Nebraska Infection Control Network

Waterborne Pathogens – Building a Water Management Plan

Andrew Sass BSN RN CIC
NICN

1

Key points – Water Management

- Understanding the:
  - Transmission of waterborne pathogens
  - Risk to your patients
  - Approaches for prevention
  - Mitigation strategies for your facility
- Know your resources:
  - ASHRAE-188
  - ST-108 (Sterile Processing Water quality)
  - CDC Water management toolkit
  - ICAP, NICN

2

Building components

- Modern Buildings are complex structures made up of multiple systems
  - Electrical
  - Tube stations
  - Medical gas
  - Data and cabling systems
  - The list goes on…

3

What building components involve water?

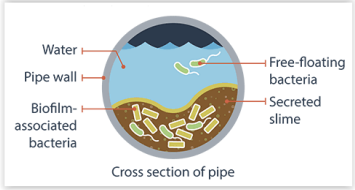
- Heating and cooling (HVAC)
- Steam generation
- Fire Suppression
- Cooling towers
- Decorative fountains
- Plumbing systems
  - Potable water
    - Hot/cold faucets
    - Ice machines
    - Eyewash stations
  - Waste water
  - Rain water drainage
- Sterile processing Departments

Hospitals are full of water!!!

4

Biofilm

- Communities of microorganisms attached to a surface
  - Produce a matrix of extracellular polymeric substances
  - Cooperate with other organisms within the biofilm
    - Passive resistance to treatment modalities
    - Metabolic cooperation
    - Enlarged gene pool, sharing of beneficial characteristics



5

Where else can water be found?

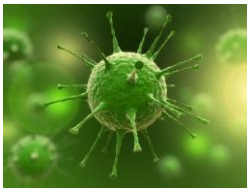
- Medical Equipment
  - Cardiopulmonary heater/coolers
  - Heating pads
  - Cooling blankets
  - CPAP
  - Hydrocollator

What examples can you think of?

6

Waterborne Pathogens

- Many pathogens of concern:
  - Bacteria
  - Protozoa
  - Viruses
  - Parasitic worms
  - Non-TB mycobacterium



7

Belleview Stratford Hotel

- American Legion Convention in Philadelphia, PA on July 21-24, 1976
  - More than 2,000 people in attendance
  - In the weeks following an estimated 180 cases of pneumonia were reported in the participants in the convention
  - 29 Deaths were attributed to this mysterious outbreak of pneumonia

8

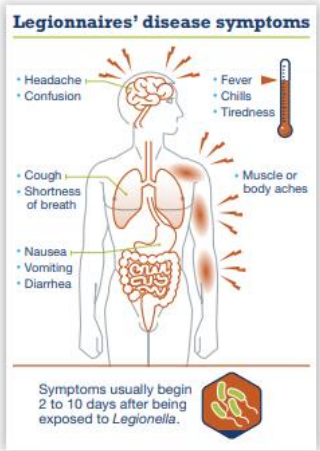
Identification of the causative agent

- The CDC was finally able to isolate the bacteria that caused the outbreak at the American Legion Convention in January of 1977
- It was named *Legionella* after the members of Legion that were part of the outbreak
- Found in the cooling tower connected to the air conditioner that served the hotel

9

Types of infections caused by *Legionella*

- Legionnaires' Disease
  - Very serious pneumonia
  - Cough, shortness of breath, fever, muscle aches, headaches
  - Caused by breathing in small droplets of water that contain *Legionella*
- Pontiac Fever
  - Milder infection that could be an inflammatory response
  - Symptoms – fever, muscle aches
  - Does not cause pneumonia



10

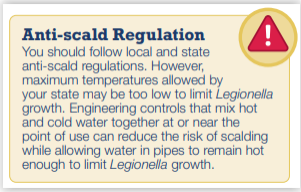
How *Legionella* enters water systems

- Level/Species Development of *Legionella*
  - Incoming potable water (undetectable or very low concentrations)
  - Systems with warm water, such as water distributions systems and air cooling systems
  - Biofilms within these systems

