

The Epidemiology of Legionellosis in Ontario

Public Health Ontario, November 21, 2011

Legionellosis Webinar



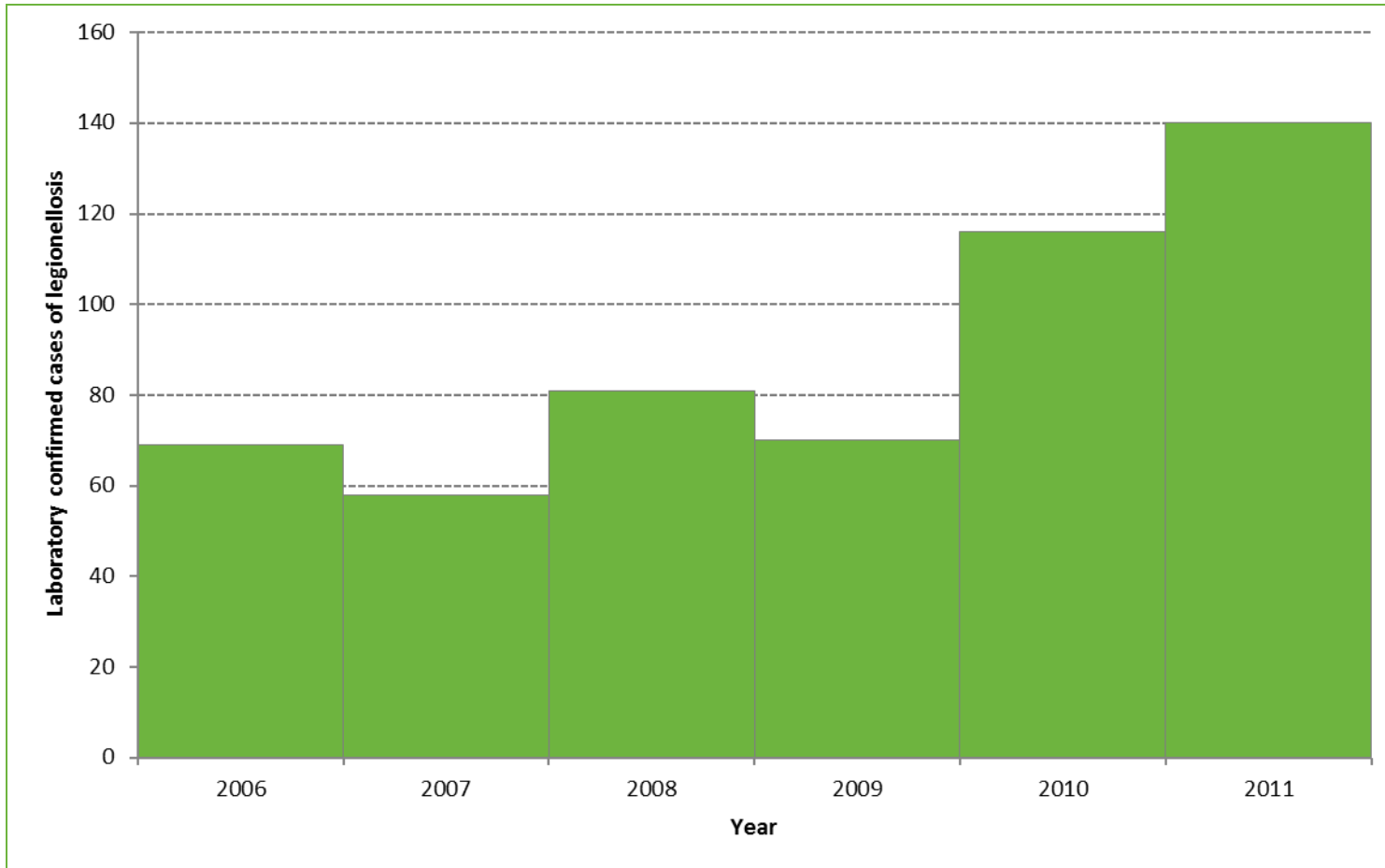
Outline

- Descriptive epidemiology
- Focus on the increase observed in 2011
- *Note that all of the Ontario information presented is based on iPHIS data*

Common attributes of legionellosis cases

- People most at risk of getting legionellosis are:
 - Older (most cases are 50+ years of age)
 - Smokers
 - Individuals with a chronic lung disease, such as emphysema
 - Individuals with underlying medical conditions, such as individuals with cancer or kidney failure, are also at higher risk.
 - Individuals with compromised immunity
 - 2.5:1 male:female ratio

Legionellosis cases in Ontario 2006 – 2011

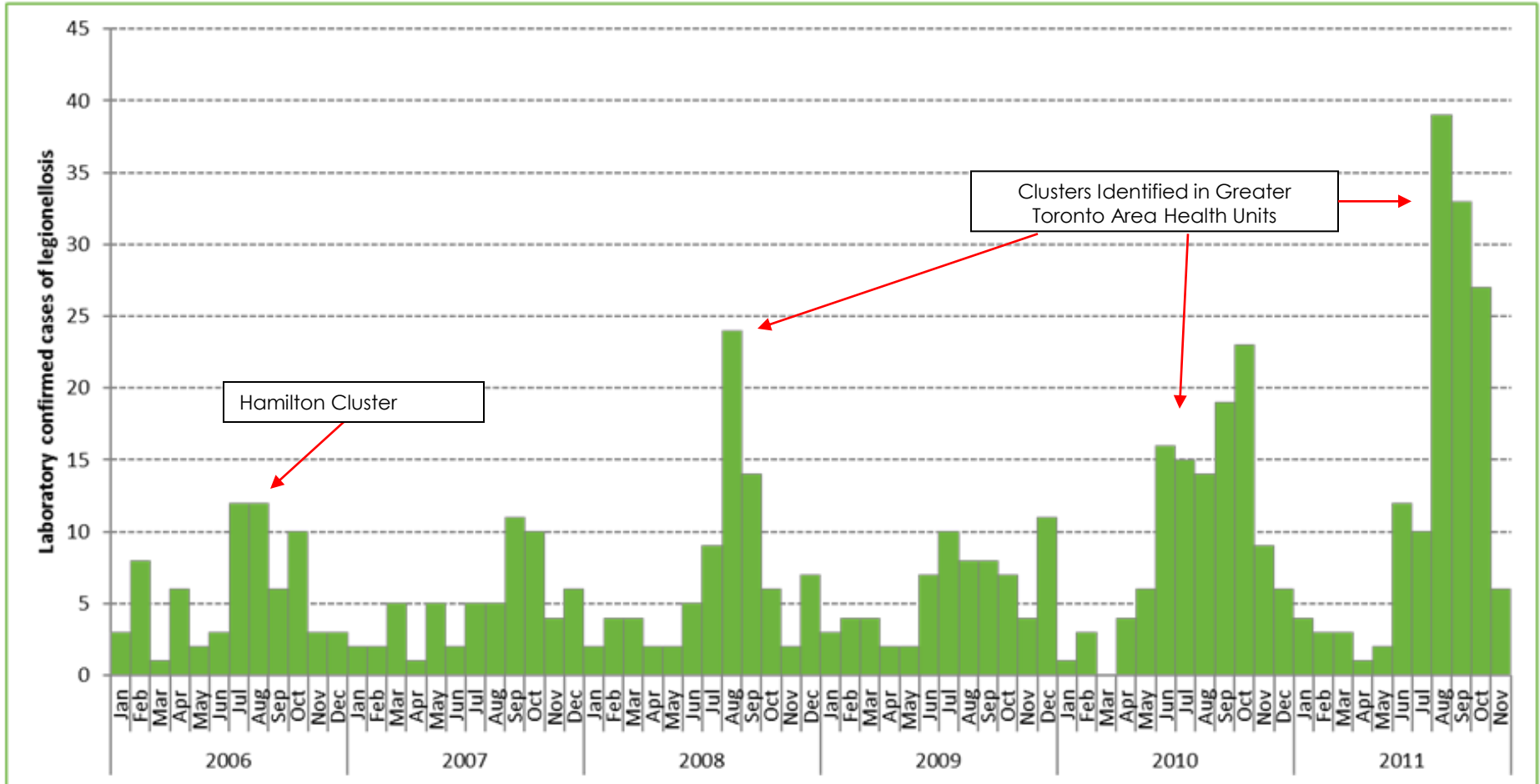


Ages of legionellosis cases in Ontario from 2006-2011

- Age breakdowns are similar across the years
- Between 2 and 3 male cases for every female case each year

Measure	2006	2007	2008	2009	2010	2011
Mean Age	60.2	58.4	58.7	63.4	60.3	62.1
Median Age	61	56.5	57	63.5	61	60.5
Min. Age	32	19	26	24	23	29
Max. Age	87	91	88	89	89	91

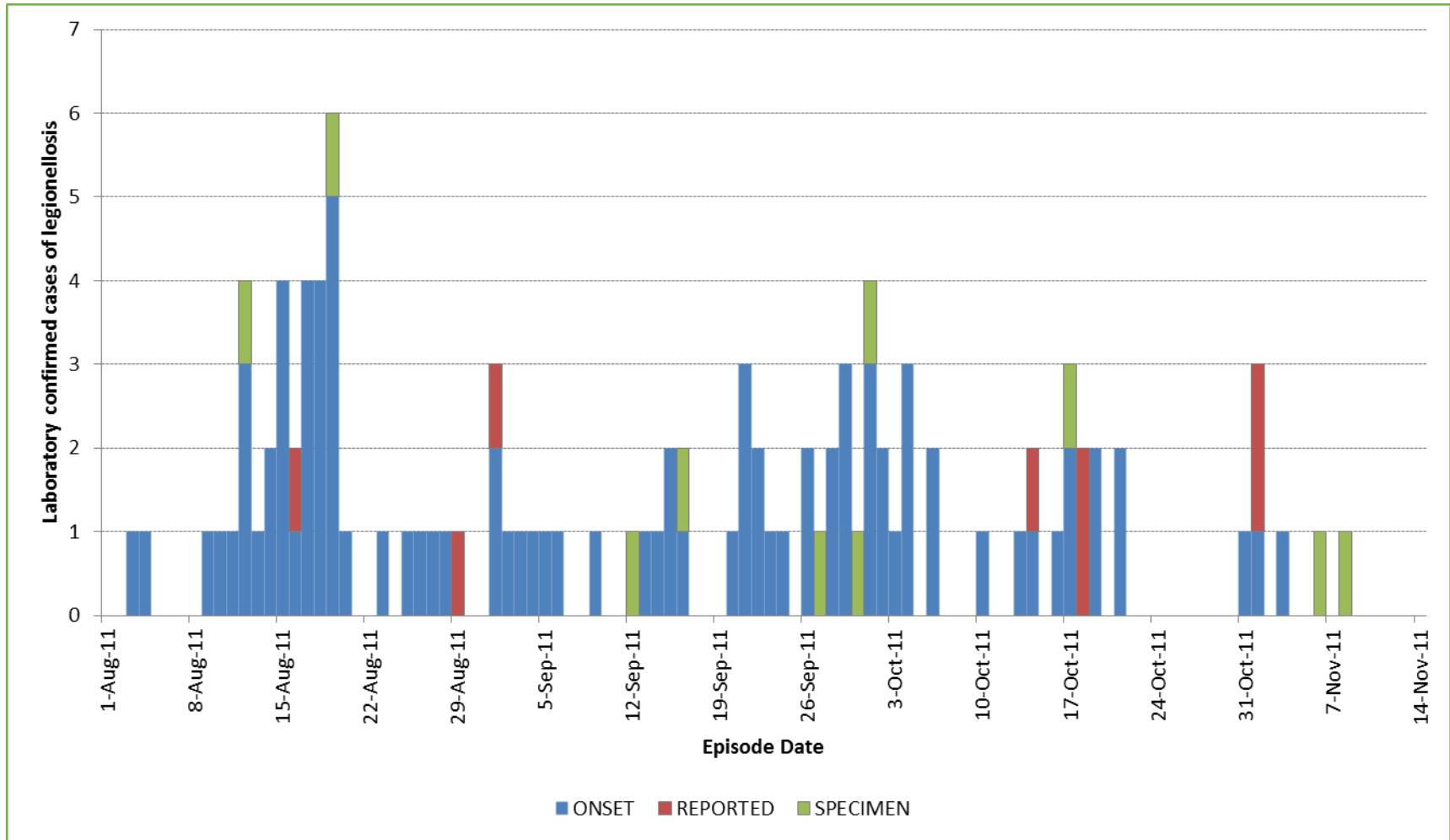
Clusters of legionellosis cases in Ontario, 2006-2011



Locations of cases in previous clusters

- 2006
 - Hamilton – a downtown cooling tower was suspected as the exposure source
- 2008
 - Counts above expected, provincially
 - GTA health units mainly Peel and Toronto, no common source identified
- 2010
 - Counts above expected, provincially
 - GTA health units mainly Peel and Toronto, no common source identified

Legionellosis cases in Ontario, Aug. 1 and Nov. 14, 2011



Legionellosis cases in Ontario, Aug. 1 and Nov. 14, 2011

- Summary information
 - 105 cases have been identified
 - Age and gender breakdown mainly fits the normal profile:
 - Male to female ratio is ~ 3:1 (79:26)
 - Average age is 62.1
 - Median age is 61 (Range 29-89)
 - Geographic distribution:
 - Most of the cases have been reported in and around Toronto:
 - Toronto, Peel, Hamilton, and Durham health units accounted for 75.2% of cases (79/105)

Legionellosis cases in Ontario, Aug. 1 and Nov. 14, 2011

- No common exposure sources have been identified to date
- Potential exposure sources for the cases included:
 - Institutions such as long-term care homes
 - Environmental water (e.g. creeks, stream, lakes)
 - Misting equipment in grocery stores or on farms
 - Home air conditioners
 - Soil exposures (e.g. construction sites) etc.

