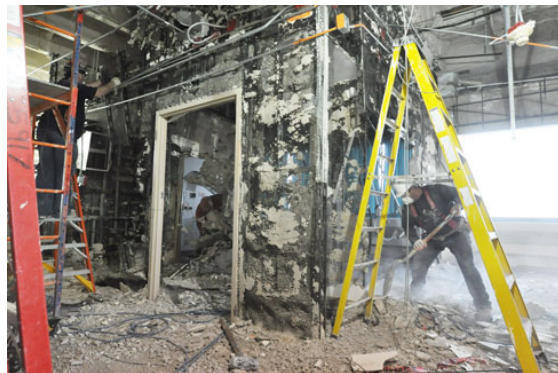


# INFECTION CONTROL ISSUES CONSTRUCTION AND RENOVATION WATER MANAGEMENT AND MOLD REMEDIATION

Evelyn Cook

**I want to begin with the premise that patients can leave the hospital sicker than they arrived if construction crews don't use established precautions to control infection during new construction or major renovations. In fact, it is estimated that there are at least 5000 construction-related infections that occur every year in healthcare facilities.**

# 5000



## INCIDENCE OF INVASIVE ASPERGILLOSIS IN AT-RISK GROUPS

Host Group	Incidence of invasive aspergillosis	Mortality
Allogenic bone marrow transplantation	5-10%	57.6%
Autologous bone marrow transplantation	0-5%	
Peripheral blood stem-cell transplantation	5%	
Cytotoxic therapy-induced granulocytopenia	Up to 70%	52.3%
Kidney transplantation	0-3%	55.9%
Liver transplantation	1-15%	
Heart/lung transplantation	0-20%	
Heart transplantation	0-25%	



## DOCUMENTED SOURCE OF SPORES IN CONSTRUCTION SETTINGS

- ▶ General construction and renovation work
- ▶ Disturbance of soil resulting from earth works associated with building construction and site development
- ▶ Removal of suspended ceiling tiles
- ▶ Removal of fibrous insulation material or fire-stopping
- ▶ Opening up of service distribution shafts
- ▶ Improper maintenance and operation of ventilation systems