11

Legionella species

- Legionella – the leading cause waterborne disease outbreaks in the U.S.
  - Gram-negative rod
  - 50+ species, 19+ pathogenic
  - Grows well in water (surface & ground) and soil
  - Commonly found in low pressure water systems
  - Temperature 80-120°F (26-49°C)
  - Ideal growth range 96-115°F (35-46°C)
  - Commensal organism (amoebae)
  - Biofilms, sediment, scale, algae



12

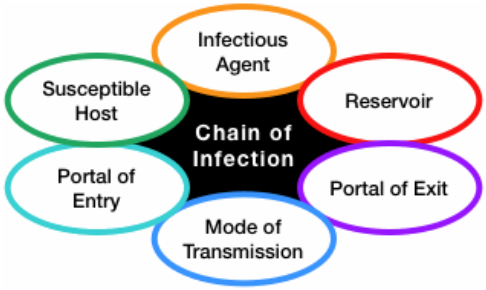
Legionella species – Water

- QUALITY
  - Sediment/scale
  - Biofilm
  - Sludge
  - Rust
  - Algae
  - Natural rubbers
  - Wood
  - Plastic
- STAGNATION
  - Complex piping
  - Dead legs
  - Long runs
  - Oversized pipes

13

Risk of Acquiring Disease

- Exposure alone does not lead to disease acquisition



14

Background risk factors

- Age ≥50 years
- Smoking – current or historical
- Chronic lung disease
  - Emphysema
  - COPD
- Compromised immune systems
- Underlying chronic conditions
  - Diabetes
  - Kidney failure
  - Liver failure

15

Let's Review

- *Legionella* is the causative agent for Legionnaires' disease
- It thrives in water from 96–115°F (35–46°C)
- Is found in biofilms inside building water systems
- Needs to be being carried on aerosolized water droplets and inhaled by a susceptible host

- What could be some specific things you could look for as possible sources of Legionella in healthcare settings?

16

Sources of *Legionella*

- Showerheads and sink faucets (aerators)
- Cooling towers
- Hot tubs
- Decorative fountains and water features
- Hot water tanks and heaters
- Large, complex plumbing systems



17

Legionnaires' Disease

How are we doing?

18

Not Great…

- Since 1976 there have been multiple outbreaks identified in public settings
  - Aria Hotel in Las Vegas – 18,000 notifications sent out
  - Mercy Hospital in Spain
  - A flower show in the Netherlands
  - Marriott Hotel in Chicago

19

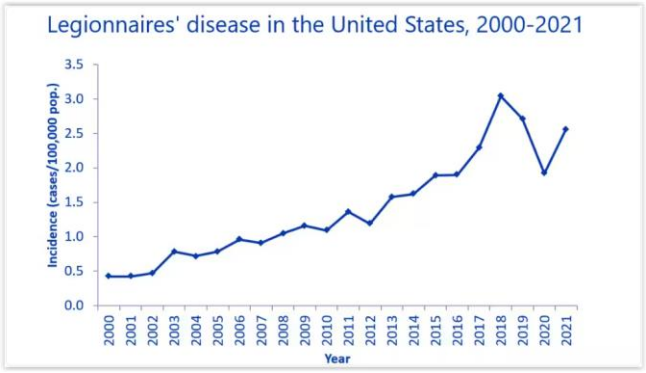
The list continues

- Outbreaks in Hospitals
  - Grady Memorial – Atlanta 2009, 80 beds were shut down for testing
  - VA Hospitals
    - Pennsylvania 2013
    - California 2017
    - Washington D.C. 2020
  - Miami Valley – Ohio 2008-2011
  - The news reports go on and on and on…….

20

Cases are on the rise

In general, reported cases of Legionnaires' disease have been increasing since the early 2000s, with a peak in 2018. While reported cases dropped during the first year of the COVID-19 pandemic, they rebounded starting in 2021



https://www.cdc.gov/legionella/php/surveillance/index.html

21

2024 and beyond…

- Experts predict Legionellosis cases will continue to increase across the globe
  - Climate change – increase in severe weather and flooding events
  - Deterioration of building infrastructures
  - Green technology encourages lower temperatures conducive to *Legionella* growth
  - Hands free devices in healthcare encourage proliferation of stagnant water
  - Increased surveillance/awareness on diagnosis
  - Improved laboratory processes for identification
  - Increased public awareness/reporting
  - Increasing population

22

Preventing Legionnaires' Disease

What can be done?

