WATER MANAGEMENT PROGRAM

Julie B. Trivedi, MD

Assistant Professor of Medicine

Medical Director of Infection Prevention, University hospitals

UT Southwestern Medical Center, Dallas TX

Objectives

- Describe key elements & principles of a water management program (WMP)
- Define terms used frequently in WMP
- Implement the steps of developing a WMP

Outline

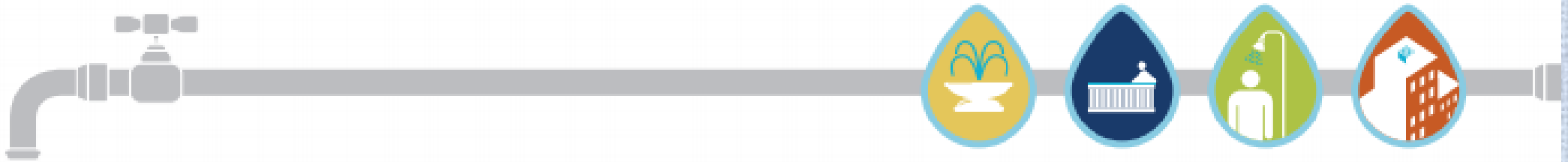
- CMS mandate
- 7 Key elements of a WMP: step by step discussion
- Case scenario
- 4 Key Principles regarding temperature, stagnation, disinfection & plumbing

Scenario 2..continued

- **Legionella** has not been identified anywhere but ongoing routine surveillance is performed.
- There are multiple suspected sources of the **NTMs** and you all agree that a formal water management team & program is needed.
- Infection prevention has made some recommendations about mitigation strategies but given the complexity of the facility, hospital administration would like to hire an outside consultant to provide guidance.

CMS requirements: June 2017

- Hospitals:
  - "..sanitary environment to avoid sources and transmission of infections and communicable diseases. There must be an active program for the prevention, control and investigation of infections and communicable diseases."
- (Skilled) Nursing facilities:
  - "..establish and maintain an infection prevention & control program designed..safe, sanitary and comfortable environment and to help prevent the development and transmission of communicable diseases & infections."
- Critical Access Hospitals:
  - System in place to identify, report, investigate and control infections & communicable diseases of patients and personnel



Developing a Water Management Program to Reduce *Legionella* Growth & Spread in Buildings

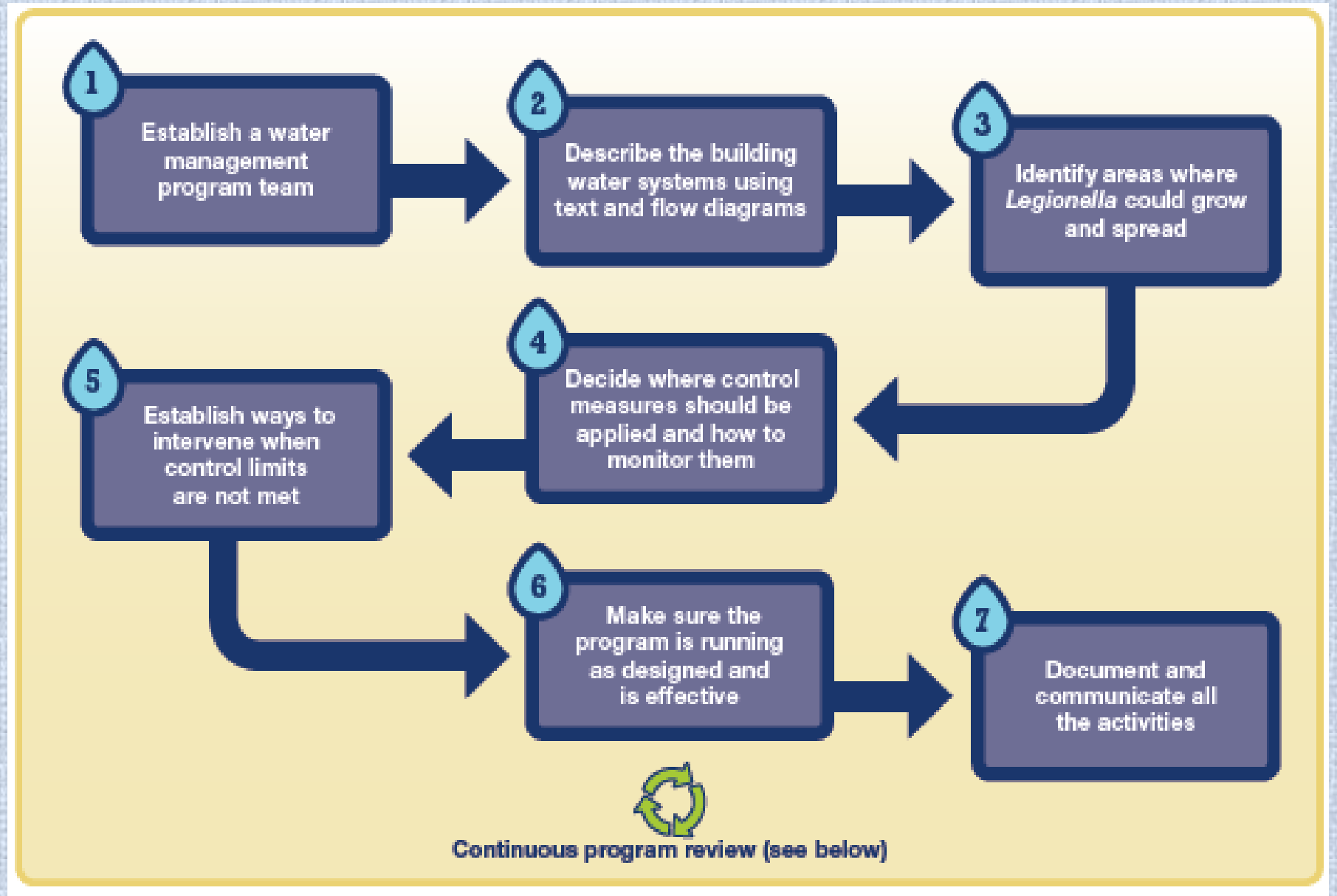
A PRACTICAL GUIDE TO IMPLEMENTING INDUSTRY STANDARDS

www.cdc.gov

- https://www.train.org/main/course/1081923/
- Hands on implementation of toolkit recommendations
- Incorporates ASHRAE* standards (188 and 12-2000)