Legionellosis cases in Ontario, Aug. 1 and Nov. 14, 2011

- Laboratory confirmation among the cases was mostly through urine antigen testing
 - 81.9% (86/105) confirmed only by urine antigen test
 - 13.3% (14/105) confirmed through culture
 - 4.8% (5/105) did not have laboratory information entered in iPHIS
- Without culture results we cannot definitively link cases to positive environmental samples

Legionellosis cases in Ontario, Aug. 1 and Nov. 14, 2011

- Commonly reported risk factors were:
 - Smoking (41.9%; 44/105)
 - Immunocompromised (14.3%; 15/105)
 - Lung disease (13.3%; 14/105)
 - Diabetes (13.3%; 14/105)
 - Other medical risk factors were also reported
- Pneumonia was reported in 65.7% of cases (69/105)
- Hospitalization was reported in 72.4% of cases (76/105)
- Five cases (4.8%) were reported to have died

Summary

- Legionellosis follows a seasonal trend in Ontario with most cases observed from July through to the end of October
- Overall the number of cases has increased in the past two years
- The epidemiology of the cases has not differed from expected
- Common exposure sources for clusters of increased cases have typically not been identified in recent years

Any Questions?

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Laboratory Testing for *Legionella* spp.

Vanessa G. Allen, MD FRCPC

November 21, 2011

Legionella Webinar



Overview

- **Clinical (human) testing**
 - Methods available
 - When to test
- **Environmental testing**
 - Environmental testing methods
 - Sampling techniques
 - Interpretation of results
- **Typing**
 - Typing methods available
 - Role in outbreak investigations



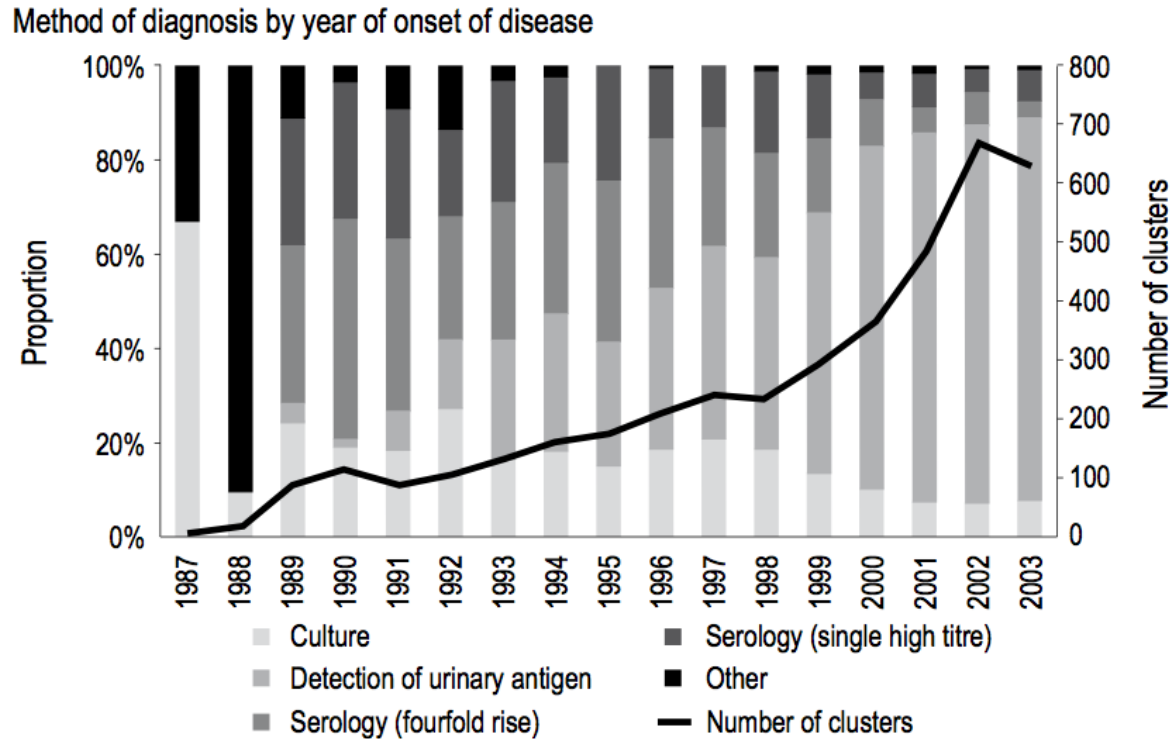
Clinical (Human) Testing for Legionella

Methods for Clinical Testing for Legionella

Test	Sensitivity	Specificity	Comments
Urinary antigen testing	64-99%	99-100%	<ul style="list-style-type: none"> •Rapid •Ease of specimen collection •Only detects <i>L. pneumophila</i> sg 1 •Typing cannot be performed •Positive for weeks
Direct fluorescent antibody (DFA)	25-90%	95-99%	<ul style="list-style-type: none"> •Rapid
Serology	80-90%	95-99%	<ul style="list-style-type: none"> •May take 3 - 9 weeks
Culture	5-99%	100%	<ul style="list-style-type: none"> •Most specific, “gold standard” •Typing can be performed •Can take up to 14 days
Polymerase Chain Reaction (PCR)	85-92%	94-99%	<ul style="list-style-type: none"> •No commercially available kit •Typing cannot be performed

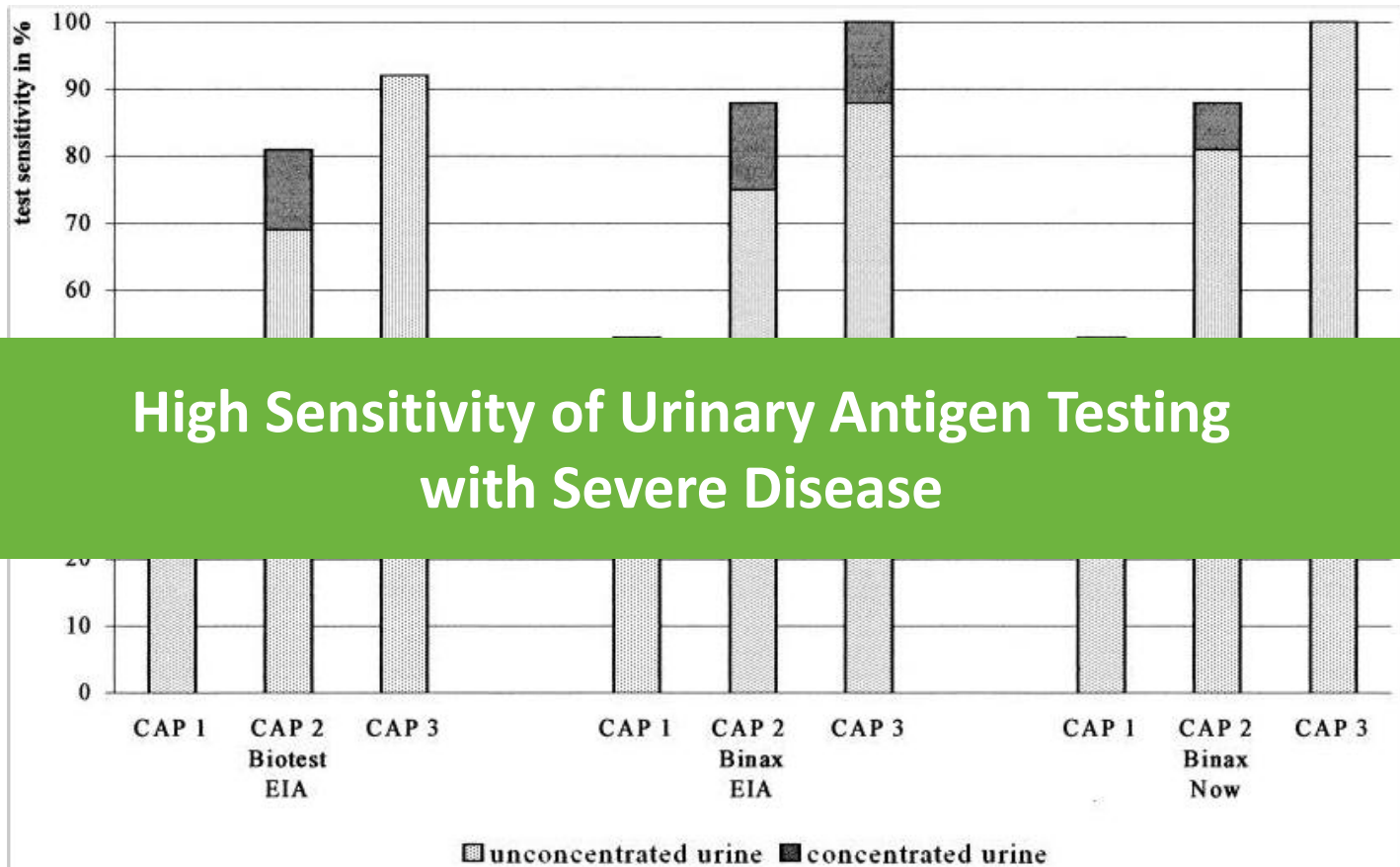
Increased Use Of Urinary Legionella Antigen

Figure 11.1 Method of diagnosis of travel-associated Legionnaires' disease in Europe and year of onset of disease



Source: Information obtained from the European Working Group for Legionella Infections (EWGLI)²⁵

Increased Sensitivity of Urinary Antigen as a Function of Disease Severity



High Sensitivity of Urinary Antigen Testing with Severe Disease

Non *Legionella pneumophila* serogroup 1

- 48 species and 78 serogroups of *Legionella*



Yu V L et al. J Infect Dis. 2002;186:127-128

<i>Legionella</i> species, serogroup	Species	Serogroup
<i>L. pneumophila</i>	91.5 (465)	
1		84.2 (428)
6		1.7 (9)
5		1.3 (7)
4		1.0 (5)
3		1.0 (5)
7		0.6 (3)
2		0.4 (2)
8		0.4 (2)
13		0.4 (2)
Unknown ^a		0.6 (3)
<i>L. longbeachae</i>	3.9 (20)	
Unknown		2.6 (13)
1		1.2 (6)
2		0.1 (1)
<i>L. bozemanii</i>	2.4 (12)	
Unknown		2.0 (10)
1		0.2 (1)
2		0.2 (1)
<i>L. micdadei</i>	0.6 (3)	
<i>L. dumoffii</i>	0.6 (3)	
<i>L. feeleii</i>	0.4 (2)	
<i>L. wadsworthii</i>	0.2 (1)	
<i>L. anisa</i>	0.2 (1)	
Unknown species	0.2 (1)	
Total	100 (508)	

NOTE. Data are percentage (no.) of isolates.

^a Serogroup unknown but not serogroup 1.

When Should People be Tested for Legionella

- IDSA/ ATS
 - Severe pneumonia requiring intensive care unit (ICU) admission
 - Failure of outpatient antibiotics
 - Active alcohol abuse
 - History of travel within the previous two weeks
 - Pleural effusion
- World Health Organization
 - Age > 40, immunosuppressed, unresponsive to beta-lactam antibiotics
 - Male
 - Underlying diseases such as: diabetes, chronic heart disease, smoking, immunosuppression, structural pulmonary disease, chronic renal failure, hematological malignancy, iron overload, transplant, surgery, smoking, alcohol abuse, other immunosuppression

How many cases missed by IDSA/ATS strategy?