8 cases of invasive fungal sinusitis  
and 5 deaths

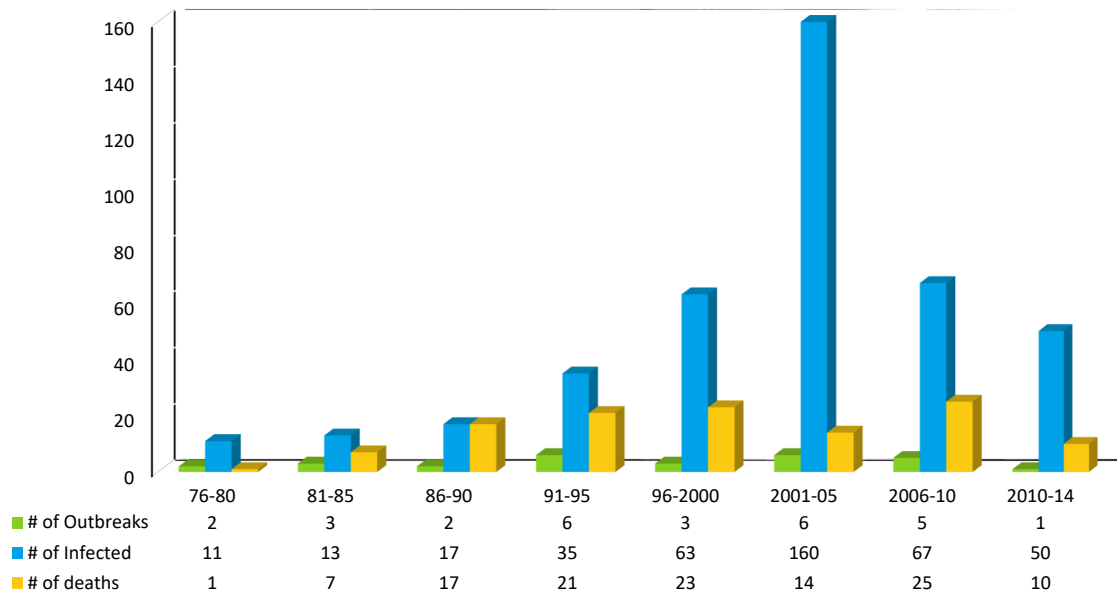


4 cases  
surgical and burn  
wound aspergillosis

**CLEAN SUPPLY**

Outside of packaging  
contaminated with  
dust

## REVIEW OF FUNGAL OUTBREAKS AND INFECTION PREVENTION IN HEALTHCARE SETTINGS DURING CONSTRUCTION AND RENOVATION



*Review of Fungal Outbreaks and Infection Prevention in Healthcare Settings During Construction and Renovation ; Hajime Kanamori, William A. Rutala, Emily E. Sickbert-Bennett, and David J. Weber  
Healthcare Epidemiology; April 2015*



## JOINT COMMISSION

### **EC.02.06.05 – The hospital manages its environment during demolition, construction or renovation (d/c/r) to reduce risk to those in the organization**

- ▶ EP 1 – When planning for new, altered or renovated space, use one of the following design criteria
  - ▶ State rule and regulations
  - ▶ 2018 FGI Guidelines for Design and Construction of Hospitals, includes ANSI/ASHRAE/ASHE Standard 170-2017 – Ventilation of Healthcare Facilities
  - ▶ When above rules, regulations and guidelines do not meet specific design needs, use other reputable standards that provide equivalent criteria



# NORTH CAROLINA STATE RULES

## MEMORANDUM

**DATE:** September 1, 2017  
**TO:** Interested Parties  
**FROM:** Nadine Pfeiffer, Rule Review Manager *NP*  
**RE:** Proposed Repeal of Hospital Construction Rules  
10A NCAC 13B Licensing of Hospitals

GS 150B-21.2 requires a rule-making body to notify certain individuals of its intent to adopt a permanent rule. It also requires notification of the date, time and location of the public hearing on the rule and any fiscal note that has been prepared in connection with the proposed rule.

The North Carolina Medical Care Commission has submitted form OAH 0300 to the Codifier of Rules, Office of Administrative Hearings, indicating its intent to repeal the following 29 rules:

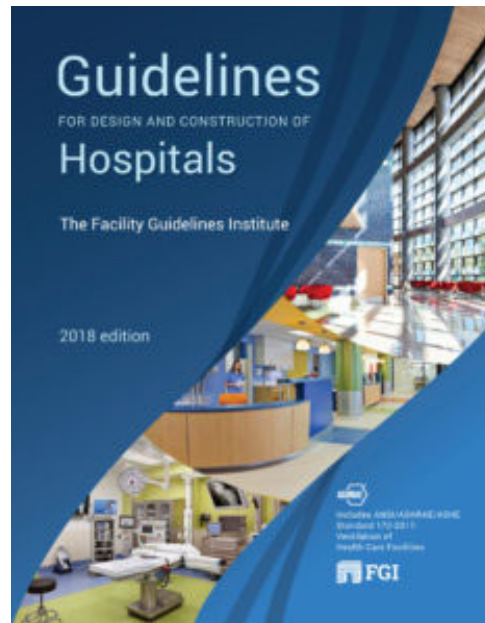
10A NCAC 13B .6001, .6002, .6104, .6201-.6206 and .6208-.6227.

The enactment of Session Law 2017-174, Senate Bill 42, known as “*An Act Directing the Medical Care Commission to Adopt the Recommendations of the American Society of Healthcare Engineering’s Facility Guidelines Institute*” that became effective July 21, 2017 requires the N.C. Medical Care Commission to repeal rules to implement the provisions of the Act. In accordance with G.S. 150B-21.4(d), a fiscal note is not required for a repeal of a rule.

