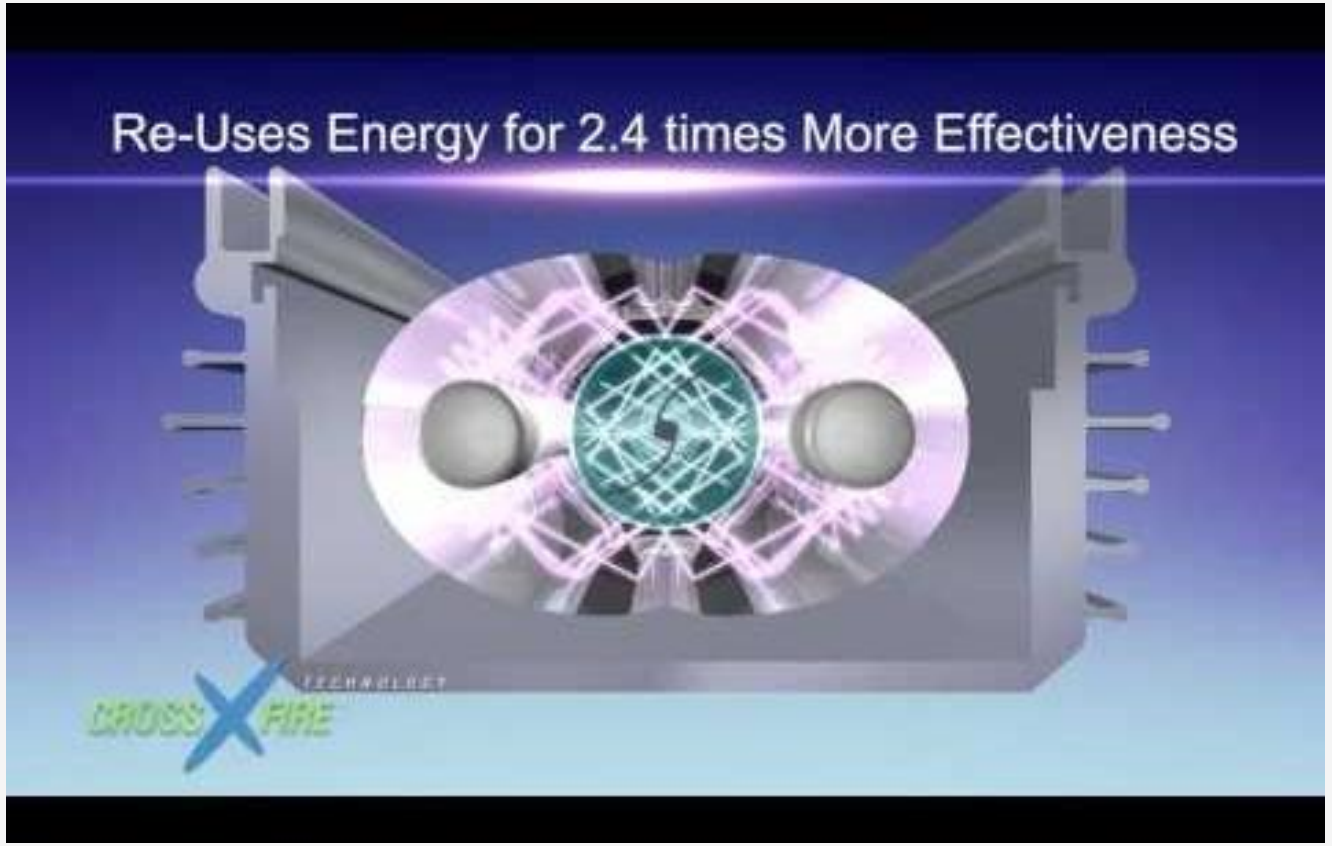
Extends life of:

- Boilers
- Dialysis equipment
- Food service equipment
- Point-of-use filters
- Ice machines
- MRI/XRAY machines, and much more

Ultraviolet Disinfection

Effectiveness

- First line of defense against harmful bacteria in your incoming water
- Highest kill rate of pathogens of any modality
- Ultraviolet disinfection destroys harmful microorganisms, cysts, viruses, cryptosporidium and bacteria
- Energy efficient with minimal maintenance
- Free of toxins and disinfection by-products
- Energy efficient and requires minimal maintenance
- Not a standalone option – works best as part of a multi barrier solution



Copper Silver Ionization

The only **EPA registered** technology for control of Legionella in drinking water