Characteristics	Met IDSA/ATS criteria for Legionella testing	Did not meet IDSA/ATS criteria for Legionella testing	All patients with Legionellosis
ICU admission	14	0	14 (38%)
Outpatient abx	4	0	4 (11%)
ETOH abuse	6	0	6 (16%)
Recent travel	1	0	1 (3%)
Plural effusion	7	0	7 (19%)
Male	15	9	24 (65%)
Anti-TNF	1	1	2 (5%)
Daily steroids	0	1	1 (3%)
Cancer	4	4	8 (22%)
Diabetes	5	6	11 (29%)
COPD	5	4	9 (24%)
Transplant	0	1	1 (3%)
HIV	1	0	1 (3%)
Abnormal liver fxn	15	5	20 (54%)
Hyponatremia	9	4	13 (35%)
Crude mortality	6	0	6 (16%)

Environmental Testing for Legionella

Environmental Testing for Legionella: Three Main Challenges

- Legionella spp. are ubiquitous in the environment
- Infectious dose is not known
 - Lack of Standards for Acceptable Levels of Environmental Legionella
- Clinical testing is predominantly achieved through urinary antigen testing
 - As a result, human and environmental isolates cannot be compared

Methods for Environmental Testing of Legionella

- Culture
 - The “Gold Standard”
 - Relatively insensitive 500 CFU/ L
- PCR
 - Much more sensitive
 - Can detect viable non-culturable organisms
 - Cannot distinguish between killed and live organisms
 - Interpretation may be a challenge given higher sensitivity

Legionella Sampling during Outbreak Investigation

Principles:

- Epidemiology related to case
- Stagnant waters
- Potential for Aerosolization

Table 16: *Legionella* – Environmental Sample Collection and Transportation Instructions

<i>Legionella</i> Investigations – Water Sampling	
<p>Collection of Samples</p> <ul style="list-style-type: none"> • Water samples can be collected in standard water bacteriology bottles distributed by the PHL. • One litre of water should be collected for potable water. Five standard water bottles filled to the fill line will satisfy this requirement. For non potable waters, a single bottle of 200mL is sufficient. • Taps or showers should not be allowed to run before sampling. Turn water on and allow the water to run slowly into sample bottles. • Use of Personal Protective Equipment (PPE) should 	<p>be guided by public health unit internal health and safety guidelines.</p> <p>Laboratory Requisitions:</p> <p>For liquid samples collected in water bottles, use either of the following requisitions:</p> <ul style="list-style-type: none"> • Bacteriological Analysis of Water – Multiple Sample Requisition for Official Agencies • Bacteriological Analysis of Water – Single Sample Requisition for Official Agencies

Wide Variability of Guidelines for Environmental Standards for Legionella

OSHA Technical Manual

Action 1: Prompt cleaning and/or biocide treatment of the system.

Action 2: Immediate cleaning and/or biocide treatment. Take prompt steps to prevent employee exposure.

Table III:7-1. Colony forming units (CFU) of *Legionella* per milliliter

Action	Cooling tower	Domestic water	Humidifier
1	100	10	1
2	1,000	100	10

French Standards for Health Care Settings

Box 6.1 Example of limit values for *Legionella* concentrations and microbiological indicators in water used in health-care settings in France

Limit values

For patients with classical individual risk factors such as the elderly, those with alcoholism or tobacco addiction:

- target level <1000 CFU/l *Legionella pneumophila*
- alert level 1000 CFU/l *Legionella pneumophila*
- maximum level 10,000 CFU/l *Legionella pneumophila*

For high-risk patients, such as those with severe immunodepression, transplantation, corticotherapy with an equivalent dose of 0.5 mg/kg per day prednisolone for 30 days or more, or 5 mg/kg per day for 5 days or more:

- target level not detectable
- alert level 250 CFU/l *Legionella* spp.

TYPING FOR LEGIONELLA

Typing Methods Used for Legionella spp.

Many methods, including:

- Sequence based typing (SBT)
- Pulsed Field Gel Electrophoresis (PFGE)
- Multilocus Sequence Typing (MLST)
- Multiple Loci Variable Number Tandem Repeat Analysis (MLVA)



Use of Sequence Based Typing of Legionella to Support Source Attribution

- 18 cases of Legionellosis between Jun 27th and November 2005
- All diagnosed by urinary legionella antigen testing, 4 also had cultures (3/4 “Benidorm” strain)

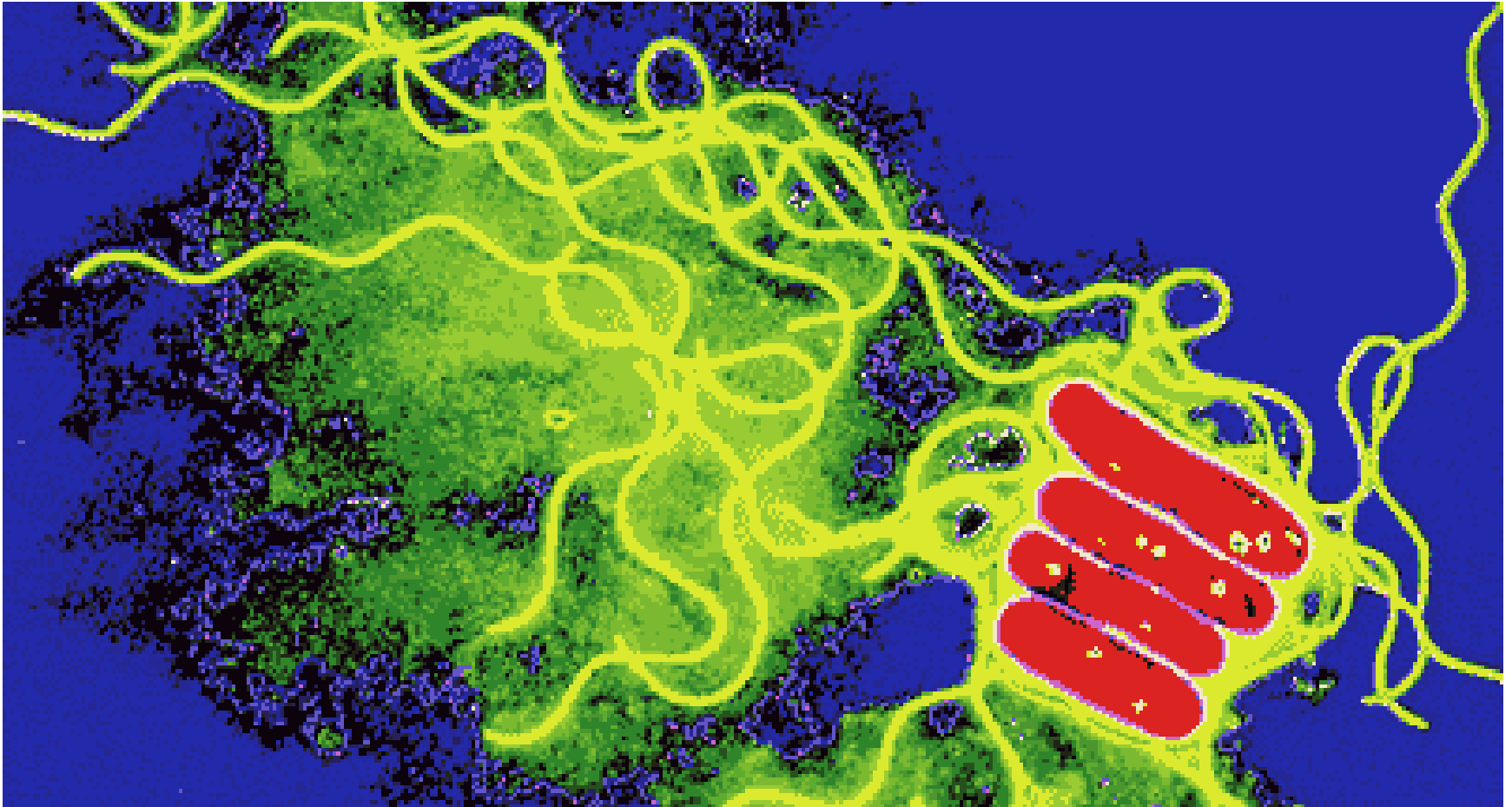
Table 2: Environmental sources positive for Legionella bacteria

Potential environmental sources	Sources		Samples	
	Number investigated	Number (%) positive	Number collected	Number (%) positive
Case-patient homes	7	1 (14.3)	37	1 (2.7)
Cooling towers	43	24 (55.8)	116	68 (58.6)
Chillers	6	5 (83.3)	10	7 (70)
Swamp coolers and sumps	9	5 (55.6)	12	5 (41.7)
Decorative fountains and ornamental waterfalls	22	2 (9.1)	42	2 (4.8)
Municipal, local and industrial water sources	22	3 (13.6)	39	6 (15.4)
Supermarket misters	8	2 (25.0)	20	2 (10)
Whirlpool spa	1	0 (0.0)	2	0 (0.0)
Restaurant A				
Fountain	1	1 (100)	4	4 (100)
Other water sources	4	0 (0.0)	9	0 (0.0)
Total	123	43 (34.7)	291	95 (32.6)

Conclusions

- Urinary antigen and culture should be considered for suspected cases of Legionellosis presenting to hospital
 - Increase in testing with the introduction of urinary antigen testing
 - Culture needed to detect serogroups and species other than *L. pneumophila* serogroup 1
 - Data for testing in other settings is needed
- Paucity of guidelines for environmental testing during outbreaks
 - Infectious dose not known
 - Testing is an adjunct to epidemiological and environmental assessment
- Typing may be a useful adjunct
 - Clinical isolates (aka culture) are required to compare to environmental isolates

Thank you... Any questions?



Legionella Exposure Dynamics and Control Methods for Buildings

John Murphy BSc MHSc MBA ROH CIH GradIOSH
President, Resource Environmental Associates

1. Natural Ecology of *Legionella*

- gram-negative, aerobic, rod-shaped bacterium, common in natural aquatic environments (lakes, streams, ponds) and damp soil
- over 50 species, 70 serotypes (serotype = sub-species having a distinguishing type of blood agglutinating protein)
- temperature range for survival: 65-120 ° F
- optimal temperature range for proliferation: 90-110 ° F (typical DHW temperature range for rooms in hospitals, long-term care centres, many hotels)



Legionella micrograph

1. Natural Ecology of *Legionella*

- Parasite of amoebae and paramecium
(*Legionella* hard to kill because of protection afforded by host organisms)
- Lives as part of an ecosystem with other microbes in fresh water
- It is likely that *Legionella* requires the nutrient conditions inside of a host cell in order to reproduce itself
- *Legionella* may only be free swimming (“planktonic”) outside the host an interim stage between host rupture and invasion of a new host

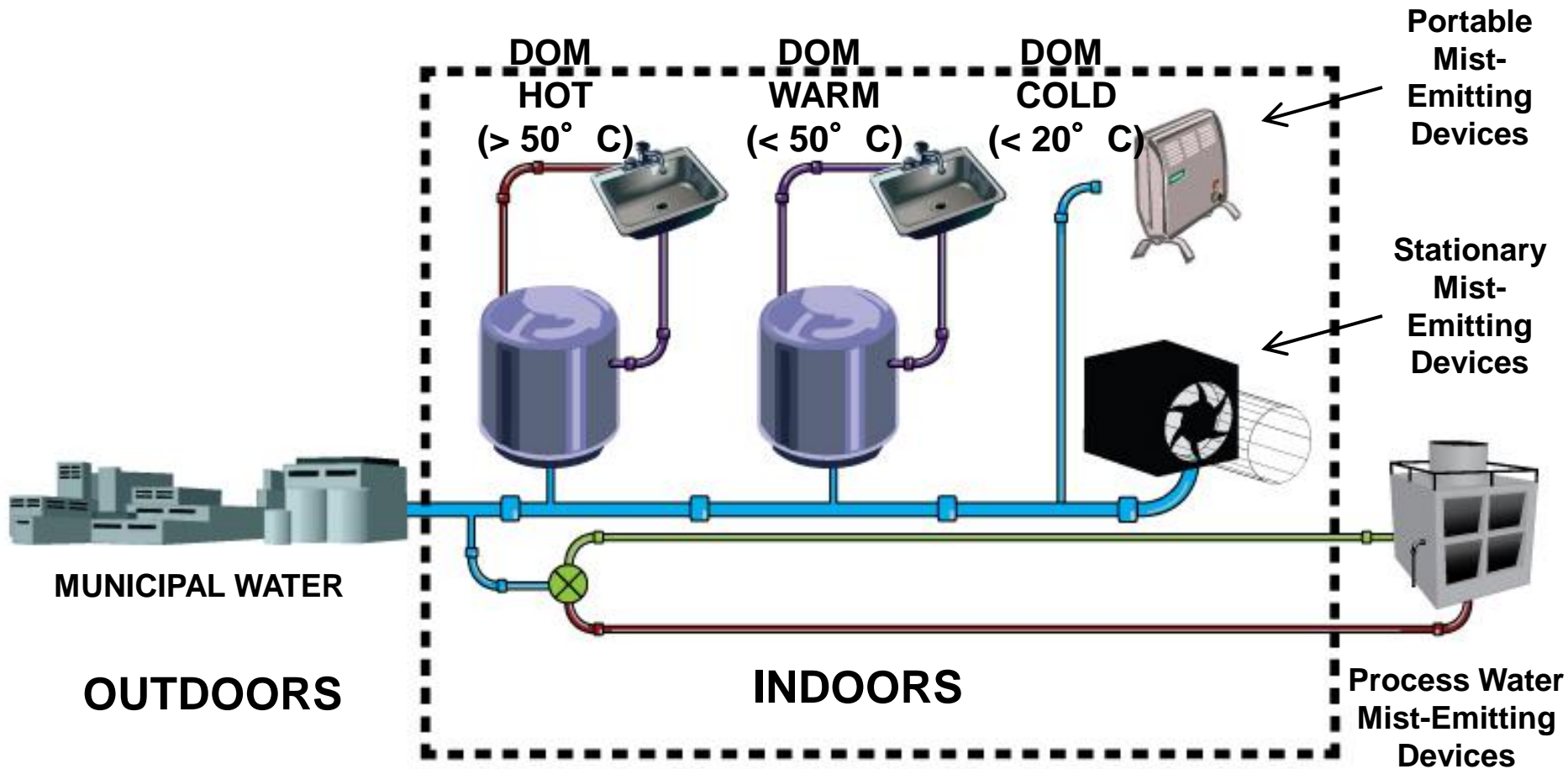


Legionella micrograph

2. Mechanisms of Exposure to *Legionella* via Building Water Systems

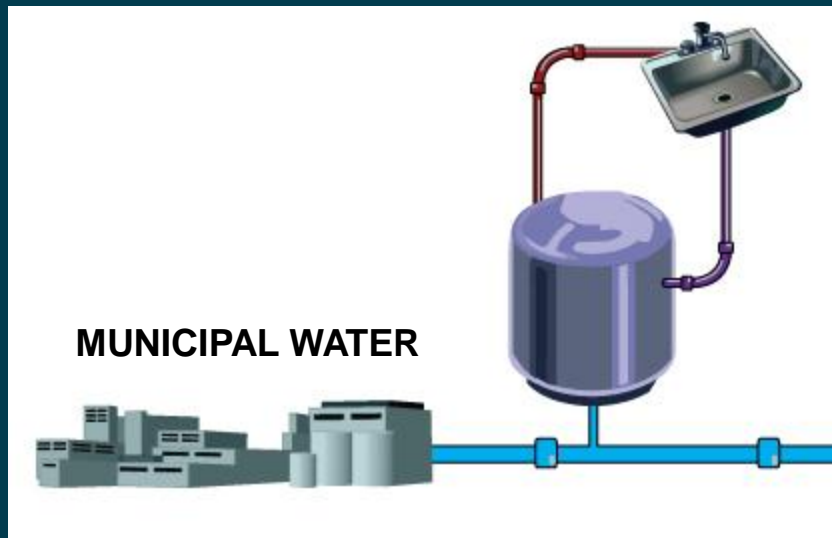
- Commonly found in treated municipal water supplies (resistant to chlorine and bromine at levels used in municipal water treatment), and private well systems
- Commonly found in domestic and cooling / process water systems -- especially **biofilm** and scale, but can also be isolated from bulk water