[www.ncdhhs.gov/dhsr/ruleactions.html](http://www.ncdhhs.gov/dhsr/ruleactions.html)



## FGI GUIDELINES



# JOINT COMMISSION

**EC.02.06.05 – The hospital manages its environment during demolition, construction or renovation (d/c/r) to reduce risk to those in the organization**

- ▶ EP 2 – When planning for d/c/r, hospital conducts a preconstruction risk assessment for air quality, infection control... and other hazards that affect care, treatment and services



## FGI 2018 GUIDELINES

Proactive

### 1.2-4 Safety Risk Assessment Components

- ▶ Infection control risk assessment
- ▶ Patient handling and movement assessment
- ▶ Fall prevention assessment
- ▶ Medication safety assessment
- ▶ Behavioral and mental health risk assessment
- ▶ Patient immobility assessment
- ▶ Security risk assessment

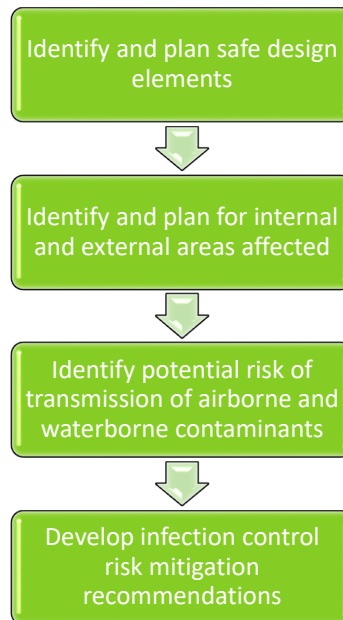
Multi-disciplinary

Documentation



# ICRA

## DOCUMENTED PROCESS TO PROACTIVELY:

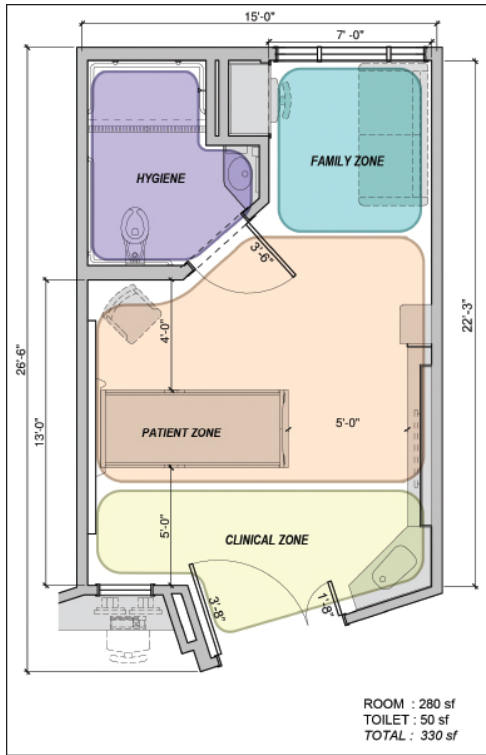


## ICRA CONSIDERATIONS

Identify and plan safe design elements

### Design Elements

- ▶ Number and location of All and PE rooms
- ▶ HVAC needs
- ▶ Number and location of Hand washing stations and hand sanitation dispensers
- ▶ Impact on water system
- ▶ Surfaces and finishes





# OTHER ICRA CONSIDERATIONS

Identify and plan for internal and external areas affected

Identify potential risk of transmission of airborne and waterborne contaminants

## Construction Elements

- ▶ Disrupting essential services
- ▶ Specific hazards and protection levels
- ▶ Location of patients
- ▶ Impact of moving debris, traffic flow, and spill clean-up
- ▶ Assessment of construction activities
- ▶ Location of known hazards

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## RISK MITIGATION

Develop infection control risk mitigation recommendations

- ▶ Patient placement/location
- ▶ Barriers and other protective measures
- ▶ Temporary phasing of HVAC/water
- ▶ Protection from demolition
- ▶ Training
- ▶ Impact of utility outages
- ▶ Movement of debris, traffic flow, cleanup and elevator control
- ▶ Provision of bathroom and food for construction workers
- ▶ Protection of building material