23

Proactive vs. Reactive

In the recent past most facilities waited to address the problem until **After** a case of Legionnaire's Disease was diagnosed

24

The government is after *Legionella*

- **ASHRAE** – American Society of Heating, Refrigerating and Air Conditioning Engineers
- **CDC** – Centers for Disease Control and Prevention
- **CMS** – Centers for Medicare and Medicaid Services
- **EPA** – Environmental Protection Agency
- **NSF** – National Sanitation Foundation
- **WRF** – Water Research Foundation

25

CMS Weighs in

DEPARTMENT OF HEALTH & HUMAN SERVICES
Centers for Medicare & Medicaid Services
7500 Security Boulevard, Mail Stop C2-21-16
Baltimore, Maryland 21244-1850

CMS CENTERS FOR MEDICARE & MEDICAID SERVICES

Center for Clinical Standards and Quality/Quality, Safety and Oversight Group

Ref: *QSO*-17-30- Hospitals/CAHs/NHs
REVISED 07.06.2018

DATE: **June 02, 2017**

TO: State Survey Agency Directors

FROM: Director
Quality, Safety and Oversight Group (*formerly Survey & Certification Group*)

SUBJECT: Requirement to Reduce *Legionella* Risk in Healthcare Facility Water Systems to Prevent Cases and Outbreaks of Legionnaires' Disease (LD)

****Revised to Clarify Expectations for Providers, Accrediting Organizations, and Surveyors****

26

Requirements For Surveyors and Healthcare Facilities

- This policy memorandum applies to:
  - Acute Care Hospitals (ACH)
  - Critical Access Hospitals (CAH)
  - Long-term Care (LTC)
- This policy memorandum is also intended to provide general awareness for all healthcare organizations

27

CMS – Expectations

- CMS expects to have water management policies in place to reduce the risk of growth and spread of *Legionella* and other opportunistic pathogens in building water systems
- Surveyors will review policies, procedures and reports documenting water management implementation

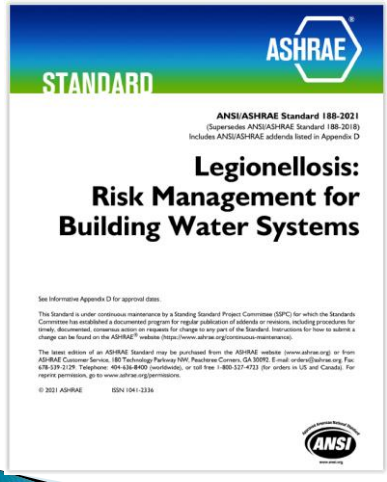
28

CMS – Expectations

- Conduct a risk assessment to identify where *legionella* and other opportunistic waterborne pathogens could grow and spread in the water system
- Implement a water management program
- Document the results of testing and corrective actions

29

ASHRAE 188 – 2021



- Facility or Building Managers should have a copy
- Available for purchase directly from ASHRAE:
  - https://www.ashrae.org/technical-resources/bookstore/ansi-ashrae-standard-188-2021-legionellosis-risk-management-for-building-water-systems

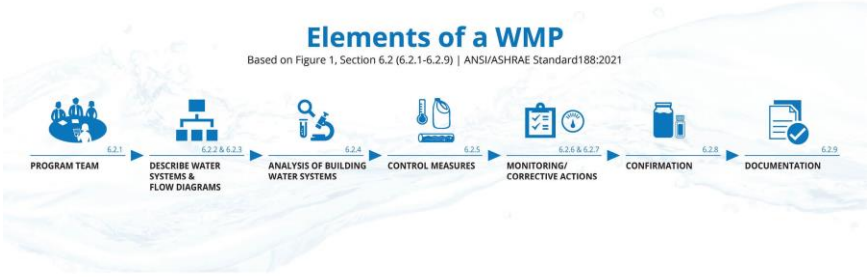
30

ASHRAE 188 – 2021

- ASHRAE 188 – Standard
  - Written in code ready language
  - Standardizes risk assessment, prevention and management
  - Compliance may be best defense to allegations of malpractice/*legionella* claims
  - **REQUIRES A WATER MANAGEMENT PROGRAM TO CONTROL *LEGIONELLA***