*American society of heating, refrigerating, and air-conditioning engineers (ASHRAE)

7 Key Elements



4 Key Principles

1. Maintaining water temperatures outside the ideal range for *Legionella** growth
2. Preventing water stagnation
3. Ensuring adequate disinfection
4. Maintaining devices to prevent scale, corrosion, and biofilm growth, all of which provide a habitat and nutrients for *Legionella**

*and other pathogens such as non-tuberculous mycobacteria and gram-negative organisms

Terms to learn

- Biofilm: layer of slime with organic, inorganic material allowing organisms to lay dormant
- Building water systems: hot & cold water distribution, other water-associated devices (hot tubs, cooling towers, fountains)
- Controls & control measures: conditions within building, protocols to limit growth of organisms
- Dead legs: sections of piping with low or no flow (i.e unused faucets)
- Disinfectant: treatment applied to water to kill germs (chlorine, monochloramine, copper-silver ionization, UV light
- Heterotrophic counts: quantity/type of bacteria found in water, does not replace legionella testing
- Residual: amount of disinfectant available to kill germs

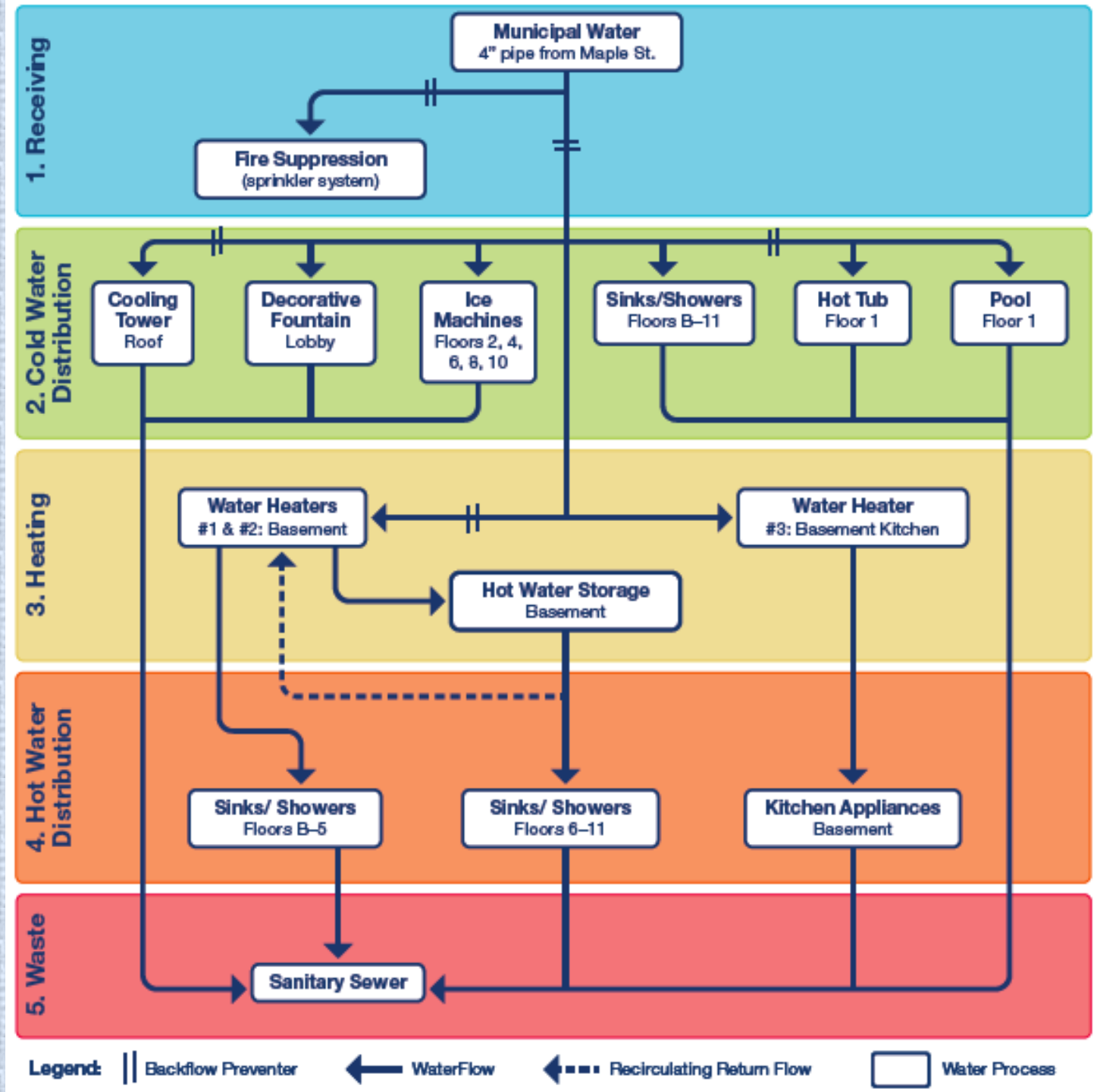
1. Water management Team

- Physician
- Infection prevention/Control
- Industrial hygienist
- Facilities
- Executive—hospital, nursing
- Environmental services
- Patient safety
- consultant

- Oversee the program
- Knowledge of water systems
- Identify control locations & limits
- Identify & take corrective actions
- Confirm, monitor & document performance
- Communicate regularly