- Effective in hot and cold water
- High pH and residual protection
- Scientifically proven (most peer review studies than any other modality)

- Higher up front cost
- Lowest consumables cost
- No harmful by-products

CSI: How it works

STEP 1

STEP 2

STEP 3

1

Water passes through the flow cell chamber

2

A direct current is applied across the electrodes, creating positively charged copper silver ions

3

The ions seek out bacteria throughout the entire plumbing system penetrating biofilm and, providing on-going disinfection

CSI Effectiveness

Protection against broad spectrum microorganisms both in vitro and in situ

In Vitro Kill Study[1]	
Microorganism	% Microbial Kill*
Escherichia coli O157:H7	99.9999
Listeria monocytogenes	99.999
Salmonella	99.999
Pseudomonas	99.99
Bacillus anthracis	99.94

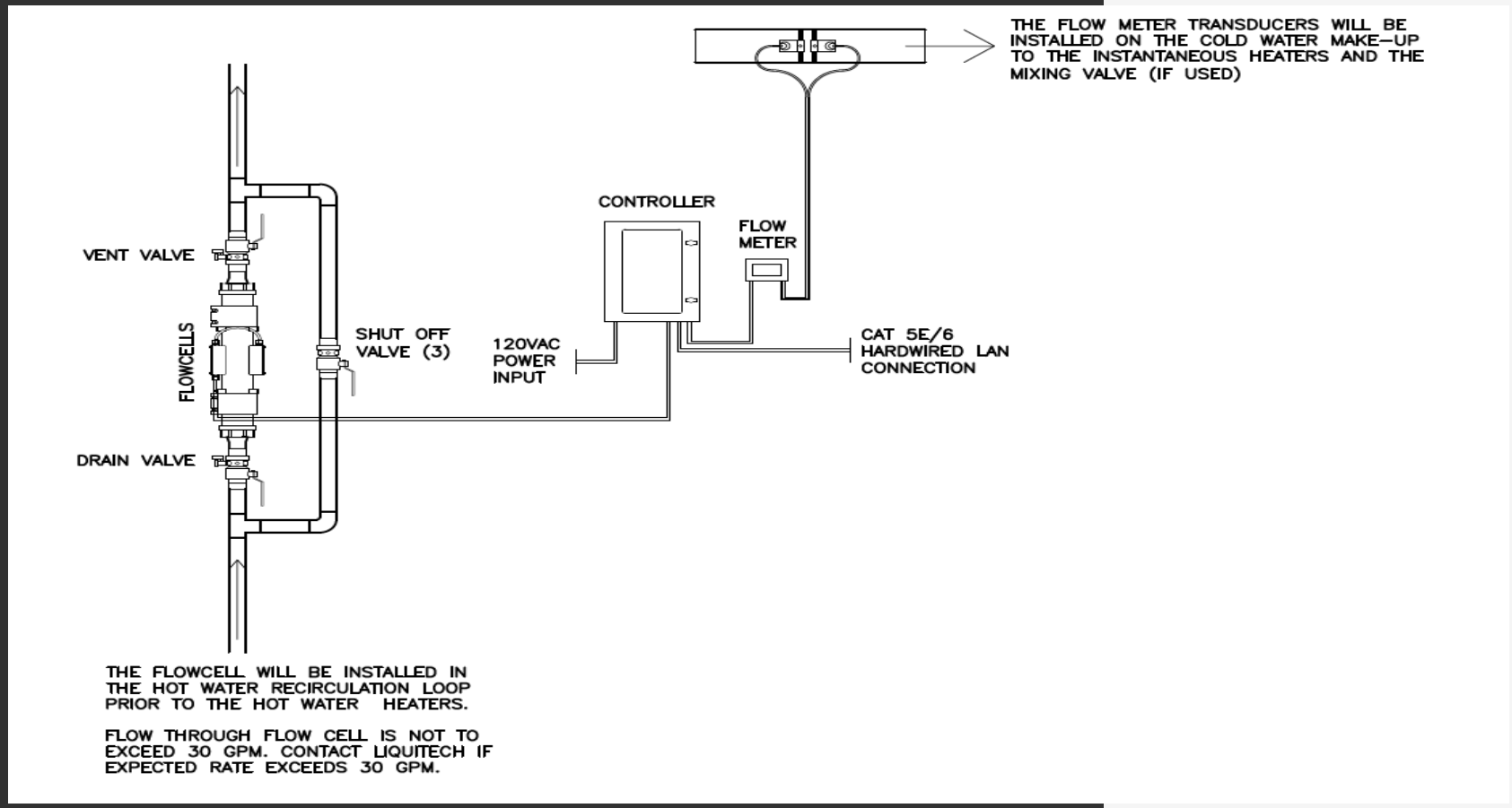
- Ion concentrations are within safe EPA Drinking water guidelines both studies.