31

Elements of Water Management Program



32

Elements of Water Management Program

- Program Team – Persons responsible for Program development and implementation
- Water Systems/Flow Diagrams – Describe potable and non-potable water systems and develop water systems-schematics
- Water Systems Analysis – Evaluate where hazardous conditions may occur and decide where control measures should be applied
- Control Measures – Determine locations where control measures shall be applied and maintained in order to stay within established control limits

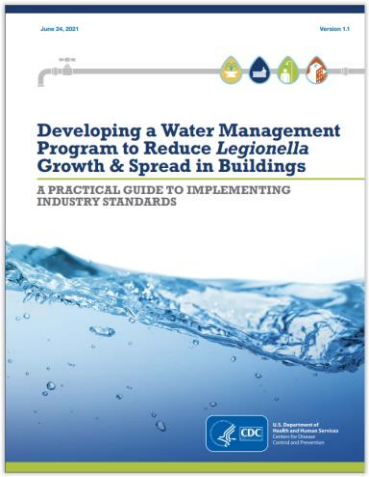
33

Elements of Water Management Program

- Monitoring/Corrective Actions – Establish procedure for monitoring whether control measures are within operating limits and, if not, take corrective actions.
- Confirmation – Establish procedure to confirm:
  - Program is being implemented as designed (verification)
  - Program effectively controls the hazardous conditions (validation)
- Documentation – Establish documentation and communication procedures for all activities of the Program

34

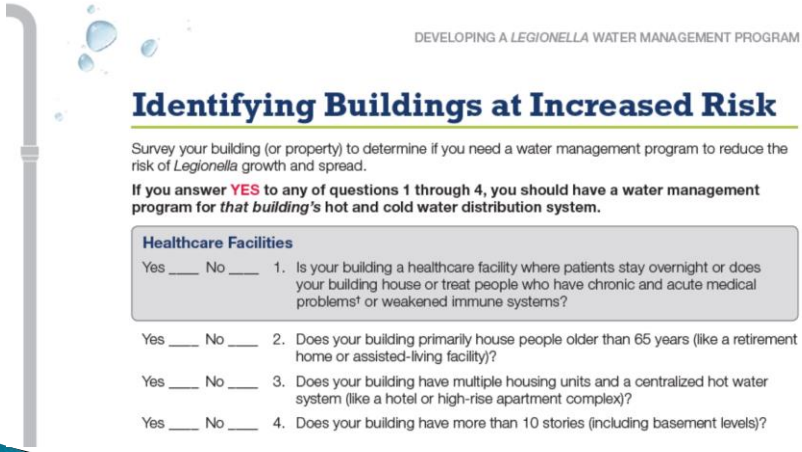
CDC Emphasizes Water Management



- Infection Prevention Departments should have a copy
- Toolkit available for free directly from CDC:
- https://www.cdc.gov/legionella/downloads/toolkit.pdf

35

Risk Assessment



DEVELOPING A *LEGIONELLA* WATER MANAGEMENT PROGRAM

Identifying Buildings at Increased Risk

Survey your building (or property) to determine if you need a water management program to reduce the risk of *Legionella* growth and spread.

If you answer YES to any of questions 1 through 4, you should have a water management program for *that building's* hot and cold water distribution system.

Healthcare Facilities

Yes ___ No ___ 1. Is your building a healthcare facility where patients stay overnight or does your building house or treat people who have chronic and acute medical problems† or weakened immune systems?

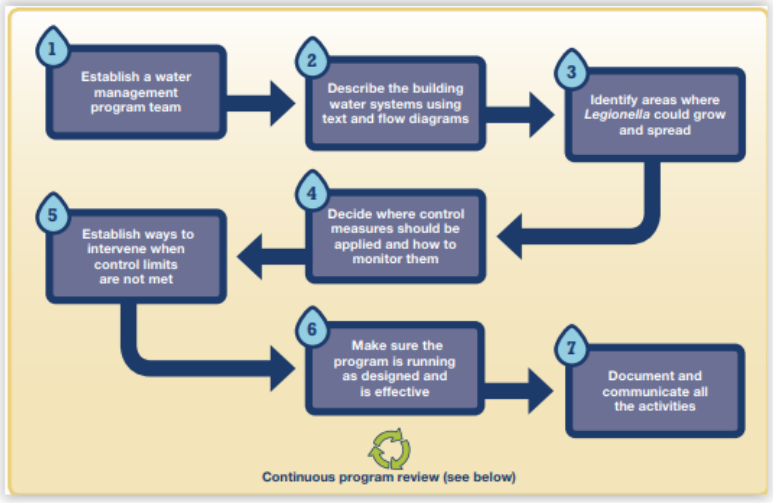
Yes ___ No ___ 2. Does your building primarily house people older than 65 years (like a retirement home or assisted-living facility)?