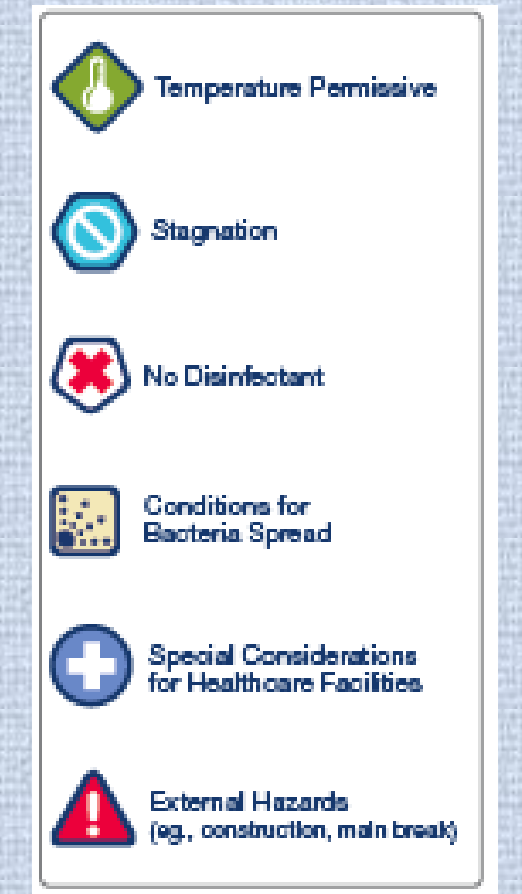
2. Describe Water system structure

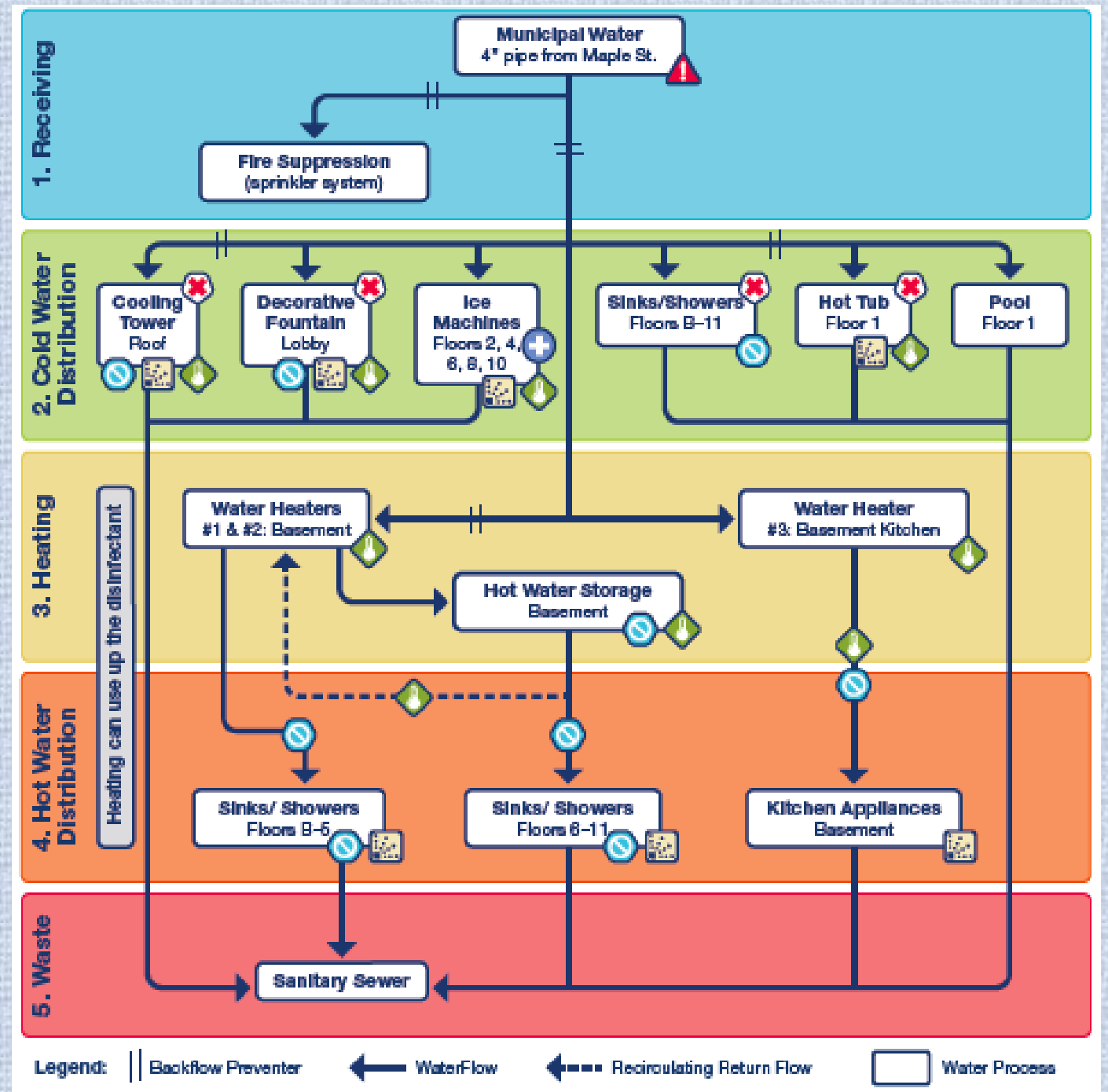
- Connection to municipal water supply
- Distribution of hot & cold water
- Location of cooling towers, boilers, hot tubs, decorative fountains etc
- patient care & clinical support areas
- Devices and equipment at risk of exposing patients to contaminated water
  - Ice machines
  - medivators


1. Receiving
Municipal Water
4" pipe from Maple St.
Fire Suppression
(sprinkler system)
2. Cold Water Distribution
Cooling Tower
Roof
Decorative Fountain
Lobby
Ice Machines
Floors 2, 4, 6, 8, 10
Sinks/Showers
Floors B–11
Hot Tub
Floor 1
Pool
Floor 1
3. Heating
Water Heaters
#1 & #2: Basement
Water Heater
#3: Basement Kitchen
Hot Water Storage
Basement
4. Hot Water Distribution
Sinks/ Showers
Floors B–5
Sinks/ Showers
Floors 6–11
Kitchen Appliances
Basement
5. Waste
Sanitary Sewer
Legend:
Backflow Preventer
WaterFlow
Recirculating Return Flow
Water Process