Typical Three-Temperature Water System



Fate of *Legionella* in the Domestic Hot Water System

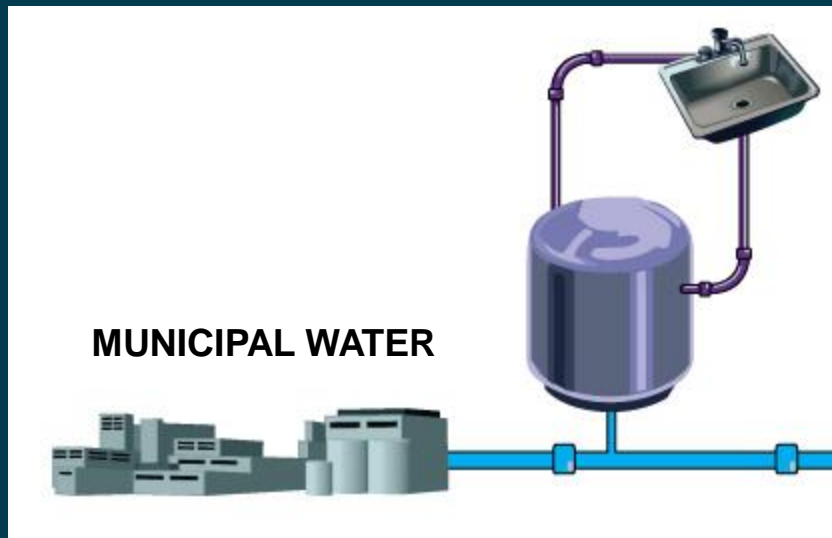
DOM
HOT
($> 50^{\circ} \text{C}$)



- The DHW system typically supplies kitchens, laundries, and tub rooms in hospitals, LTC facilities, and hotels
- $> 50^{\circ} \text{C}$ suppresses and kills *Legionella*
- *Legionella* should not be present in significant concentrations in the DHW tank nor the supply lines to faucets so long as the delivery temp. is at least 50°C
- *Legionella* may colonize biofilm in the recirculation lines if temps. are $< 50^{\circ} \text{C}$ (which is typical)

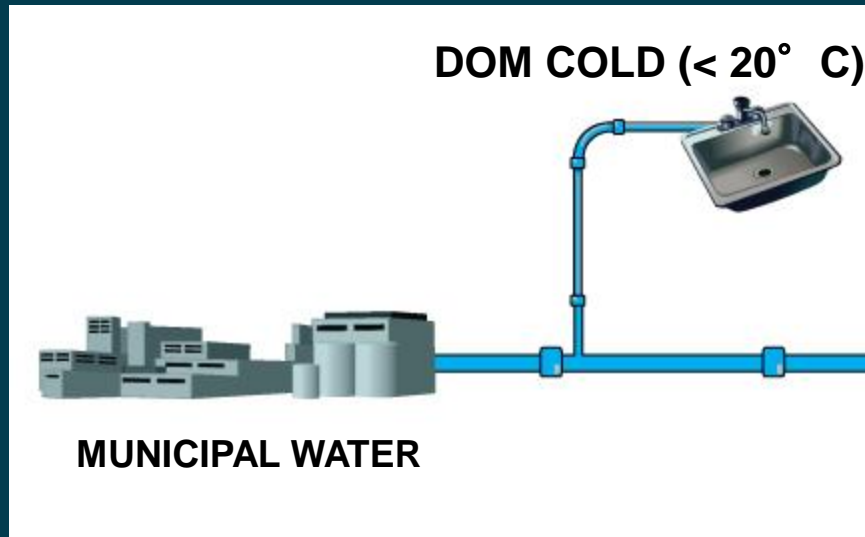
Fate of *Legionella* in the Domestic Warm Water System

DOM
WARM
($< 50^{\circ} \text{C}$)



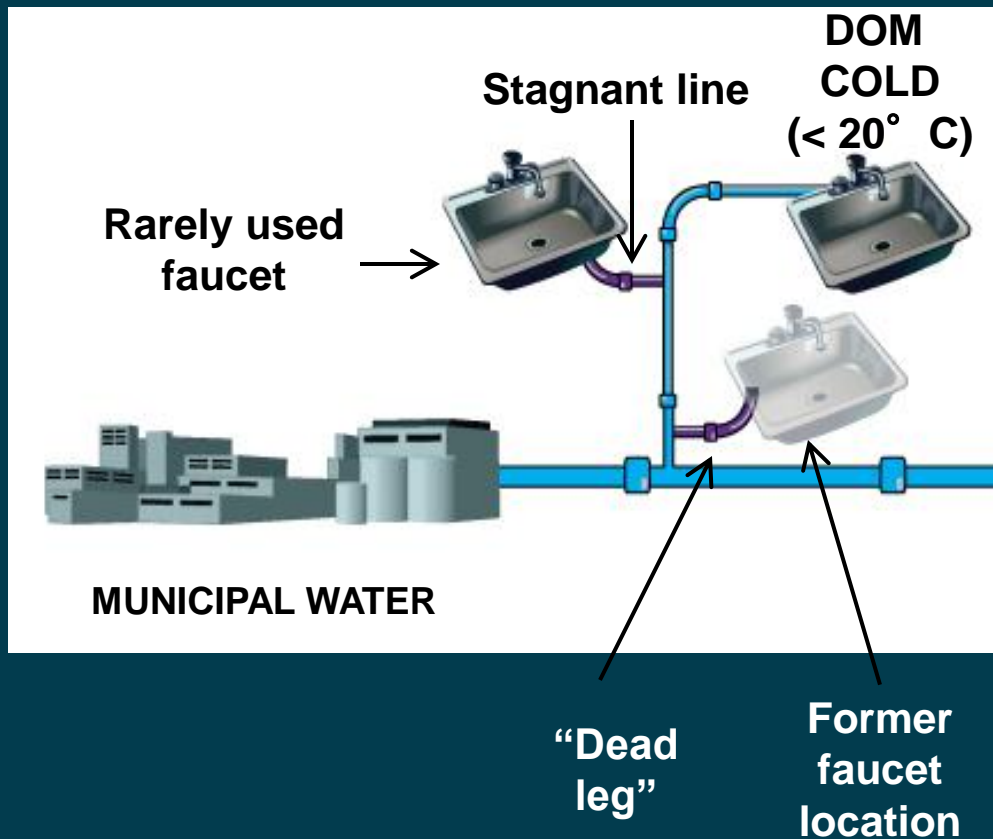
- The DWW system typically supplies patient / resident rooms, and public washrooms in hospitals, LTC facilities, and hotels
- 35°C to 45°C is the ideal temperature range for *Legionella* proliferation
- If other habitat factors are present, there is potential for *Legionella* colonization of the DWW system (tank, supply lines, recirculation lines)

Fate of *Legionella* in the Domestic Cold Water System



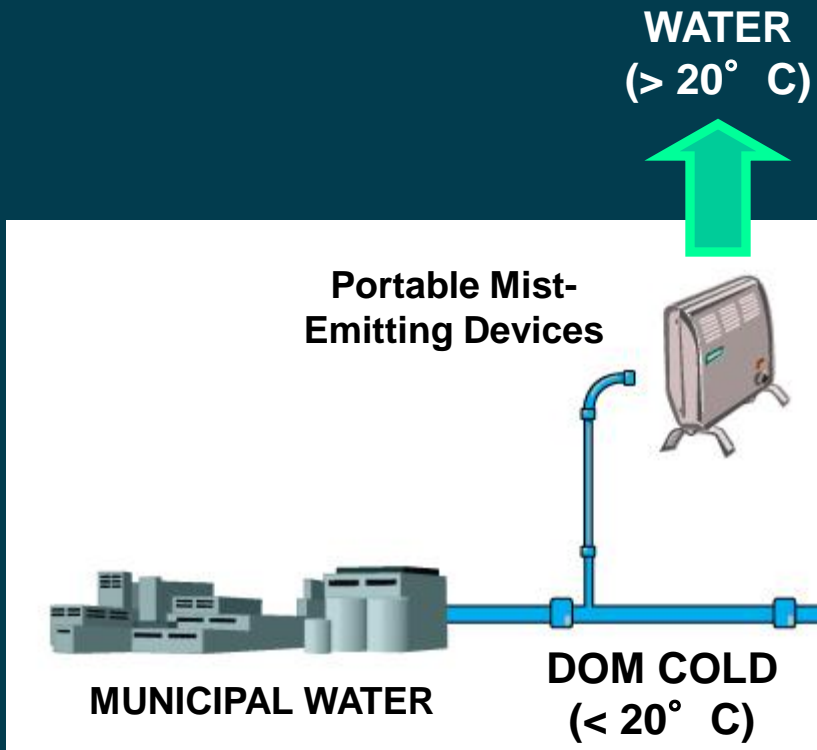
- The DCW system typically supplies all potable and utility faucets (e.g. outdoor faucets, dishwashers, washing machines, janitor's sinks, etc.)
- Typically no recirculation
- *Legionella* is dormant < 20° C
- Colonization of the cold system is not likely to occur unless there are “**dead legs**” or other stagnant areas with more moderate temperatures

Fate of *Legionella* in the Domestic Cold Water System with Dead Legs or Stagnant Zones



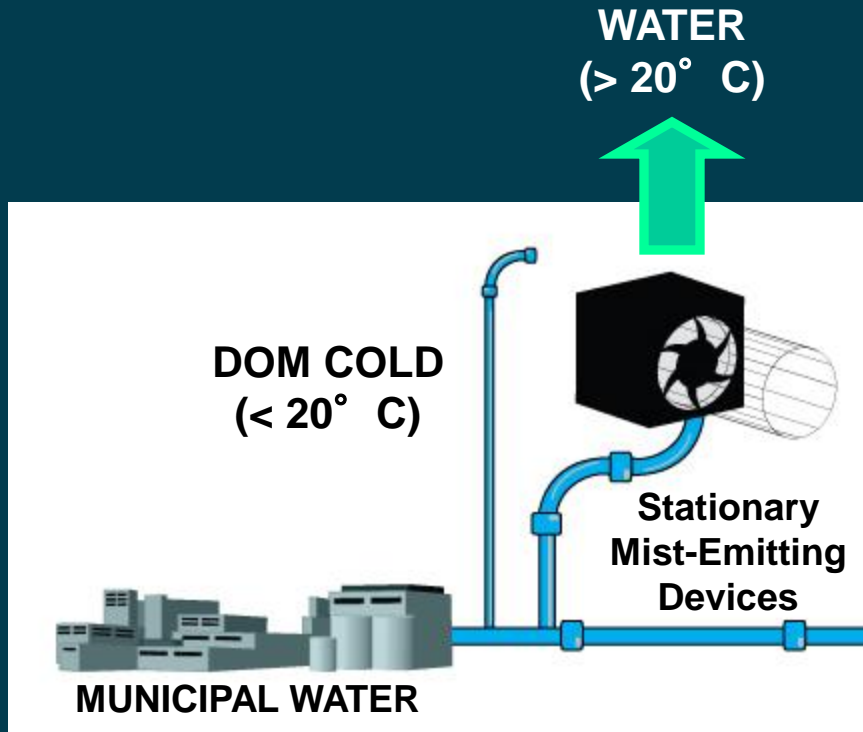
- A “**dead leg**” is a section of pipe that has no flow due to it being capped off at the terminus
- Water temperatures in dead legs and stagnant lines can be at room temperature or higher (e.g. if beside a DHW line or air duct)
- Colonization can occur in dead legs and stagnant lines