*Time kill study within 24 hours

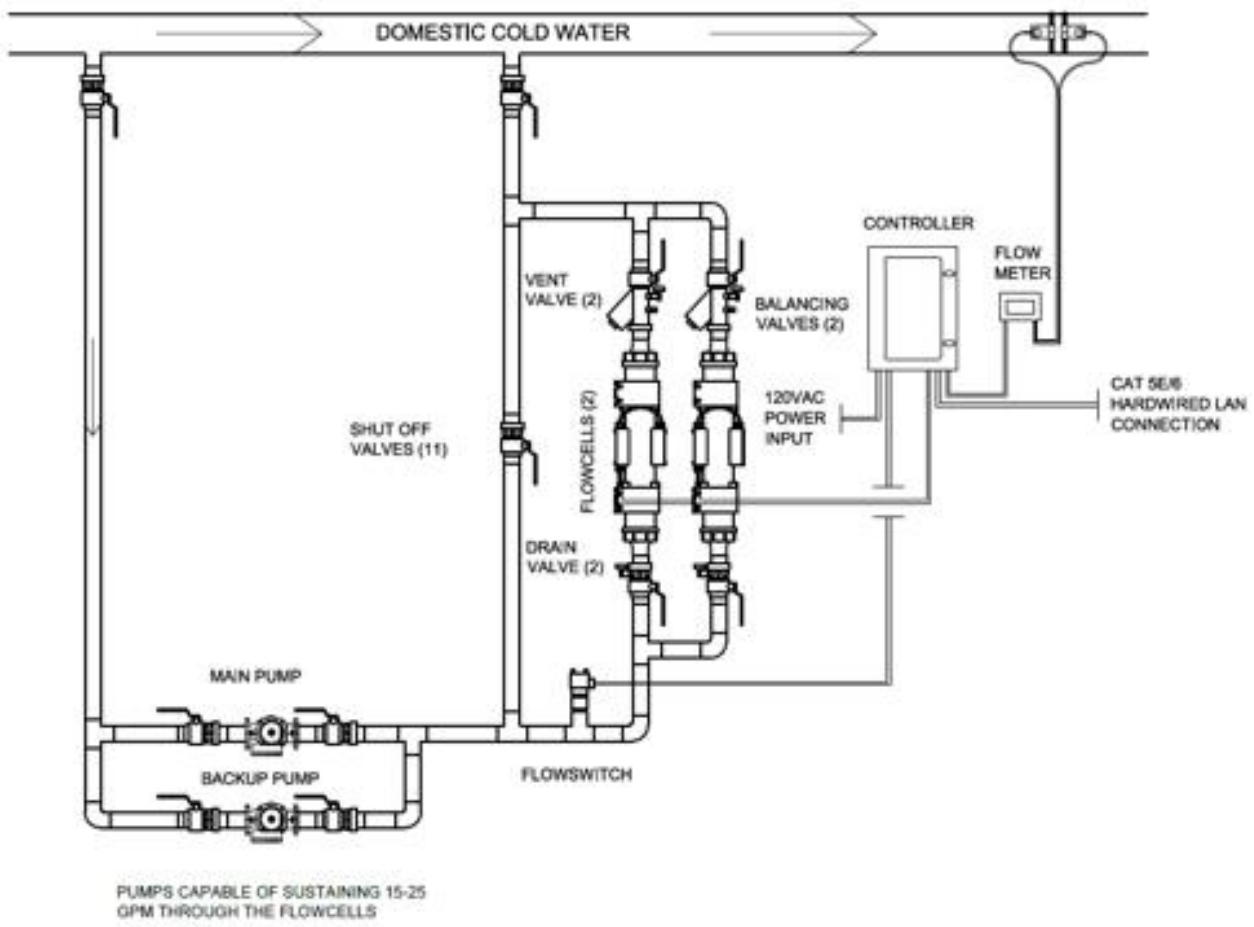
Peer Reviewed Efficacy	
Microorganism	% Microbial Kill*
Legionella[2345]	99.9999
Acinetobacter[6]	99.999
M. avium[7]	99.99
S. maltophilia[8]	99.9999