3. Areas at risk

- water temperature
- low water flow
- Stagnation
- deadlegs





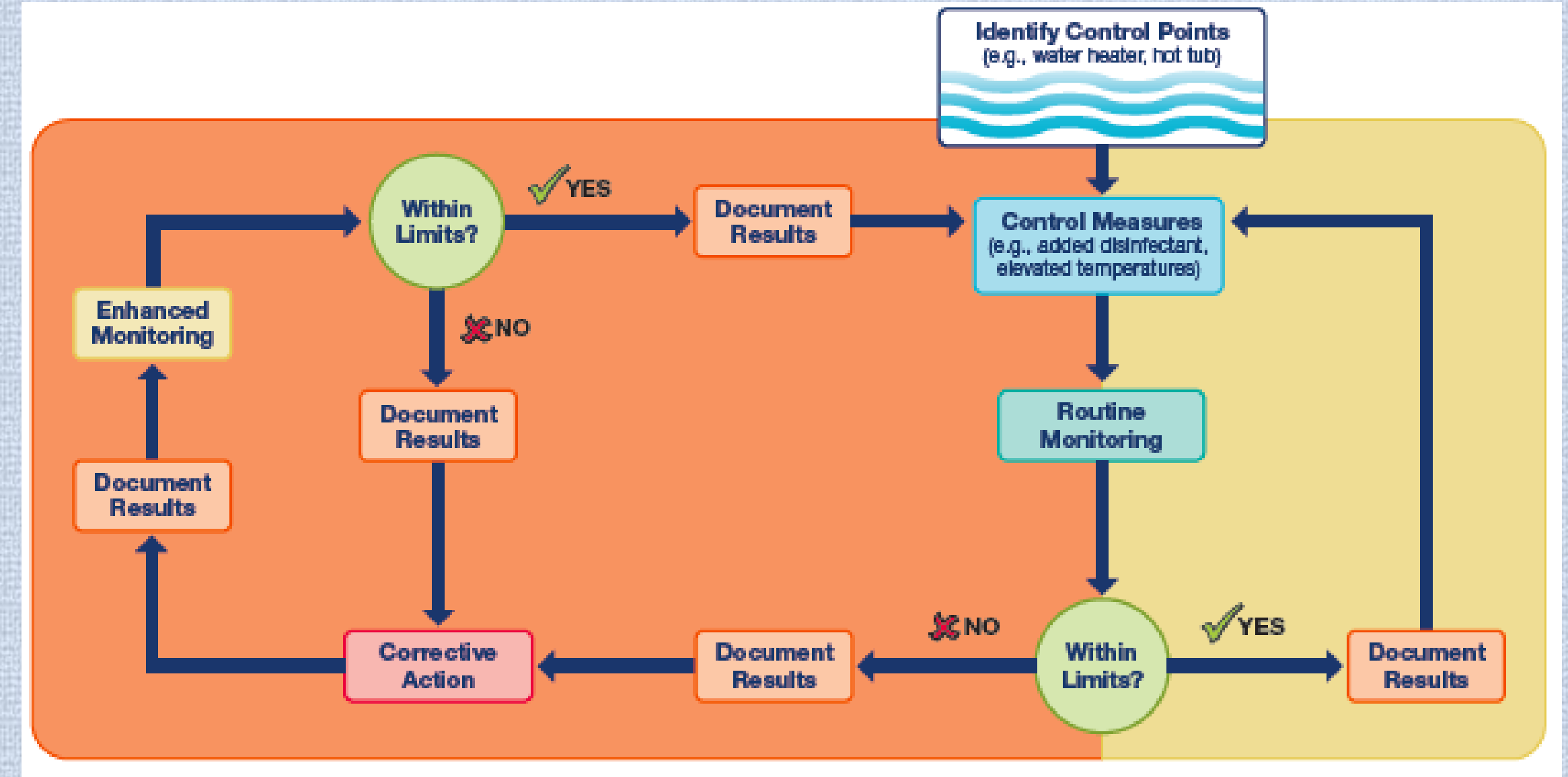
www.cdc.gov

Considerations for Healthcare facilities

- Medical procedures → exposure to water droplets
  - Pulse lavage
  - Hydrotherapy

- Vulnerable patients:
  - Oncology
  - Transplant (bone marrow or solid organ)
  - Intensive care units (adult and pediatric)