Legionella in Portable Mist-Emitting Devices



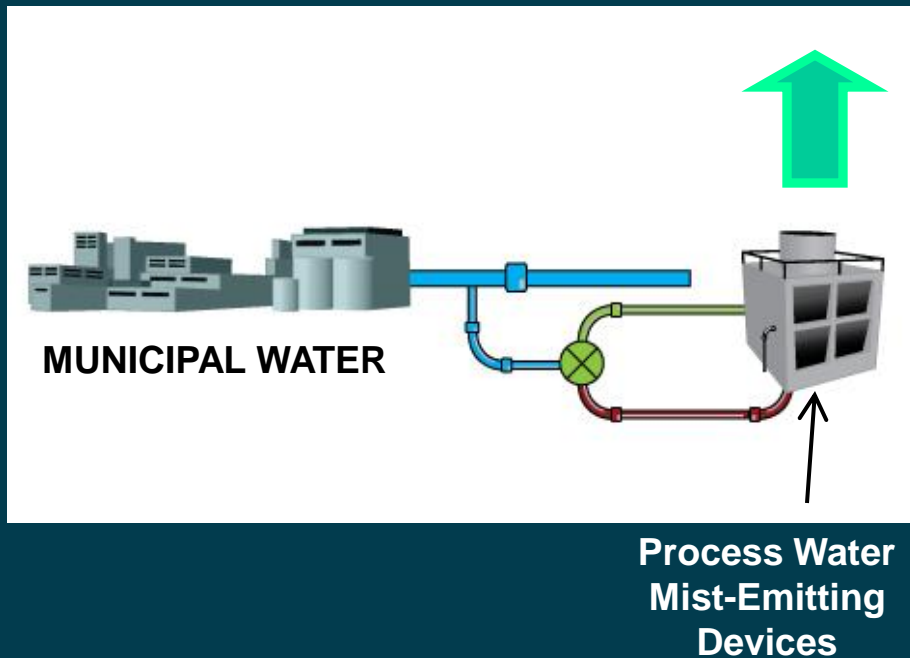
- The temperature of water in portable mist-emitting devices (e.g. humidifiers) will be room temperature or higher
- If fed with cold water, the initial *Legionella* concentration should be low
- The concern with these devices is the potential for biofilm formation from constant use and inadequate cleaning, *Legionella* proliferation in the biofilm, followed by emission in mists

Legionella in Stationary Mist-Emitting Devices



- The temperature of water in stationary mist-emitting devices (e.g. ventilation system mist humidifiers) will be room temperature or higher
- If fed with cold water, the initial *Legionella* concentration should be low
- The concern is the potential for biofilm formation in lines and drip pans from inadequate cleaning, *Legionella* proliferation in the biofilm, and mist emission

Legionella in Process Water Mist-Emitting Devices



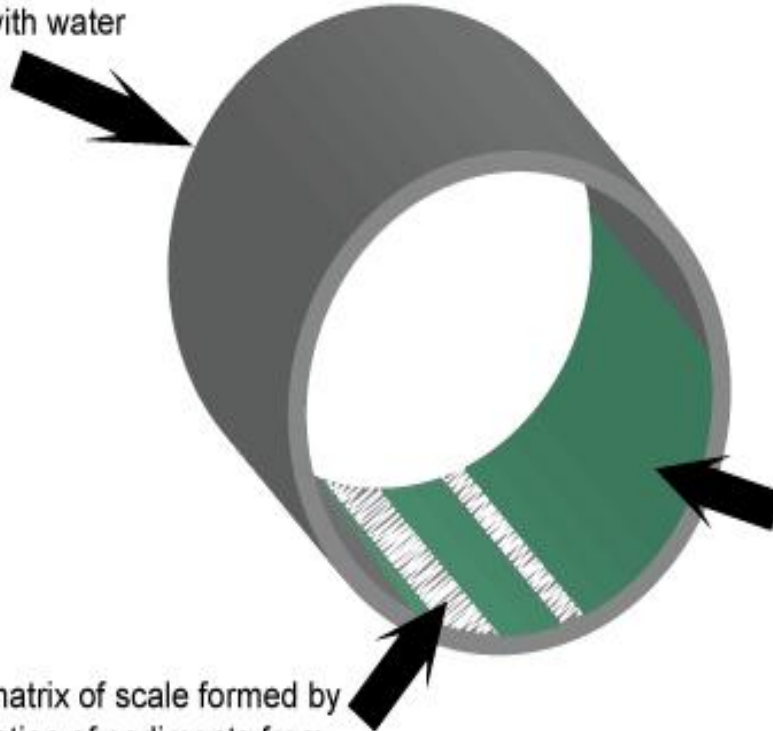
- Cooling towers are the most common process water mist-emitting devices
- The water temperatures in these systems are usually optimal for *Legionella* proliferation
- These systems are also prone to scale and sediment build-up, which promotes biofilm formation
- Proper programs of cleaning, disinfection and testing are essential to control *Legionella*

3. The Importance of “Biofilm”

- **Biofilm** is a slimy film lining the inside walls of water pipes, that consists of an agglomeration of living and dead microorganisms.
- Biofilms are often adhered to mineral scales comprised mostly of precipitated calcium, magnesium and iron oxides, that line the inside walls of water pipes. Scale formation is more common where the water is “hard” (i.e. has high concentrations of calcium, magnesium and / or iron).
- Commensurate microorganisms for *Legionella* include algae, *Flavobacteria*, and *Pseudomonas*, which supply essential nutrients for growth of *Legionella*, and hosts such as amoebae and protozoa.

What is a “Biofilm”?

Metal water pipe or any metal surface
with constant contact with water



Trace bacteria, algae and slime mould
in the water colonize the microscopic
openings in, and the surface of the scale,
creating a habitat supporting a range of
microbes = the biofilm

Porous matrix of scale formed by
accumulation of sediments from
galvanic reaction between dissolved
minerals and the metal surface

Risk Factors for Biofilm Formation and *Legionella* Proliferation

- Water conditions that tend to promote the growth of *Legionella* include:
 - stagnation
 - temperatures between 20° and 50° C (68° -122° F)
 - pH between 5.0 and 8.5
 - sediment / scale that tends to promote growth of commensal micro flora (which in turn is often a function of water hardness)
 - microorganisms such as algae, flavobacteria, and *Pseudomonas*, which supply essential nutrients for growth of *Legionella*, or protozoa that harbor the organism such as amoebae and protozoa



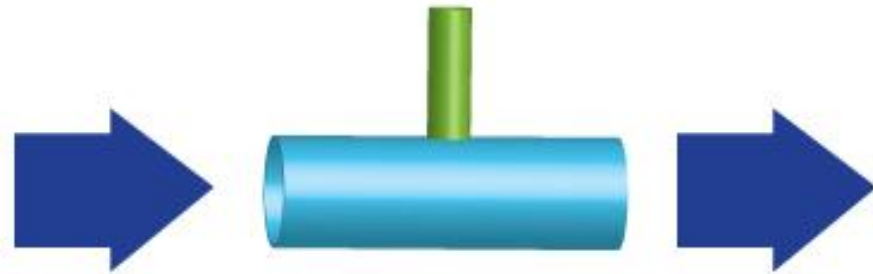
Factors affecting Legionella colonization and proliferation

Potential Host Water Systems

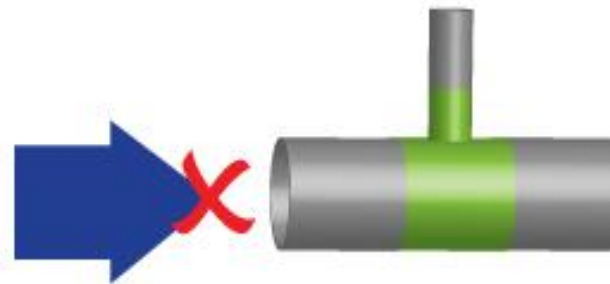
- **Water systems that frequently provide optimal conditions for growth of *Legionella* include:**
 - **cooling towers**
 - **condensing towers**
 - **evaporative condensers**
 - **fluid coolers that use water evaporation to reject heat**
 - **domestic hot-water systems with water heaters that operate below 60° C (140° F) and deliver water to taps below 50° C (122° F)**
 - **poorly maintained humidifiers and decorative fountains that create a water spray and use water at temperatures favorable to growth**
 - **spas and whirlpools with aeration**
 - **dental water lines, which are frequently maintained at temperature above 20° C (68° F) and sometimes as warm as 37° C (98.6° F) for patient comfort**
 - **stagnant water in fire sprinkler systems**
 - **warm water for eye washes or safety showers**

Scenario: Stagnant Water Dispersal Following System Shut-Down

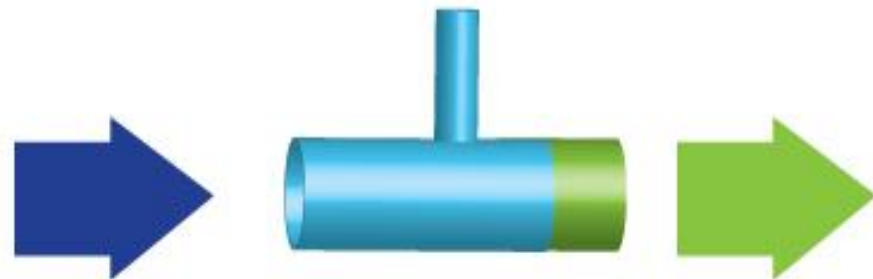
Initial Condition –
Stagnant Water in Dead Leg



Shut-Off Condition –
Stagnant Water in Main Line

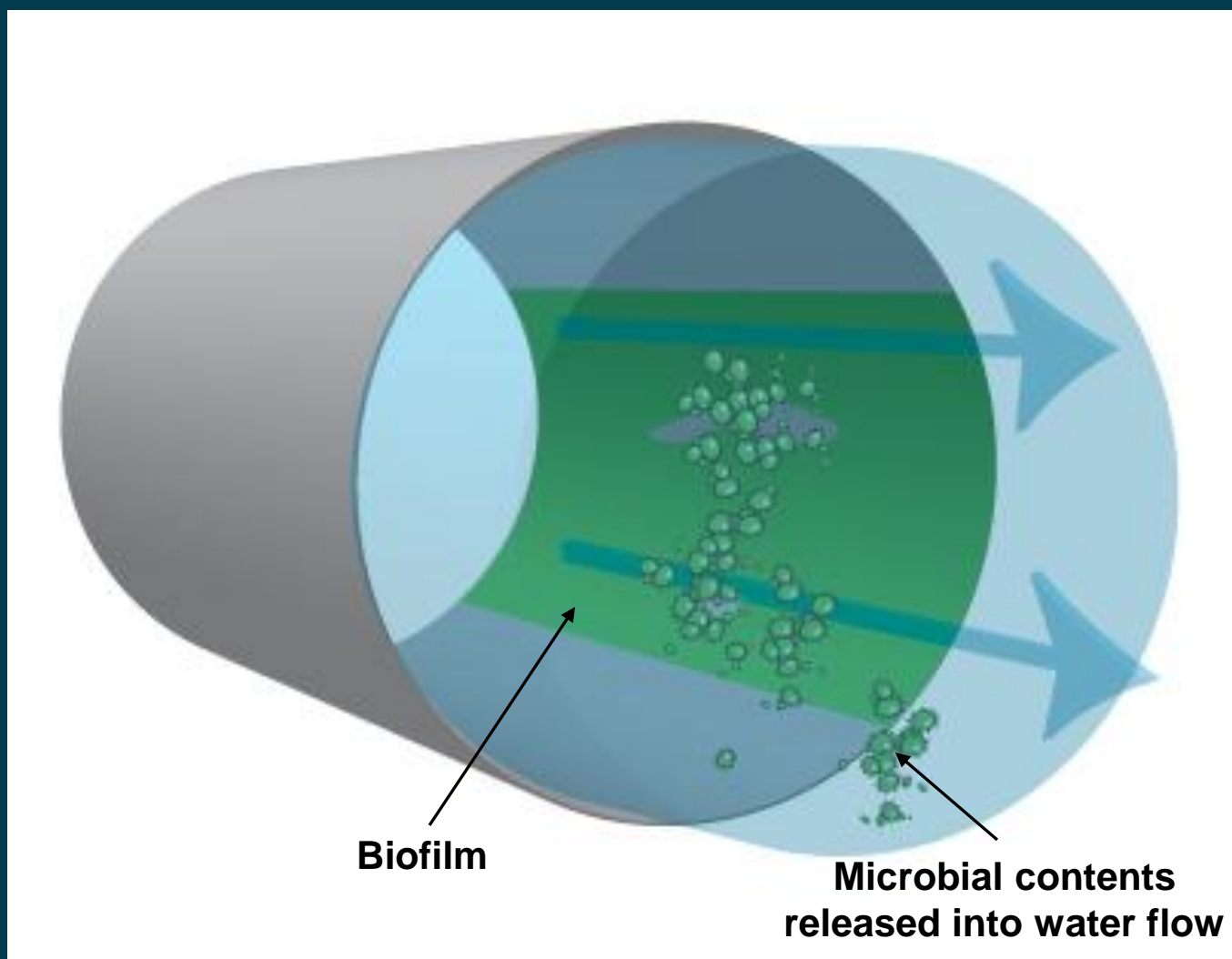


Turn-On Condition –
Stagnant Water Plug Moves to
Discharge Points



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Scenario: Biofilm Disturbance in Domestic Water System



Don't Forget to Flush!