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# RISK MITIGATION

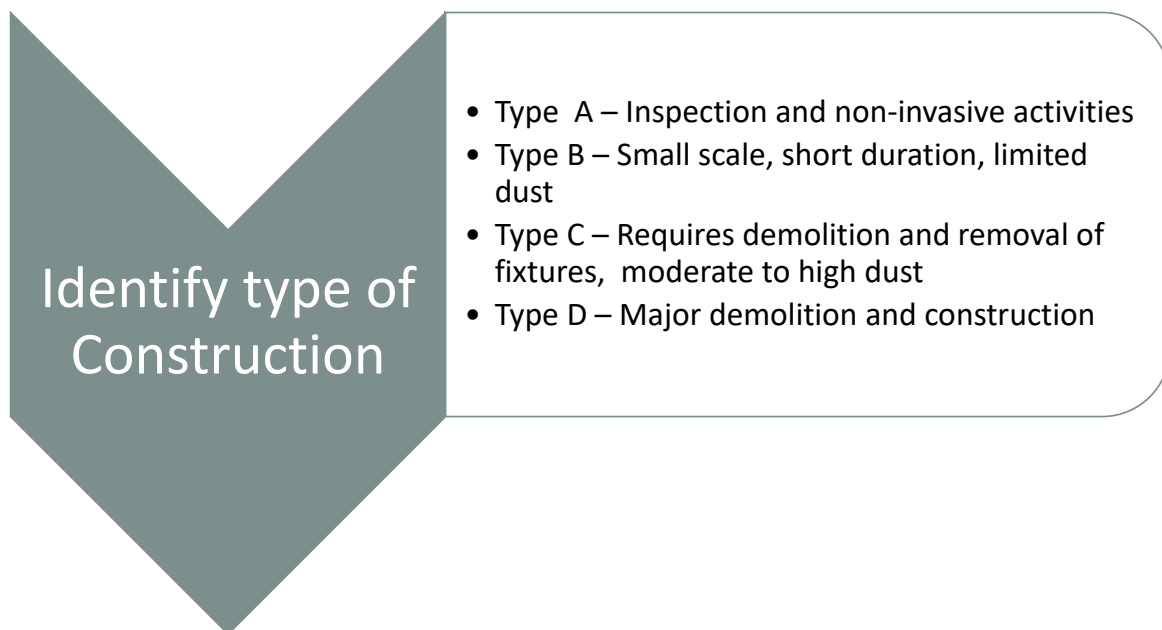


## Monitoring plan and procedures

- ▶ Determined by the governing body
- ▶ Conducted by IP, epidemiologist, construction coordinators, safety staff or an outside consultant
- ▶ Have written procedures for emergency suspension of work
- ▶ Protective indicating the responsibilities of each party (governing body, contractor, designer, and monitor)



# DETERMINING CONTROL MEASURES



# DETERMINING CONTROL MEASURES

## Patient Risk Groups

- Low risk – Office areas, public areas
- Medium risk – Outpatient clinics, cafeterias, public corridors
- High risk – All inpatient nursing units (except ICU/Stepdown), ER, L&D, etc.
- Highest risk - All ICUs and Stepdowns, Oncology, Surgical suites (OR, PACU), Transplant clinics

# DETERMINING CONTROL MEASURES



## Complete Risk Matrix

Risk Group	Type A	Type B	Type C	Type D
Low	I	II	II	III/IV
Medium	I	II	III	IV
High	I	II	III/IV	IV
Highest	I-III	III/IV	III/IV	IV

# INFECTION CONTROL PRECAUTIONS BY CLASS



During Construction	Upon Completion
<ol style="list-style-type: none"><li>1. Minimize raising dust</li><li>2. Replace displaced ceiling tiles</li></ol>	<ol style="list-style-type: none"><li>1. Clean work area upon completion</li></ol>



# INFECTION CONTROL PRECAUTIONS BY CLASS



During Construction	Upon Completion
<ol style="list-style-type: none"><li>1. Provide active means to prevent airborne dust dispersal</li><li>2. Water mist surfaces</li><li>3. Seal unused doors</li><li>4. Sticky mat at entrance</li><li>5. Seal air vents</li><li>6. Isolate HVAC system</li></ol>	<ol style="list-style-type: none"><li>1. Wipe work surfaces with disinfectant</li><li>2. Contain waste before transport in covered containers</li><li>3. Wet mop or Vacuum (HEPA filtered) before leaving</li><li>4. Restore HVAC system</li></ol>