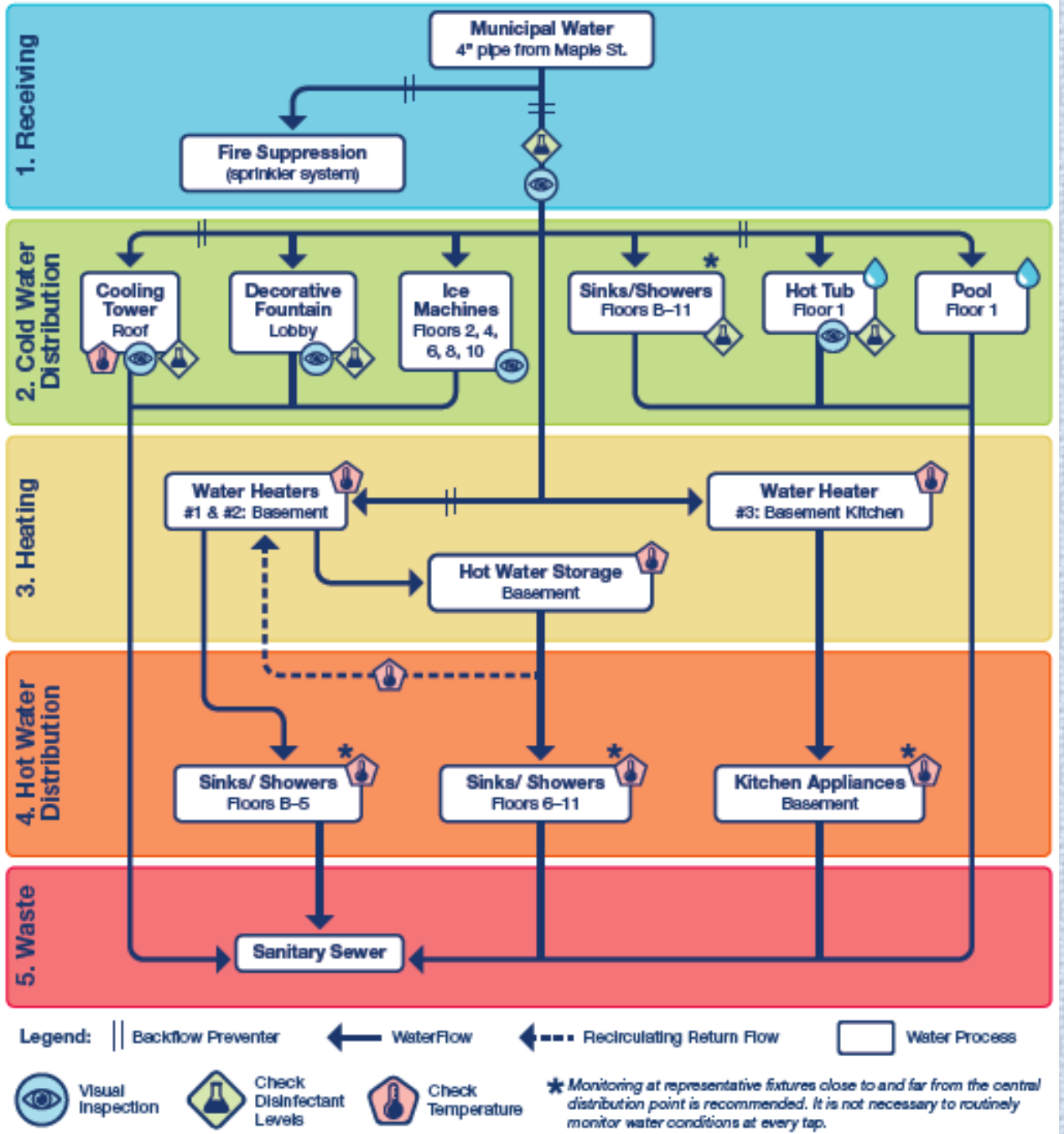
Implement & Monitor Control Measures



4. Control measures & control limits

- Control points are locations in the water system where you can apply the measures.
- Measures are chemical and physical.
- Establish control limits:
  - Max and/or minimum value or range of values that are acceptable for the control measures
- Examples:
  - Water heaters kept at appropriate temperature (determine range)*
  - Levels of disinfectant & other chemicals cooling towers, hot tubs
  - Cleaning: debris in fountains, biofilm on faucets/showers

*Anti-scald regulations may limit hot water temperatures; may need to use mixing valves to reduce temperature at distal points (for patients)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4" pipe from Maple St.
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5. Waste
Sanitary Sewer
Legend:
Backflow Preventer
WaterFlow
Recirculating Return Flow
Water Process
Visual Inspection
Check Disinfectant Levels
Check Temperature
* Monitoring at representative fixtures close to and far from the central distribution point is recommended. It is not necessary to routinely monitor water conditions at every tap.

Working Document
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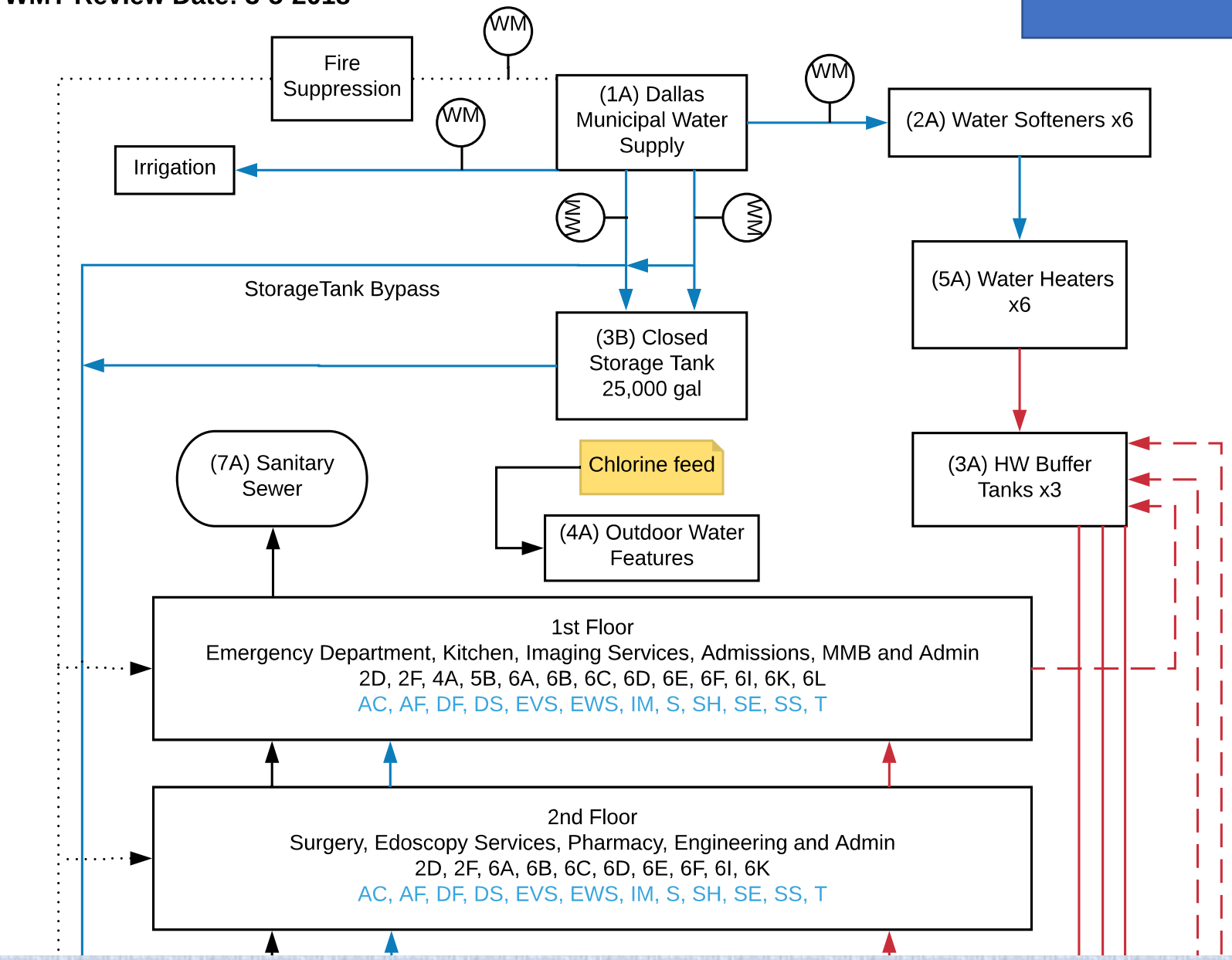
WMT Review Date: 3-5-2018