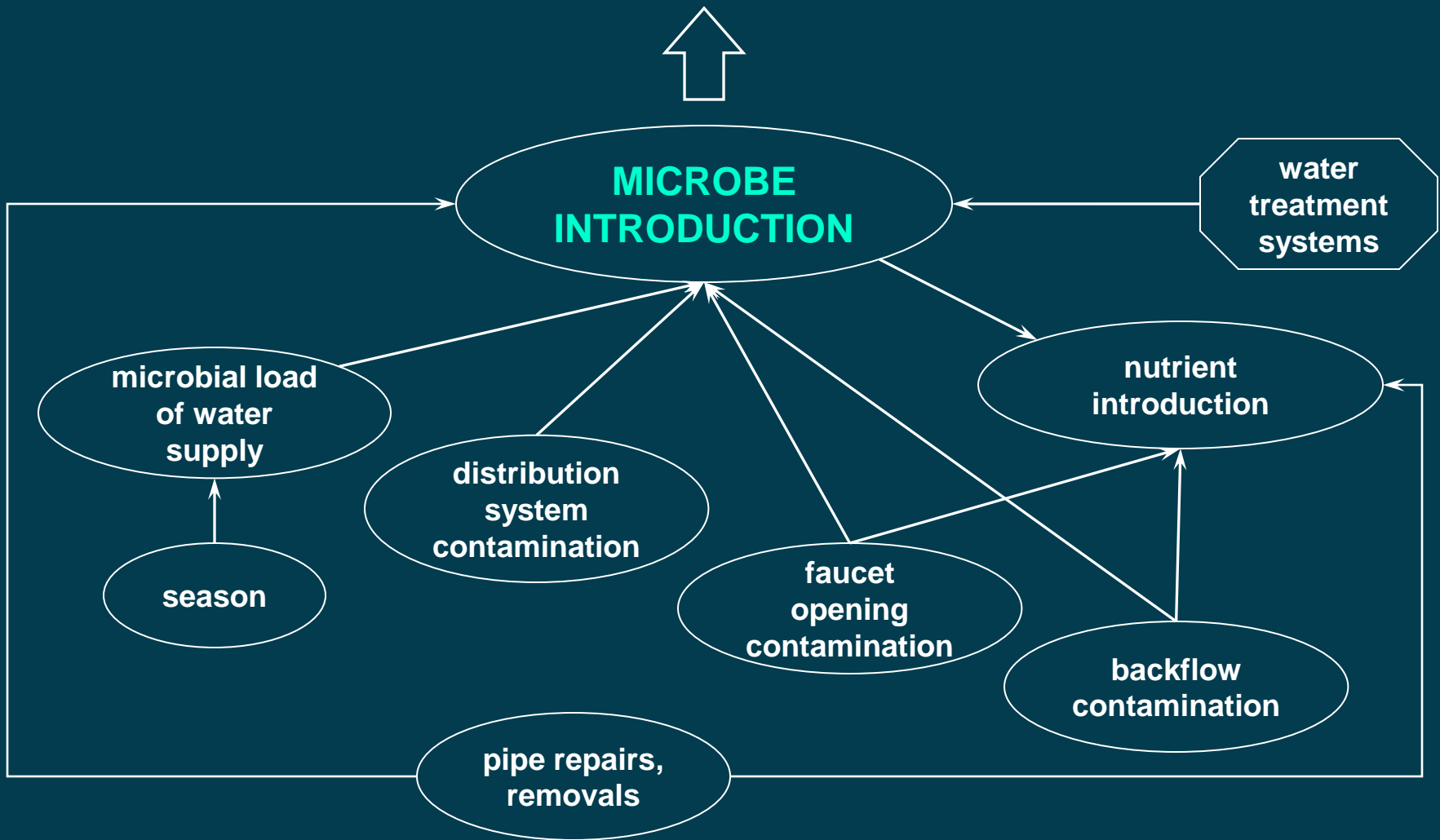
- **These scenarios illustrate why it is important to thoroughly flush domestic water systems following repairs and shut-downs; and it may be prudent to flush domestic systems on a regular basis over the course of prolonged construction or renovation projects.**
- **Plumbing system shut-downs, construction and maintenance and activities are commonly associated with discolouration, rust or sediments in the domestic water, and it would be prudent to assume that when these conditions appear, biofilm dispersal may also have occurred.**