# INFECTION CONTROL PRECAUTIONS BY CLASS



During Construction	Upon Completion
<p>ALL CLASS I, II plus</p> <ol style="list-style-type: none"> <li>1. Isolate HVAC</li> <li>2. Construct critical barriers</li> <li>3. Maintain negative pressure, HEPA equipped air filtration units</li> <li>4. Contain construction waste in tightly covered containers</li> </ol>	<ol style="list-style-type: none"> <li>1. Do not remove barriers until project completed, inspected and cleaned</li> <li>2. Remove barriers carefully to minimize dust dispersal</li> <li>3. Vacuum (HEPA filtered) work area</li> <li>4. Wet mop area w/ disinfectant</li> <li>5. Restore HVAC</li> </ol>

# INFECTION CONTROL PRECAUTIONS BY CLASS



During Construction	Upon Completion
<p>ALL CLASS I, II, III plus</p> <ol style="list-style-type: none"> <li>1. Seal all holes, pipes, and conduits</li> <li>2. Construct Anteroom at entrance, must vacuum off prior to exiting or wear coveralls</li> <li>3. All personnel wear shoe covers. Covers removed at exit</li> </ol>	<ol style="list-style-type: none"> <li>1. Do not remove barriers until project completed, inspected and cleaned</li> <li>2. Remove barriers carefully to minimize dust dispersal</li> <li>3. Vacuum (HEPA filtered) work area</li> <li>4. Wet mop area w/ disinfectant</li> <li>5. Restore HVAC</li> </ol>