1. Receiving
A - Municipal Supply

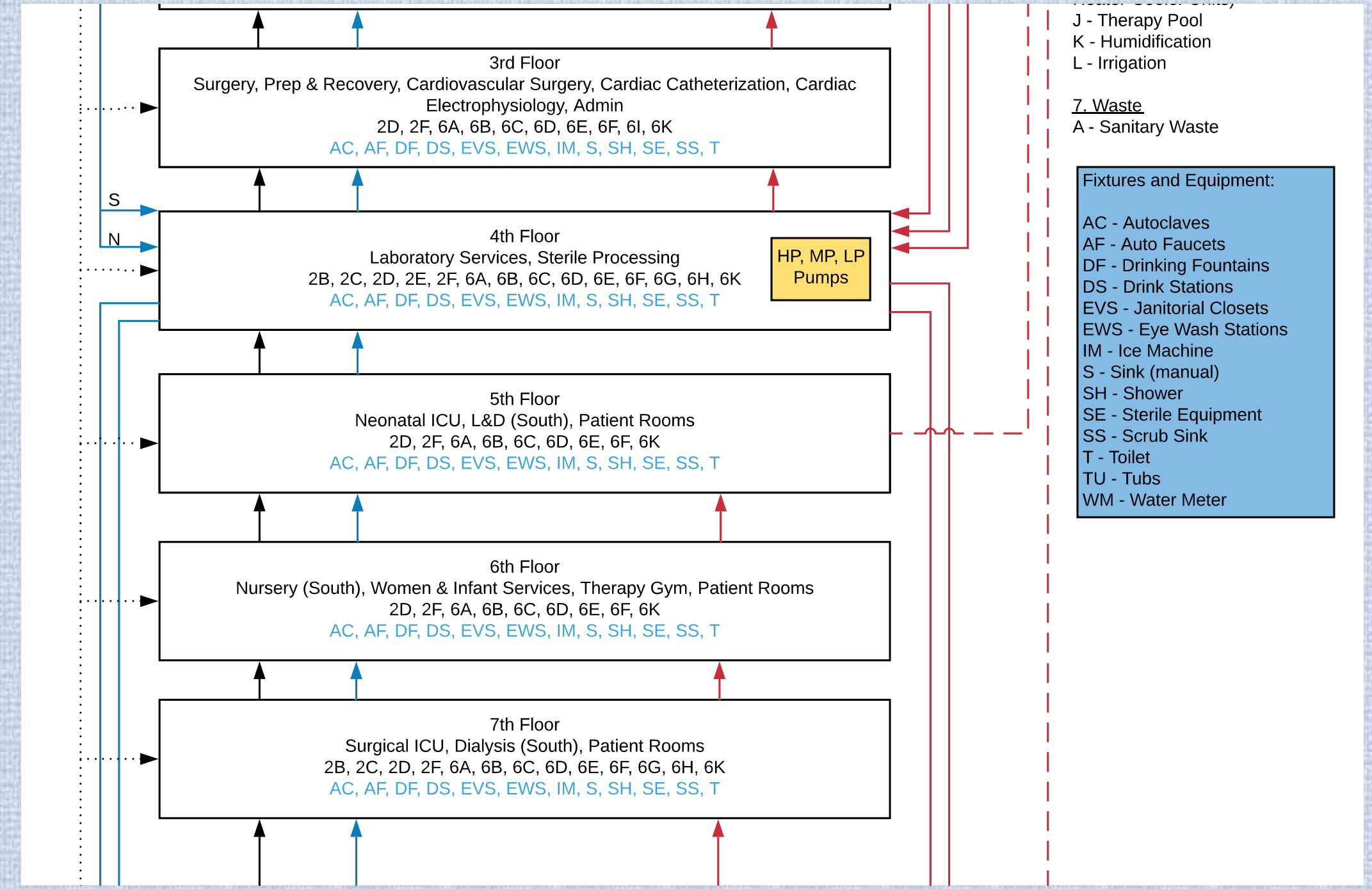
2. Conditioning
A - Softening
B - DI System
C - RO System
D - Filtration (Ice Machine)
E - Laboratory Equipment
F - Faucet Aerator