Yes ___ No ___ 3. Does your building have multiple housing units and a centralized hot water system (like a hotel or high-rise apartment complex)?

Yes ___ No ___ 4. Does your building have more than 10 stories (including basement levels)?

36

Water Management Program



37

Who participates on the Program Team

- Designate a Multi-Disciplinary team
  - Someone who understands accreditation standards and licensing requirements
  - Someone with expertise in infection prevention
  - A clinician with expertise in infectious diseases
  - Risk and quality management staff
  - Building owner
  - Building manager/administrator
  - Maintenance or engineering employees
  - Safety officers
  - Equipment or chemical suppliers

38

Roles of the Program Team

39

Describe your water system

- Provide a simple description of the building water system
  - Where the building connects to the municipal water supply
  - Distribution of cold water
  - Heating of cold water
  - Hot water distribution
  - Where waste water is discarded
  - Location of significant sources of water (ice machines, pools, hot tubs, decorative water features, etc.)

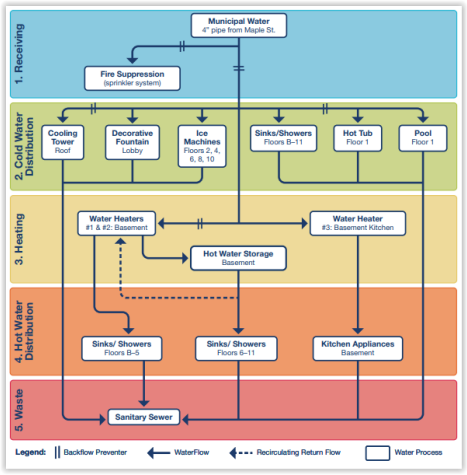
40

Develop a Water Flow Diagram

- Review as-built drawings for potable/non-potable water systems;
- Compare drawings with current conditions;
- Amend/change as necessary ensuring drawings reflect current conditions; and,
- Develop accurate facility specific water flow diagrams

41

Process flow diagram



- Diagram does not need to be as detailed as the building's plans
- Should be easy to understand by all members of the team

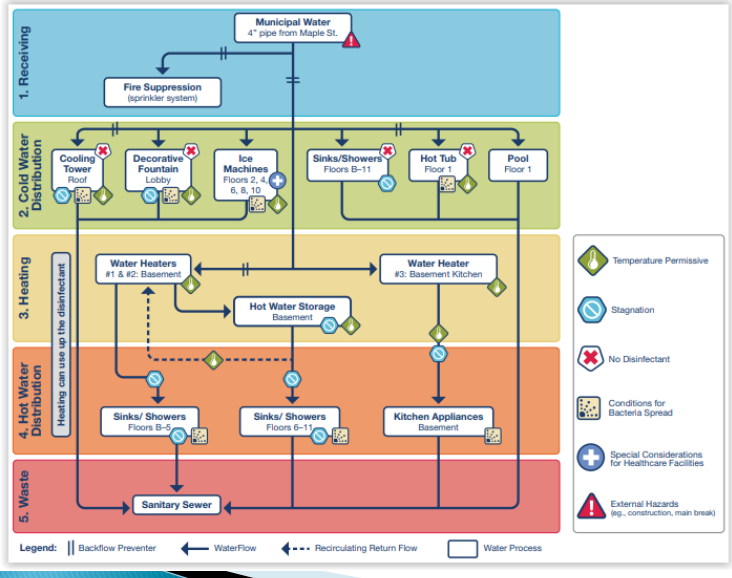
42

Risk Management Process

- Risk Exposure Points
  - Higher probability of infection based upon:
    - Intended use of water-based processes
    - Vulnerability of patients
    - Estimated likelihood of disease
    - Potential for the development of aerosols
- Areas with greatest risk should get increased scrutiny
  - All clinical support areas
  - All patient care areas
  - All water used end points