4. Legionnaire's Disease Risk Model

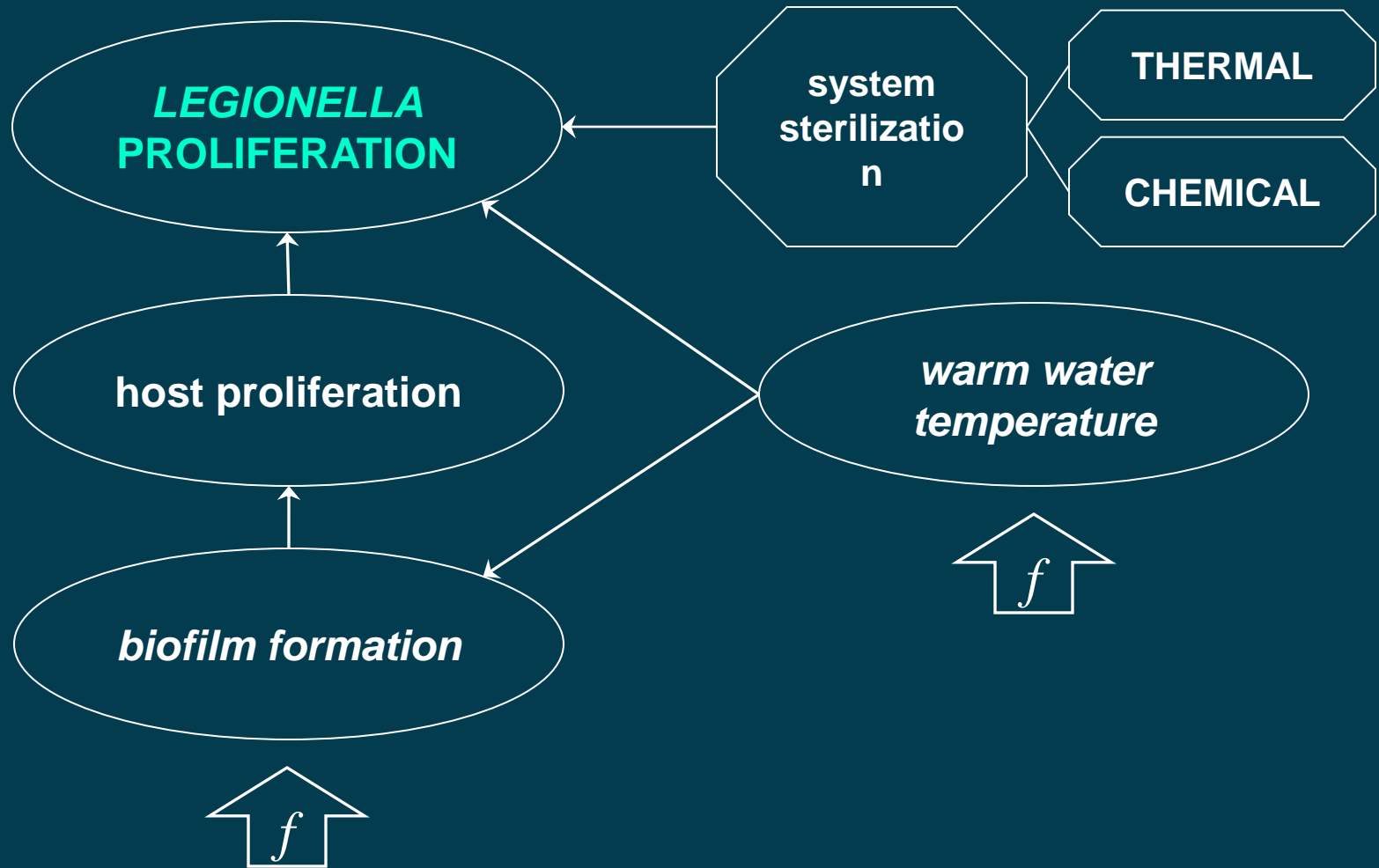
Legionnaires' Disease Risk =

**[*p* Introduction] • [*p* Proliferation] • [*p* Dispersal]
• [*p* Discharge] • [*p* Exposure] • [*p* Susceptibility]**

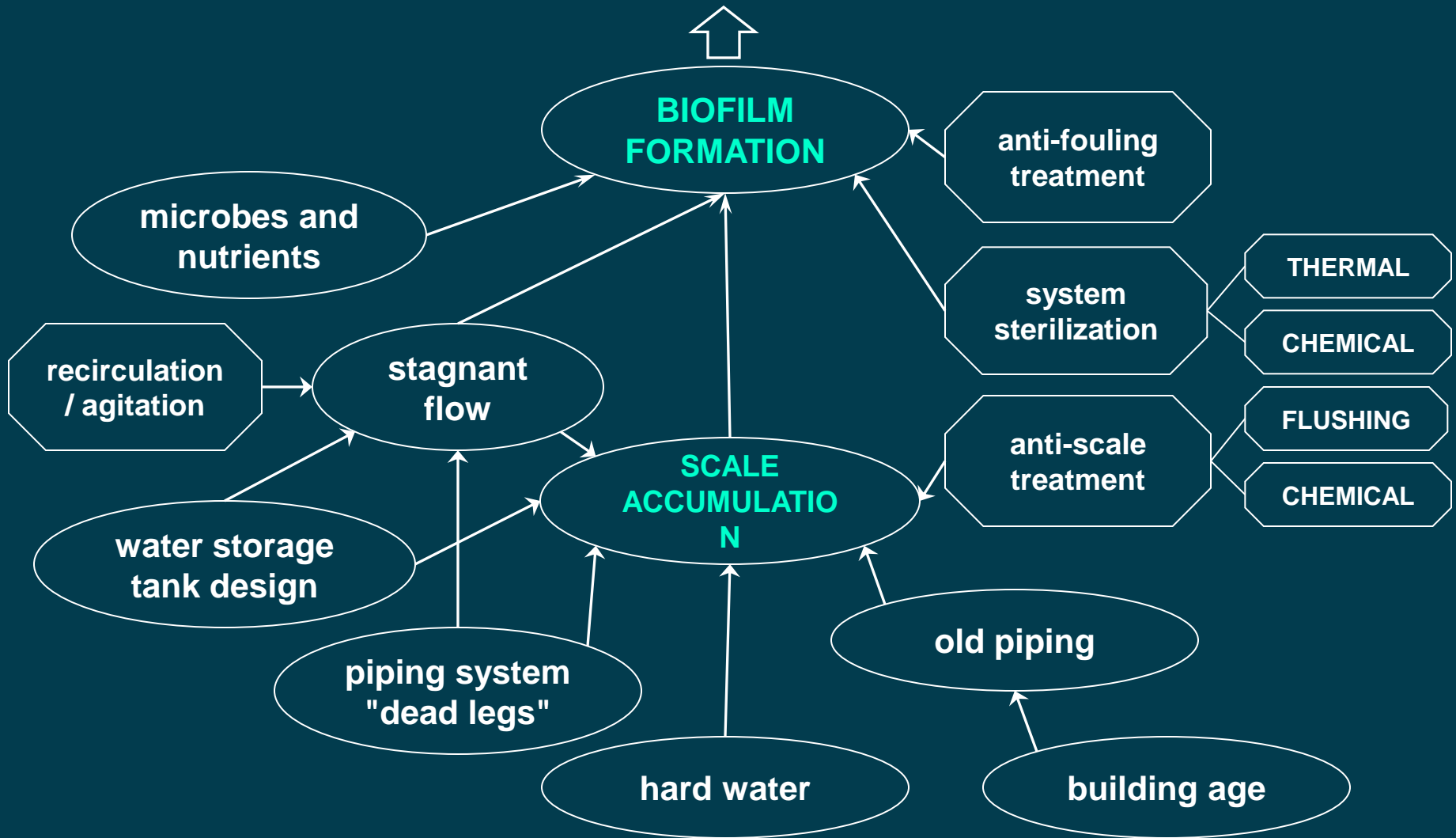
p Introduction



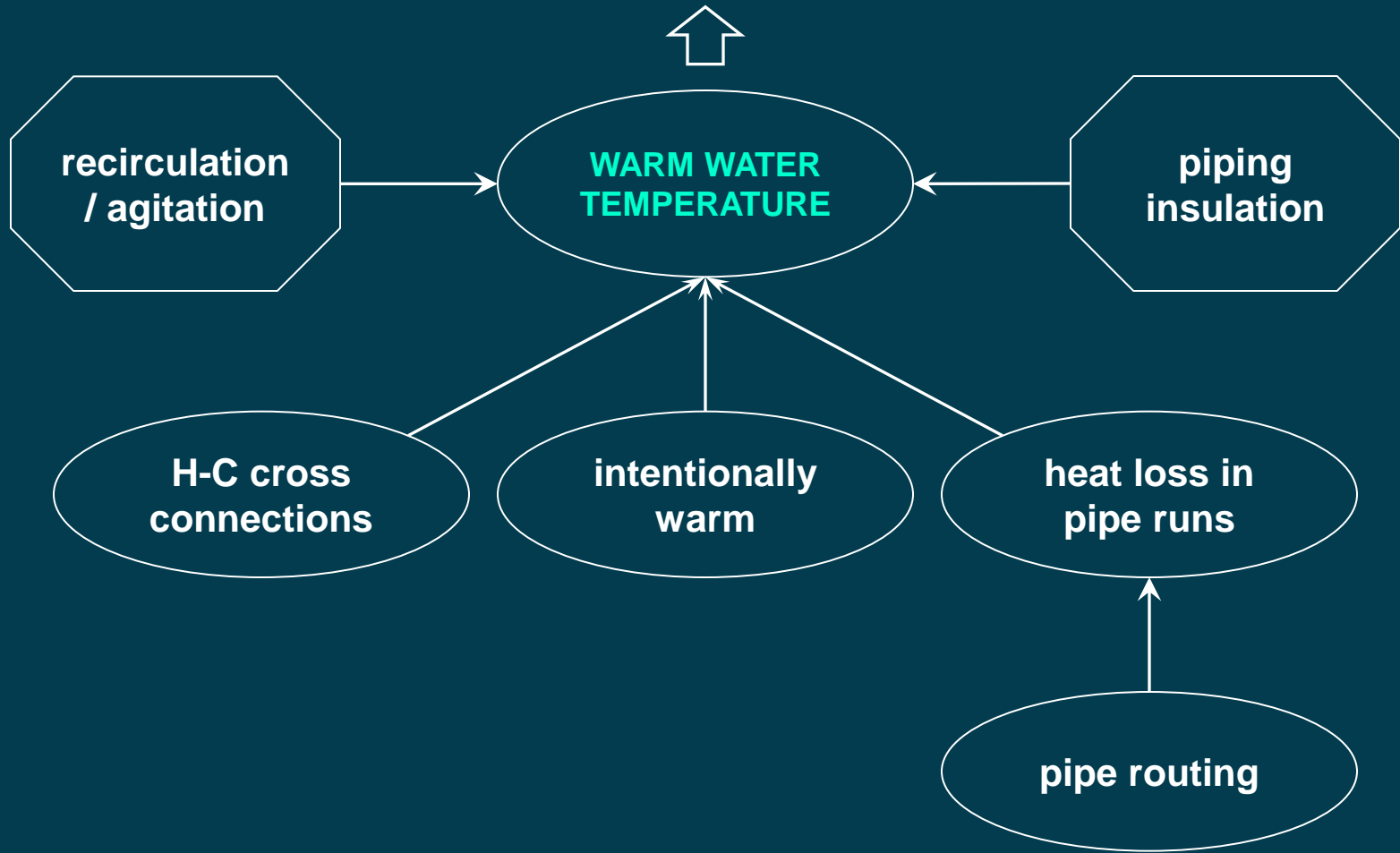
p Proliferation



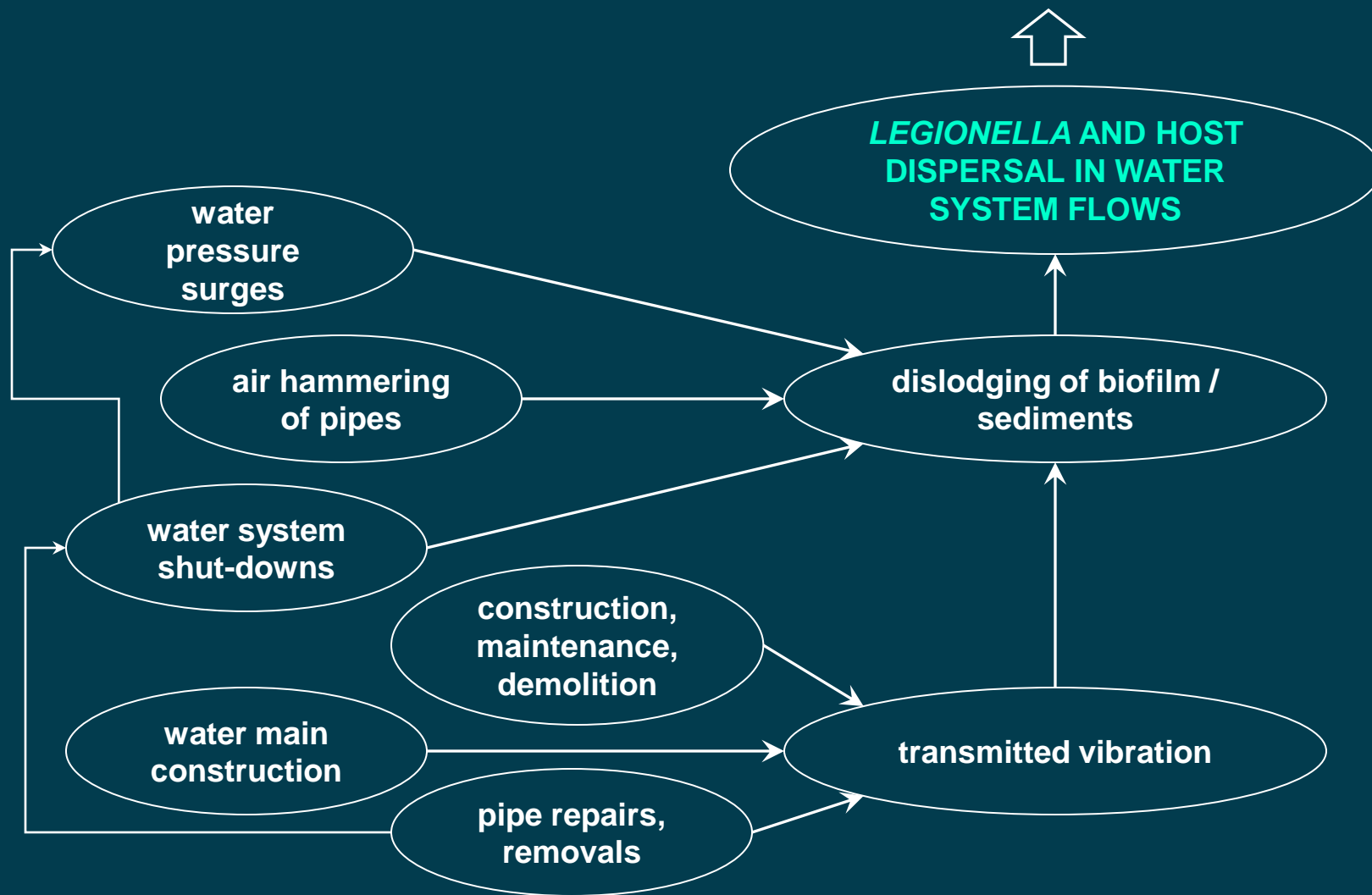
f Biofilm Formation



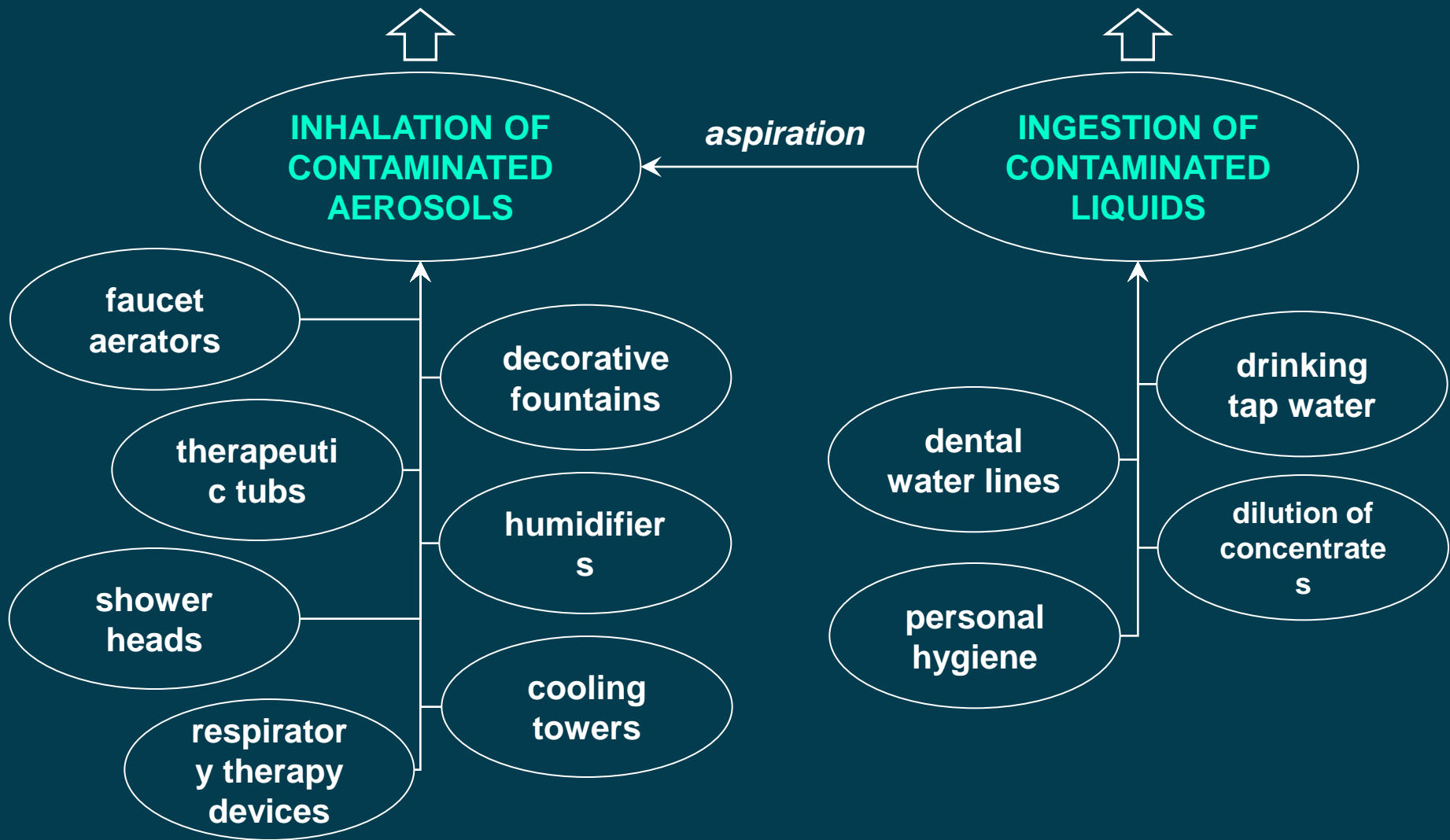
f Warm Water Temperature



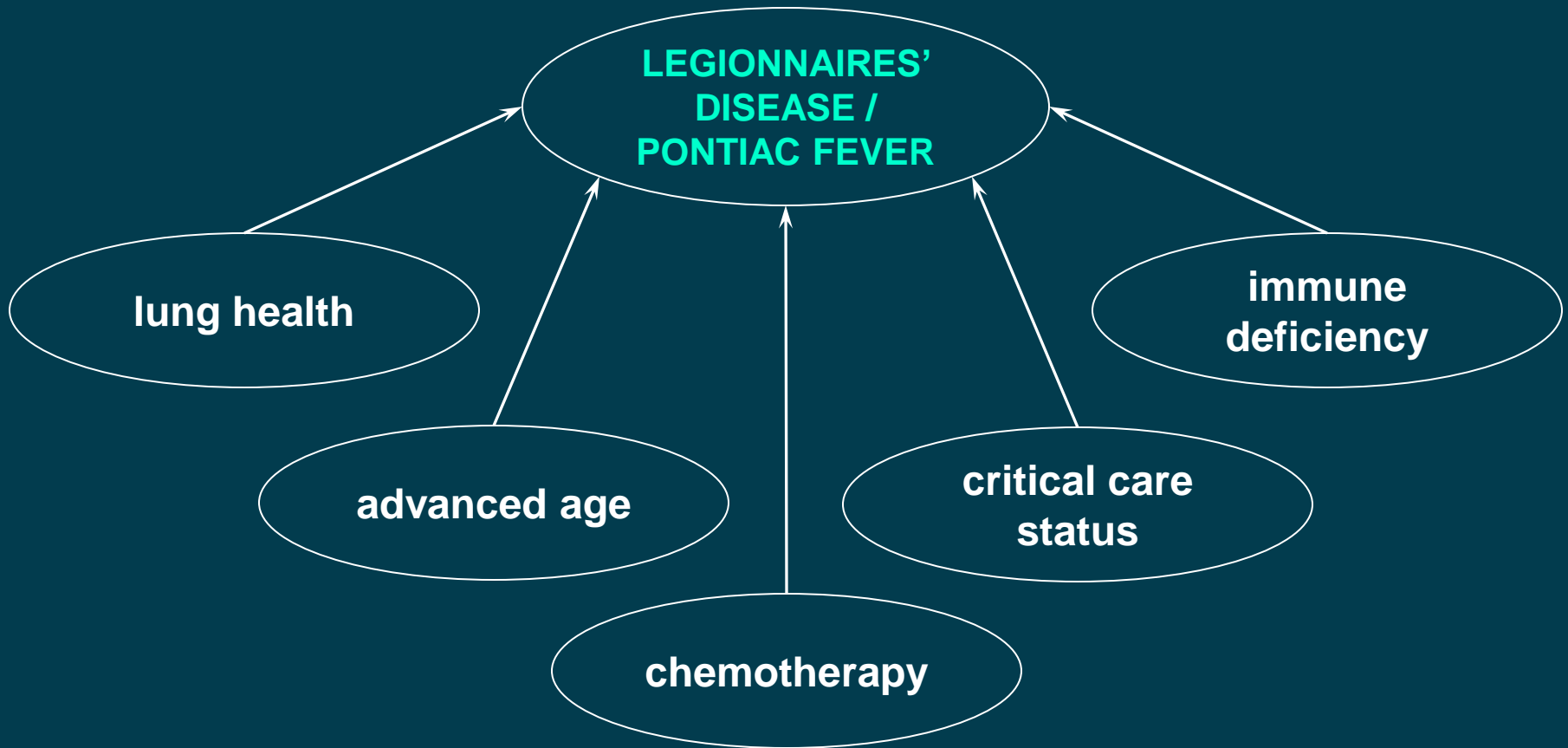
p Dispersal



p Discharge, p Exposure



p Susceptibility



5. Environmental Hygiene Precautionary Risk Assessment

DOMESTIC WATER SYSTEM					
Risk Factors		Risk Sub-Factors	Risk Rating		
			Low	Med	High
Biofilm formation potential	Scale accumulation potential	Water hardness			
		Hot water tank horizontal v vertical position			
		Hot water cold bottom feed / hot top out opposite			
		Hot water tank agitator			
		Water tank dumping and cleaning practices			
	Microbial contamination potential	Expected microbial load of source water supply			
		Potential degree of water supply line contamination			
		On-site water treatment system microbial prevention			
		Extent of potential backflow contamination			
		Extent of system openings subject to contamination			
	Microbial proliferation potential	Domestic HW tank temperature			
		Domestic HW line temperature			
		Domestic HW tap delivery temperature			
		Adequacy of pipe insulation			
		Presence of HW recirculation system			
		HW recirculation system feed back to HW tank			
		Reverse osmosis treatment			