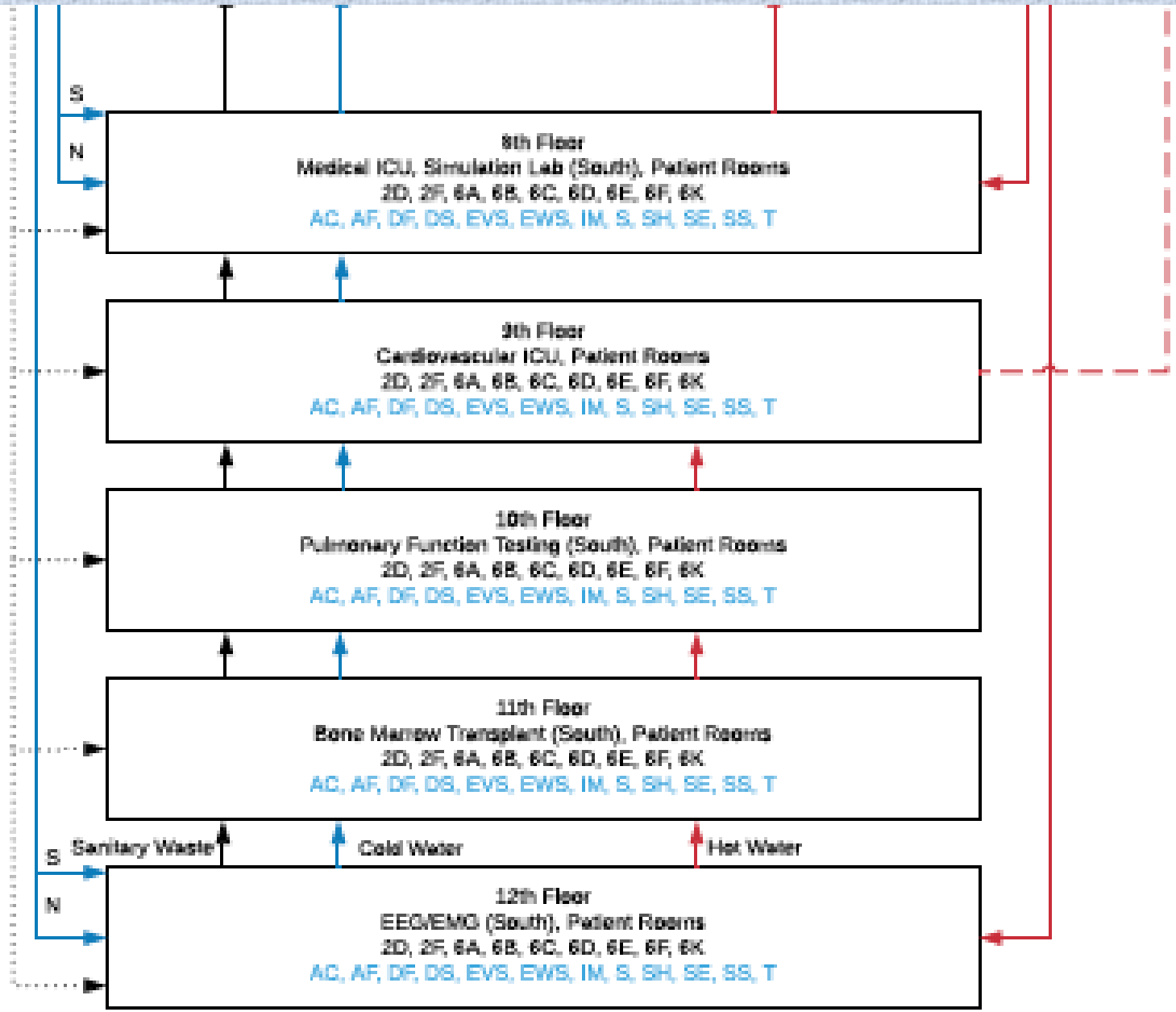
3. Storage
A - Hot Water Storage, 125 ºF
B - CW Storage

4. Outdoor Fountains
A - Secondary Disinfection

5. Heating
A - Instantaneous HW, 125 ºF
B - Kitchen HW, 140 ºF

6. Distribution
A - Cold Water
B - Ice Machines
C - Fire Suppression
D - Hot Water, 120 ºF
E - Hot Water, 140 ºF
F - Lab/Surgical Equipment
G - Reverse Osmosis
H - Distilled Water
I - Medical Devices (CPAP, Hydrotherapy, Bronchoscopes, Heater-Cooler Units)
J - Therapy Pool


3rd Floor
Surgery, Prep & Recovery, Cardiovascular Surgery, Cardiac Catheterization, Cardiac Electrophysiology, Admin
2D, 2F, 6A, 6B, 6C, 6D, 6E, 6F, 6I, 6K
AC, AF, DF, DS, EVS, EWS, IM, S, SH, SE, SS, T
S
N
4th Floor
Laboratory Services, Sterile Processing
2B, 2C, 2D, 2E, 2F, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6K
AC, AF, DF, DS, EVS, EWS, IM, S, SH, SE, SS, T
HP, MP, LP Pumps
5th Floor
Neonatal ICU, L&D (South), Patient Rooms
2D, 2F, 6A, 6B, 6C, 6D, 6E, 6F, 6K
AC, AF, DF, DS, EVS, EWS, IM, S, SH, SE, SS, T
6th Floor
Nursery (South), Women & Infant Services, Therapy Gym, Patient Rooms
2D, 2F, 6A, 6B, 6C, 6D, 6E, 6F, 6K
AC, AF, DF, DS, EVS, EWS, IM, S, SH, SE, SS, T
7th Floor
Surgical ICU, Dialysis (South), Patient Rooms
2B, 2C, 2D, 2F, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6K
AC, AF, DF, DS, EVS, EWS, IM, S, SH, SE, SS, T
J - Therapy Pool
K - Humidification
L - Irrigation
7. Waste
A - Sanitary Waste
Fixtures and Equipment:
AC - Autoclaves
AF - Auto Faucets
DF - Drinking Fountains
DS - Drink Stations
EVS - Janitorial Closets
EWS - Eye Wash Stations
IM - Ice Machine
S - Sink (manual)
SH - Shower
SE - Sterile Equipment
SS - Scrub Sink
T - Toilet
TU - Tubs
WM - Water Meter



Municipal Cold Water is supplied by the city of Dallas via two 8" lines that enter at Thermal Energy Plant. A storage tank in TEP has 25,000 gallons city water in circulation. Fire water is fed from separate city supply line.