43

Flow Diagram – Identify Hazardous Conditions



44

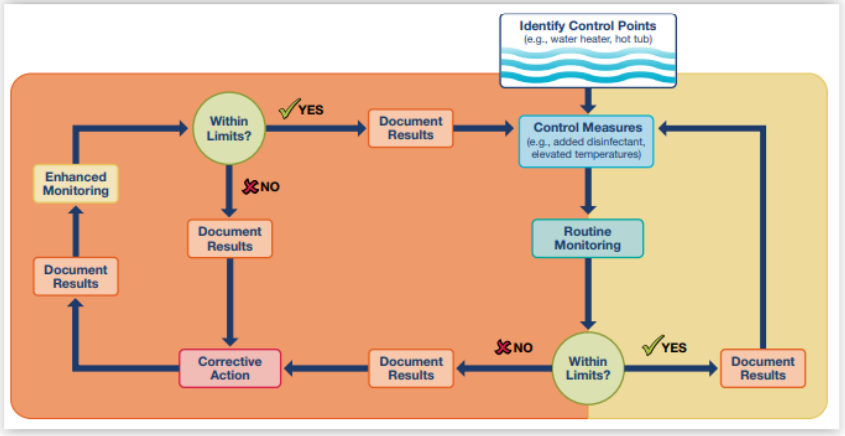
Control Measures, Monitoring & Corrective Actions

- Establish control measures (chemical/physical)
- Identify locations where water quality can be measured
  - Chlorine levels
  - Temperature
- Monitor for deviations from established control limits
- Determine corrective actions to be taken should control limits not be achieved

45

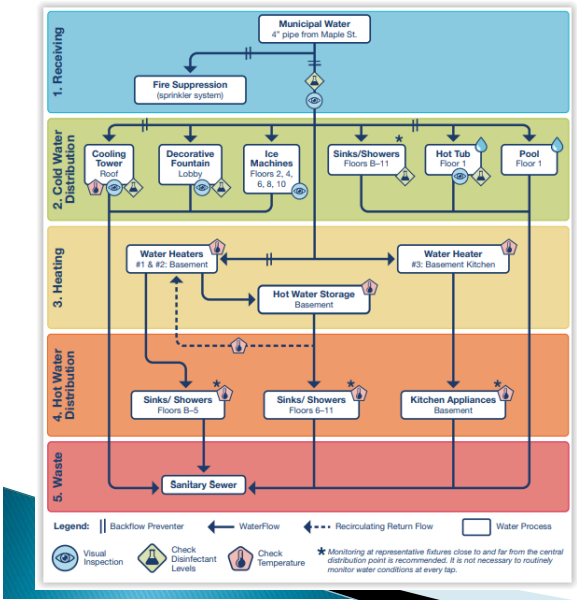
Control Measures, Monitoring & Corrective Actions

Example diagram from CDC Toolkit



46

Monitoring of Control Measures



- Connects monitoring to the risks identified on the flow diagram

47

Confirmation

- Establish procedures for the following:
  - Verification
    - Confirm the program is being implemented as designed
    - Those assigned the task should not verify their own work, it should be checked by someone else
  - Validation
    - Establish ways to confirm that the water management program is effective
      - Environmental Testing for *Legionella* – should be determined by the program team
      - Routine surveillance activities for healthcare-associated Legionnaires' disease

48

Environmental Testing

- *Legionella* Testing – that is the question
  - Water testing is not specifically required under ASHRAE 188-2021 in the absence of disease although verification/validation might actually infer a testing requirement for compliance
- Testing in the Presence of Disease
  - Select testing locations based upon disease history at the facility
  - Physical plant structure
  - Possible environmental sources
  - Enact emergency response/remediation protocol
  - Follow most recent CDC or other national guidelines and established IC processes

49

Environmental Testing

- Testing Without Disease
  - **CAUTION: Do NOT perform environmental testing for *Legionella* unless you have a program in place establishing *Legionella* testing criteria and response protocol (if *Legionella* is found) and have the resources available to fully comply with your facility plan**
- 2021 CDC Toolkit – Environmental testing for Legionella is useful to validate the effectiveness of control measures. The program team should determine if environmental testing for Legionella should be performed and, if so, how test results will be used to validate the program.