5. Environmental Hygiene Precautionary Risk Assessment

DOMESTIC WATER SYSTEM					
Risk Factors		Risk Sub-Factors	Risk Rating		
			Low	Med	High
Biofilm formation potential	Microbial proliferation potential	Extent of dead legs			
		Extent of inactive / stagnant lines			
		Piping system sterilization practices			
Potential for dislodging biofilm		Water pressure surges			
		Air hammering			
		Construction			
		Demolition			
		Maintenance			
		Water system shutdown			
		Water main construction			
		Pipe repair / removal			
Exposure potential	Potential for inhalation of aerosols	Faucet aerators			
		Indoor decorative fountains			
		Outdoor decorative fountains			
		Central mist humidifiers			
		Portable mist humidifiers			
		Showering			

5. Environmental Hygiene Precautionary Risk Assessment

DOMESTIC WATER SYSTEM					
Risk Factors		Risk Sub-Factors	Risk Rating		
			Low	Med	High
Exposure potential	Potential for inhalation of aerosols	Therapeutic whirlpool / jacuzzi tubs			
		Use of tap water to clean respiratory therapy devices			
	Potential ingestion of bulk water	Use for beverages / drinking water			
		Face washing			
		Bathing / Showering			
Occupant risk factors		Advanced age			
		Lung health			
		Chemotherapy			
		Critical care			
		Transplant			
		Immune deficiency			

5. Environmental Hygiene Precautionary Risk Assessment

COOLING TOWER AND CHILLER					
Risk Factors	Aspect	Risk-Sub Factor	Risk Rating		
			Low	Med	High
Biofilm fouling	Design / Construction	There are dead legs, stagnant lines, and loops that are difficult to drain.			
		Constructed of corrosion resistant materials			
		Construction of smooth and non-porous materials			
		Multiple-cell cooling tower basins can be individually isolated			
		Distance of piping between the cooling tower and the chiller (total wetted surface)			
	Operating Practices	Chiller barrel inspection, cleaning, disinfection practices.			
		Cooling tower inspection, cleaning, disinfection practices.			
		Cooling towers maintained according to manufacturer's recommendations.			
		Proper dosing with biocides			
		Rotation of biocides			
		Proper dosing with biodispersants			
		Free halogen in the cooling tower / chiller circuit kept in the range of 0.5 to 1.0 mg/L free halogen (as per Cooling Tower Institute recommendations)			
		Proper water testing regime			
		Make-up water filtered and treated with trace (or greater) halogen residual.			
		Are the tower, lines and chiller barrel drained, cleaned and disinfected before start-up, and after any long shutdown period (greater than 1 week)?			

5. Environmental Hygiene Precautionary Risk Assessment

COOLING TOWER AND CHILLER					
Risk Factors	Aspect	Risk-Sub Factor	Risk Rating		
			Low	Med	High
Biofilm fouling	Operating Practices	Cleaning, flushing and disinfection at (a) start-up; (b) post lay-up; and (c) on a regularly scheduled basis.			
		Tower, lines and chiller barrel drained and kept dry when the tower is taken out of service			
		Non-removable dead legs in the piping system - blown down regularly? (particularly after biocide treatments and cleanings)			
		Direct free cooling (chilled water) risers - blown down weekly?			
		Is the basin inspected with regular frequency to determine need for cleaning?			
		All valves in the system are exercised periodically by opening and closing them fully			
		Proper dosing with anti-corrosion chemicals			
	Siting	Potential for entry of plant life and nutrients.			
		Prevailing winds can introduce bacterial nutrient sources into the cooling tower (e.g. kitchen exhausts, industrial emissions having nutrient value, forests or fields that generate appreciable airborne organic dusts, etc.)			

5. Environmental Hygiene Precautionary Risk Assessment

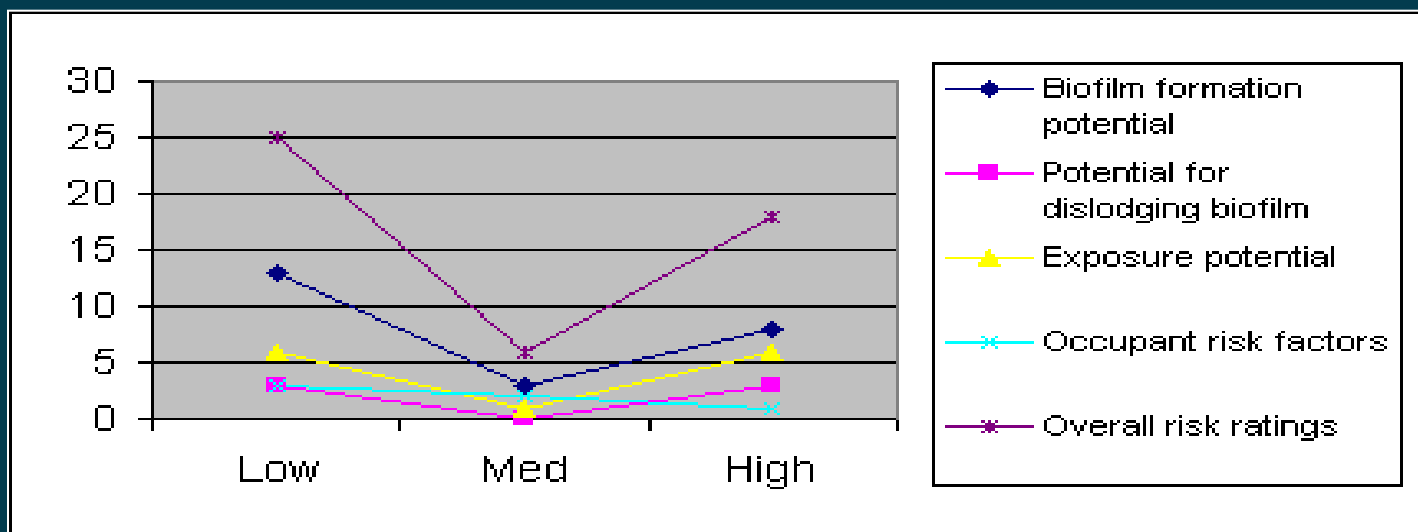
COOLING TOWER AND CHILLER					
Risk Factors	Aspect	Risk-Sub Factor	Risk Rating		
			Low	Med	High
Mist dispersal	Design / Construction	High efficiency mist drift eliminators present and maintained			
	Siting	Potential for mist drift to nearby air intakes			
		Prevailing winds blow mists to target receptors			
		Tower drift proximity to the facility's air intake system.			
Potential for exposure	Protective Equipment	Workers exposed to cooling tower mist drift provided with appropriate respiratory protection.			
	Entry to building	Openable windows / doors in downstream proximity to mist emissions points.			
		Filtration in air handling systems			

5. Environmental Hygiene Precautionary Risk Assessment

AIR HANDLING AND COOLING SYSTEMS					
Component	Risk Sub-Factors	Risk Rating			N / A
		Low	Med	High	
Outdoor Air Handling Units	Protected from rain infiltration				
	Adequate air filters				
Humidifiers - Mist Discharge	Not recommended for use. If present, Risk Rating is "High"				
Humidifiers - Pressurized Steam Discharge	Discharge line self-draining when non-operational				
	Drip pan designed to minimize water accumulation				
	Drip pan drain lines clear and functioning				
Humidifiers - Evaporative Steam Discharge	Water temperature achieved in heating pan				
	Water pan discharge / dumping frequency				
	Water pan descaling / cleaning practices				
Cooling Coils	Drip pans designed to minimize water accumulation				
	Drip pan drain lines clear and functioning				
Acoustic Lining	Air plenum free of moisture-absorbing acoustic lining				
	Duct work free of moisture-absorbing acoustic lining				

5. Environmental Hygiene Precautionary Risk Assessment

RISK FACTOR PROFILES	Low	Med	High
Biofilm formation potential (<i>i.e. introduction, proliferation</i>)	13	3	8
Potential for dislodging biofilm (<i>i.e. dispersal</i>)	3	0	3
Exposure potential (<i>i.e. discharge, exposure</i>)	6	1	6
Occupant risk factors (<i>i.e. susceptibility</i>)	3	2	1
Overall risk ratings	25	6	18
As % of possible rating	48%	14%	35%



6. Water System Bacterial Remediation Methods

ADVANTAGES	METHOD			
	Chlorination and Flushing (chlorine, chlorine dioxide, etc.)	Superheating and Flushing	Portable silver-copper ionization system (no flushing)	Silver nitrate treatment (no flushing)
Effective	✓	✓	✓	✓
Fast implementation	✓	✓		
Immediate / quick effect	✓	✓		
Easy to do	✓	✓		
Relatively inexpensive	✓			
Water system available			✓	✓
Some residual suppression			✓	✓
In the peer reviewed literature	✓	✓		

6. Water System Bacterial Remediation Methods

DISADVANTAGES	METHOD			
	Chlorination and Flushing (chlorine, chlorine dioxide, etc.)	Superheating and Flushing	Portable silver-copper ionization system (no flushing)	Silver nitrate treatment (no flushing)
Dosing system required	√		√	√
Plumbing mod'ns required	√			
Water system unavailable	√	√		
Risks to residents / patients	√	√		
Risk of damage to plumbing	√	√		
Need "strong" DHW system		√		
"Requires math"	√	√	√	√
Requires conc'trn monitoring			√	√
Delayed / slower effect			√	√
No residual suppression	√	√		

7. Water System Bacterial Prophylactic Methods

FEATURES	Chemical Treatment Systems (Ozonation, Chlorination)	UV Lamp	Reverse Osmosis	Water Softening	Permanent silver-copper ionization system (no flushing)	Periodic Superheating and Flushing
Biofilm suppression					✓	✓
Reduction in scale formation			✓	✓		✓
Biofilm suppression					✓	✓
Bacteria suppression	✓	✓	✓		✓	✓
Legionella suppression					✓	✓

Questions?

Legionella: Biofilms and More

Legislative Authority during Environmental Investigations

Tony Amalfa
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Ministry of Health & Long-Term Care

November 21, 2011

Introduction

For public health responses, the *Health Protection and Promotion Act* is the over arching legislation that allows certain actions to be taken.

The purpose of the Act (in part)

- **“prevention of the spread of disease and the promotion and protection of health of the people of Ontario”.**

Other provincial legislation and partners may support public health investigations depending on the particular type of establishment.

Health Protection and Promotion Act

Sections applicable to environmental health investigations under the HPPA

- Section 10 Respond to health hazards
- Section 11 ministry with primary authority
- Section 13 Order by MOH or PHI re health hazard
- Section 14 Directions by MOH
- Section 41
 - Right of entry and purpose
 - Examination
 - Samples or Extracts

Legionella Investigation

Scenario

- A long term care home in rural Ontario reported a death of a resident who tested positive for Legionella
- The home is not municipally serviced and operates on individual private drinking water and waste disposal services

Legislation

- *Health Protection and Promotion Act, Section 11*
- *Long- Term Care Homes Act*
- *Occupational Health and Safety Act*
- *Safe Drinking Water Act*
- *Building Code Act*

Legislation Applicable to other Settings

- Retirement Homes Act
- Day Nurseries Act
- Education Act

Summary

- The *Health Protection and Promotion Act* provides the legislative authority for environmental health investigations to assess health hazards
- Other provincial statutes play an important role in addressing public health and safety issues in a variety of settings

Questions

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