A separate 8" line off the municiapl loop feeds the 2nd floor of MMB for hot water supply. This line supplies water to 6 resin-exchange softeners, 6 heat exchangers and 3 hot water buffer tanks.

The Cold Water and Hot Water supplies travel to the 4th floor of CUH where it is pumped through the facility to supply a high pressure zone (floors 9-12), medium pressure zone (floors 5-8) and low pressure zone (floors 1-4). CW also has separate lines for the North and South side of CUH. The hot water continuously recirculates on a loop, where the high pressure loop returns from the 9th floor, the medium pressure loop returns from the 5th floor and the low pressure loop returns from the 1st floor to the MMB heat exchangers.

5. Interventions: Control limits not met

- Corrective action: response to systems performing outside of control limits
  1. Biofilm noted in the decorative fountain→
  2. shut off fountain, drain it and scrub with recommended detergent→
  3. refill fountain per protocol and check residual disinfectant levels→
  4. document and report to supervisor.
- Contingency responses: “The Why?”
  - persistent issues despite corrective action OR emergent events
  - Biofilm example: why did the fountain have excessive biofilm growth?
    - Growth noted near fountain lighting causing water to be warm allowing for growth
    - Corrective action: replace incandescent bulb with LED and monitor fountain.

6. Ongoing maintenance of program

- Verification: Establish procedures to confirm that WMP is being implemented as designed.
  - review adherence to them
- Validation: Is our WMP effectively controlling the hazardous conditions in the water supply?
  - Environmental testing for Legionella
- Update program as needed

Program review: Annually and as needed

- Control measures outside of control limits
- Infections or cases thought to be associated with water supply
- Changes in regulations, standards or guidelines
- Major events or changes in water service:
  - Construction
  - Change in equipment
  - Change in treatment products
  - Change in water usage
  - Changes in municipal water supply
- Update diagrams, control measures routinely
- Train personnel as required

7. **Documentation** & Communication

- Program team: names, titles, roles on team, contact information
- Building description: location, age, occupants
- Water system description: general summary, uses of water, aerosol generating devices and process flow diagrams
- Identify Control measures, control points & control limits
- Confirmatory procedures: Verification & Validation
- Document collection & transport methods, lab performing environmental testing

7. Documentation & **Communication**

- “If it isn’t written down, then it didn’t happen”
- Communicate regularly with appropriate parties:
  - Hospital executives
  - Colleagues: physicians & nurses-–be vigilant for issues, suspected cases of Legionella
  - Patient safety

Scenario..continued

- A reputable company is hired
- A team is put together
- After assessing the facility, a flow diagram is put together (much more complex than the sample)
- Control points identified and measurements taken:
  - Temperature
  - Disinfectant levels (on entry, at distal points, problem areas)
  - Environmental cultures taken (on entry, distal points for each riser, ice machines, medivators, faucets in select patient rooms)

Case Scenario: Findings

- Temperature: hot water storage tanks were <140F (60C)
- Stagnation: Multiple rooms where showers not utilized (long hoses, inadequately draining water)
- Biofilm: noted extensively on faucet aerators
- Disinfectant: Monochloramine system, adequate on entry to facility, however inadequate residual in hot water loops, certain patient rooms, water from ice machines; increased NH3 levels
- Cultures:
  - multiple non-tuberculous mycobacterial species identified from ice machines, medivator, bronchoscopes, faucets in certain units;
  - sequencing of isolates (M.avium) from patients and related environmental sources show that they are the same

Principle 1: Temperature

- Maintain cold water temperature less than 20C (68F)
- Hot water storage tanks should be set to 60C (140F).
- Hot water should constantly recirculate in patient care areas.
- Maintain hot water temperatures at the return at the highest temp allowed by state regulations or code
  - preferably at least 51C (124F);
  - if a temperature greater than or equal to 51C is allowed, consider engineering options such as thermostatic mixing valves at the tap to minimize scald risk.
- If codes limit hospital water to 41C–49C [105F–120F] or nursing care facility water to 35C– 43C [95F–110F]), then additional processes for prevention of Legionella needed.

Gamage et al 2016 ID Clin NA

Principle 2: Water stagnation

- Slow/nonmoving water, dead legs, low usage
- Biofilm, lower level of inhibitory controls (hot water, disinfectant)
- Low oxygen levels all contribute to pathogen growth
- Flushing programs

Principle 3: Disinfection

- Disinfectant residual
  - “the net amount of a chemical disinfectant remaining in the treated water after chemical demand exerted by the water is satisfied.”
  - Influenced by water, age, organic/inorganic load
  - Evaluate need for additional chemical disinfection
- Secondary disinfection
  - Monochloramine
  - Chlorine dioxide
  - Chlorination
- Treatment:
  - Copper-silver
  - Ozone
  - Thermal shock

Environmental monitoring

- Cultures
- pH
- Levels of disinfectant
- temperature

Principle 4: Maintain plumbing

- If scale, sediment or corrosion identified, should be promptly addressed

Case Scenario: Recommendations

- Temperature: system to heat water in storage tanks to >140F (60C)
- Stagnation: run showers for 10 minutes while rooms are cleaned
- Biofilm: Aerators to be replaced with laminar flow devices; discussion about whether faucet heads need to be replaced
- Cleaning: remove charcoal filters from ice machines, clean thoroughly, replace tubing and use particle filters instead
- Disinfectant: Install a secondary disinfection system due to low monochloramine, high ammonia levels
- Cultures: repeat every 3 months, monitor clinically

Summary

- Keep up with regulations, potential legal ramifications (lawsuits)
- WMP: multidisciplinary approach between clinical, infection prevention and engineering staff
- Interventions often multifocal:
  - Temperature
  - Stagnation
  - Cleaning
  - Disinfection
  - Monitoring
- Communication esp with administration (can be quite costly)

References:

- Li et al. Systematic review of waterborne infections from non-tuberculous mycobacteria in health care facility water systems. Int J of Hygiene & Envt Health. 220: 611-620, 2017.
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Thank you!

Julie.Trivedi@utsouthwestern.edu