50

Environmental Testing

- Goal – to not have Legionella detected
  - This may not be possible due to source water content
- Don't chase zero
  - Zero Legionella is virtually impossible to achieve in complex water systems

51

Documentation

- Written program should include at least the following:
  - **Program team:** including names, titles, contact information, and roles on the team
  - **Building description:** including location, age, uses, and occupants and visitors
  - **Description of the water system:** including general summary, uses of water, aerosol-generating devices (e.g., hot tubs, decorative fountains, cooling towers), and process flow diagrams
  - **Control measures:** including points in the system where critical limits can be monitored and where control can be applied
  - **Confirmatory procedures:** including verification steps to show that the program is being followed as written and validation to show that the program is effective
  - **Document** collection and transport methods and which lab will perform the testing if environmental testing is conducted

52

Example of Documentation

Table 1 Hazard identification and risk assessment table, including and add rows as required)

System component	Hazard and hazardous event	Risk score	Possible control measures
Incoming water	Incoming water contamination	High	Isolate incoming water - see what the contaminate is and how to treat it, then sanitize whole system with approptiate method
	Loss of supply	High	Pull up MOUs with other facilities to get water supplies here if an extended outage is anticipated
	Failure of backflow prevention device	Moderate	Repair/replace back flow preventer - if believe contamination occurred to the water system - would sanitize water system
Hot water system	Water stored below 140 debrees	Moderate	open
	Heater failure or under capicity	Low	The hot water heating systems has a redundency built into the system. If one water heater was not functioning then would bring another hot water heater on line.
	Build up of sludge in tank - Physical Therapy	Low	Annual PMs completed - if sludge noted the sludge would be cleaned out
	Thermal stratification	Low	Thermal stratification can only occur in PT - PT department would know if they did not have hot enough water. Maintanence would immeiately check out the water heater.
	Low flow in recirculationg loops	Moderate	this would not be an issue each - this is checked daily - each loop has its own booster
Cold Water system	Water stagnation	Low	Waste water Wednesdays on the Patient Wing
	Water temp >68 degrees	Low	open
	Dead legs and capped pipes	Moderate	Open
	Cross connections between potable and non-potable lines	Moderate	Back flow preventors and check valves help prevent this. Would know this because of the flow of water. Backflow preventer or check valve is to be repaired or replaced

53

Additional Considerations

- Specifications for system start up/shut down
- System maintenance
- Water treatment
- Emergency response