- Safer for guests/patients, plumbing system, and environment
- More effective than conventional chemicals (Suppression vs Lysis)

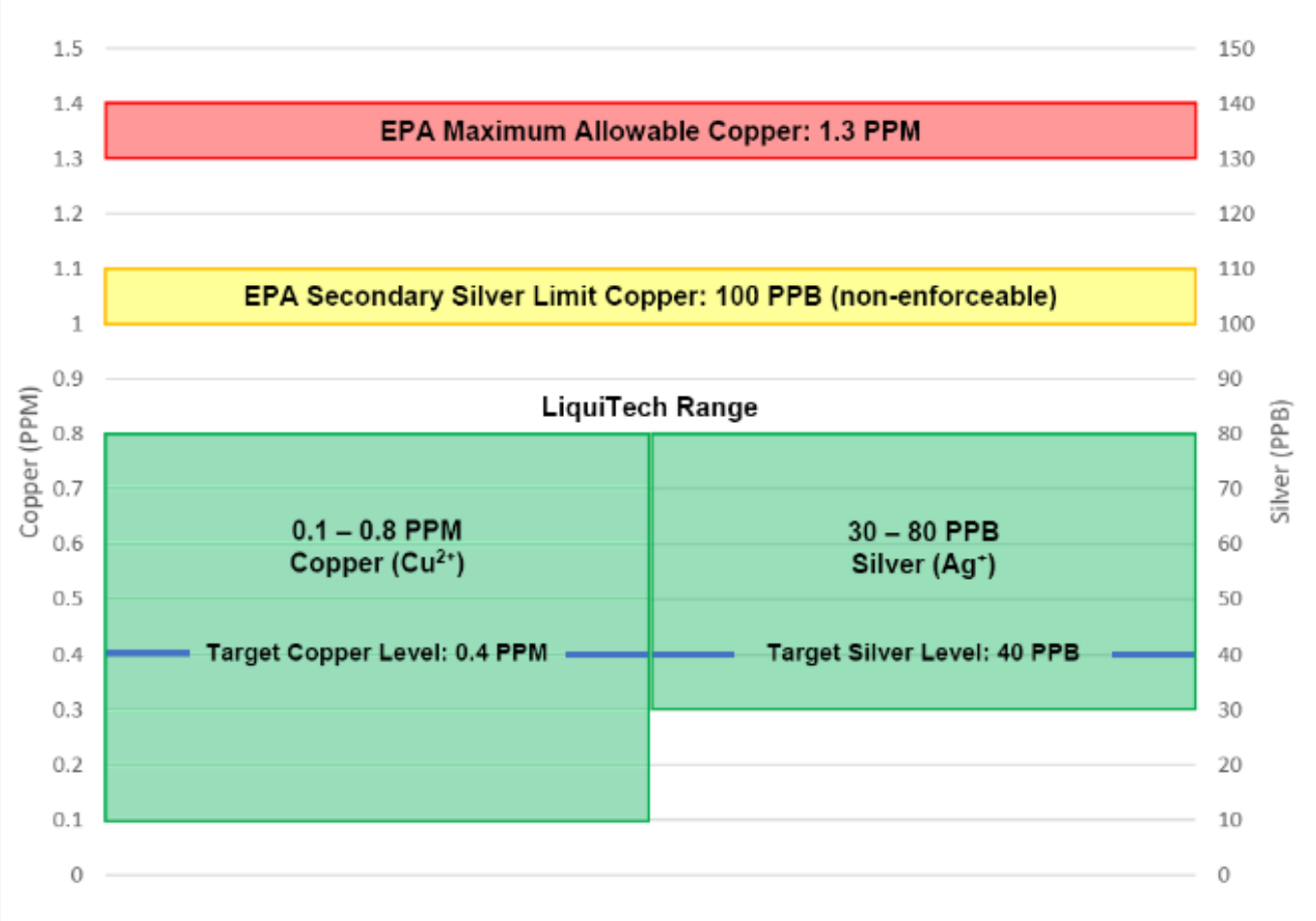
Single Flow Cell Hot Water Installation



Multi Flow Cell POE Installation



Validation: Target System Output Levels



Point of Use Filters

The final barrier of protection against harmful organisms

Features

- Quick and easy to implement in emergency situations
- Added barrier in critical care areas in conjunction with ongoing secondary disinfection program
- Costly as a standalone solution
- Reduces readmissions

Filters Offered

- Shower head
- Sinks
- Faucets
- Ice machines

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