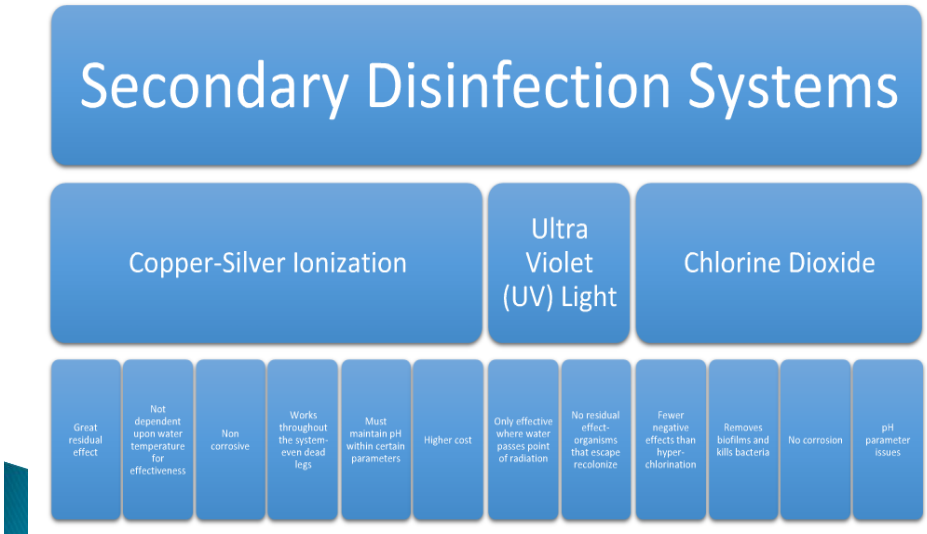
54

Additional Considerations

- Ex: Ice Machines – CDC– Major control point
  - Source of several high profile outbreaks even though cold water is usually not a good source for *Legionella* growth
  - Up to 20% of ice machines may harbor *Legionella*
    - *Consider/compressor inside machine can warm cold water reservoir to temperatures conducive to growth*
  - Process
    - Distinguish between ice storage and ice making recommendations
    - Identify responsible parties
    - Identify use requirements
    - Identify periodic (quarterly, daily cleaning requirements
    - Special considerations (start up, water boil advisory etc.)

55

Risk Mitigation



56

Surveyor – RED FLAGS

- Lack of responsible, knowledgeable water risk management team
- Failure to maintain any secondary disinfection system
- Prior inability to control water temperature fluctuation/stagnation issues/biofilm/sediment
- Untreated cooling towers or lack of drift eliminators
- Lack of documentation–maintenance logs, remediation, response actions, results
- Failure to comply with any state, local regulations

57

Legionnaires' Disease

You found a case,
what happens next?

58

Any time there is a suspected case of Legionnaires' disease associated with your facility you should:

- Contact your local and/or state health department or work with them if they contact you
- At the direction of your local health department – Notify anyone who could be affected by the growth and spread of *Legionella* in your building
- Important: Tell clinicians so they can test patients with healthcare-associated pneumonia for Legionnaires' disease with both culture of lower respiratory secretions and the *Legionella* urinary antigen test
- Decontaminate the building water systems if necessary (you may need to get additional help from outside experts)
- Review the water management program and revise it, if necessary, including the Water Management Team and Facility Leadership

59

Risk Mitigation

- Activate emergency disinfection response program/plan and ensure safety of occupants
- Assemble team of experts
- Assess exposure points (cooling towers, fountains, whirlpools. Etc.) and potential causes (temperature, stagnation, sediment, etc.) and obtain baseline serology (MUST TEST FOR *Legionella* presence)
- Initiate emergency response procedures to control and prevent additional exposures – bottled water, point of use (POU) filtration, turn off source of problem if possible
- Report case to local health department – cannot stress this enough
- Determine if full investigation is needed – CDC

60

Risk Mitigation

- Thermal Shock – Maintain water temperature at 160-170F through each outlet for 30 minutes/REGROWTH – major issue unless combined with secondary disinfection. Water temperatures > 140 inhibit (but won't prevent) growth.
- Chemical Treatment – Shock halogenation (20-50 ppm) for a minimum of 2 hours. Confirm levels are within EPA limits prior to restarting water systems/mixed success rate
- Monitor, Monitor, Monitor
- Documentation and **Continuous** Verification **INTERIM MEASURE ONLY!!!!**

61

Summary

- Legionnaires' disease is increasing
- Potable Water systems, especially in healthcare facilities with complex hot water systems, are the most important source of *Legionella* transmission
- Proactive prevention: ASHRAE 188-2021 Water Management Programs and Risk Assessments
- Environmental testing for *Legionella* may be a key indicator for ongoing disease risk

62

Local resources

- NICN – http://www.nicn.org/
- ICAP – https://icap.nebraskamed.com/
- APIC (Membership fees apply)
  - National – https://apic.org/
  - Nebraska – http://www.goapic.org/
  - Central Iowa – https://community.apic.org/centraliowa/home

63

Resources

ANSI ASHRAE Standard 188-2021; Legionellosis: Risk Management for Building Water Systems

Recognition, Evaluation and Control of Legionella in Building Water Systems 2nd Edition; AIHA 2021

CDC Guidelines for Environmental Infection Control in Healthcare Facilities; CDC/HICPAC 2003 (updated July 2019)

The guidelines for Design and Construction of Hospital Facilities; FGI 2022

CDC MMWR From the January 18, 1977, special issue of {MMWR} Epidemiologic Notes and Reports Follow-up on Respiratory Illness – Philadelphia; January 24, 1997

CDC Legionella website; https://www.cdc.gov/legionella/index.html

64

Questions

65