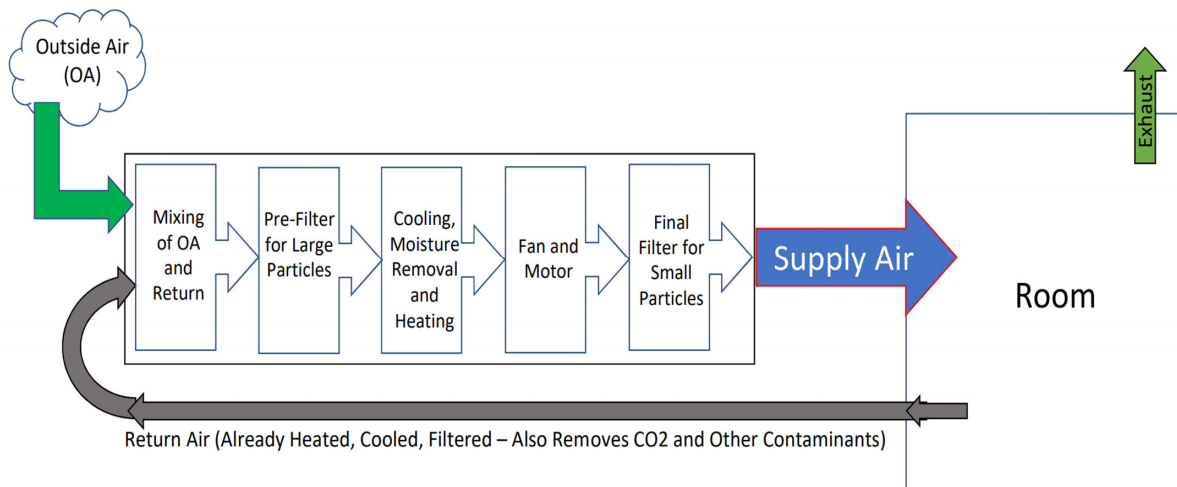
# INFECTION PREVENTION AND CONSTRUCTION HIGHLIGHTS FOR IP



**CICCTI**  
CONSTRUCTION INFECTION CONTROL TRAINING INSTITUTE

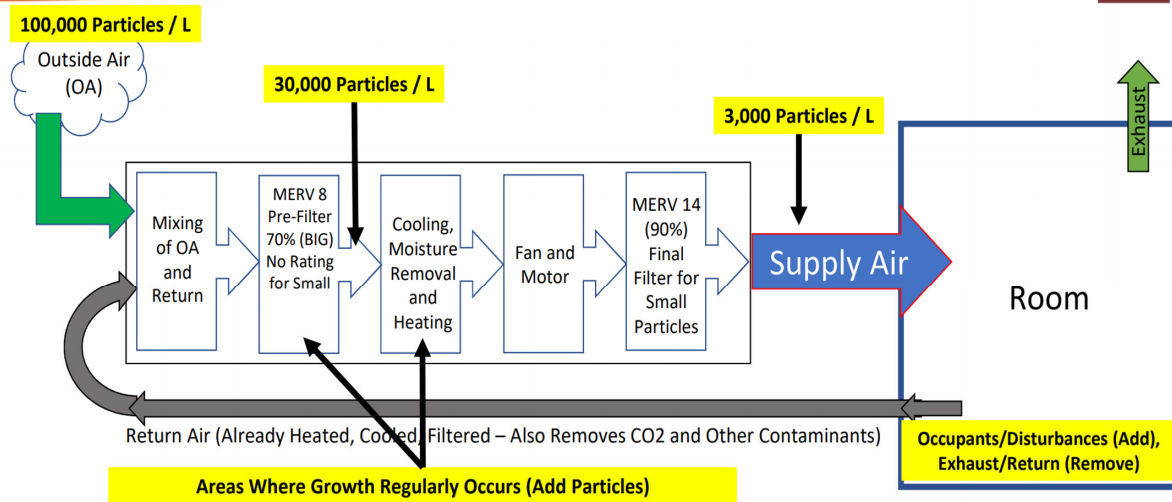
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## BUILDING SYSTEMS – AIR HANDLING UNITS



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# AIR HANDLING UNITS AND FILTRATION

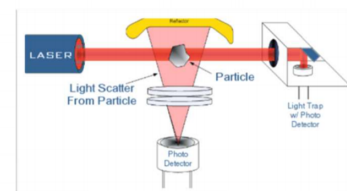


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# MONITORING DUST

## Laser Particle Counters

- Measures Dust Concentrations in Air
- Concentration per Unit of Air
- Compare Outdoor Air to Facility Indoor Air
- Actual Numbers are Relatively Meaningless
- Relationship or % **Difference** IS Important !!!
- **Tied to MERV Rating on AHU Filters (MERV 16 = 95%)**



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## MONITORING – PARTICLE COUNTERS



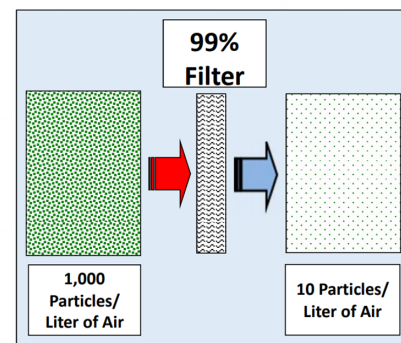
- Used to Assess Baseline Conditions
    - Baseline Conditions Acceptable (Within 10% of MERV Expectation)
    - Baseline Questionable (Within 30% of MERV Expectation)
    - Baseline Conditions Warrant Immediate Action (> 30% Variance in Expectation)
  - If Baseline Relationships Maintained = No Extra Dust
  - Construction Breakdowns Are UNMISTAKABLE (100-1000% Swings)
- 

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## EXERCISE: HEPA TESTING



- How Much Dust Entering System?
- How Much Dust Leaving System?
- Can We Demonstrate >99% Removal?
- This is EXTREMELY Important if Exhausting into Hospital Spaces



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## MOBILE CONTAINMENT UNITS



**Used for short term access / minor work above grid and tile in sensitive areas**

- Constructed of durable, cleanable material
- Provides full coverage from floor to ceiling
- Achieves good seal at the ceiling or wall connections
- Coupled with HEPA air scrubber for negative pressurization
- Has lockable wheels
- Sealable entry / exit
- Properly Maintained!!!



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## CONTROLLING AIR FLOW

### **Ventilation of the Construction Space**

Airflow into the construction zone from occupied spaces by dedicated ventilation/exhaust system for the construction area

- ▶ Location of exhaust discharges, fresh air intakes, sealing of existing air ducts
- ▶ Use of existing building systems
- ▶ Pressure differential of at least 0.03 inch water gauge (7.0 pascals)
- ▶ Visible display of negative pressure

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# CONTROLLING DUST

- ▶ Mats changed weekly
- ▶ HEPA vacuum only-documentation from construction company
- ▶ Particle counter
  - ▶ Baseline
  - ▶ Daily
  - ▶ HEPA units/filter
    - ▶ # of particles going in
    - ▶ # of particles coming out

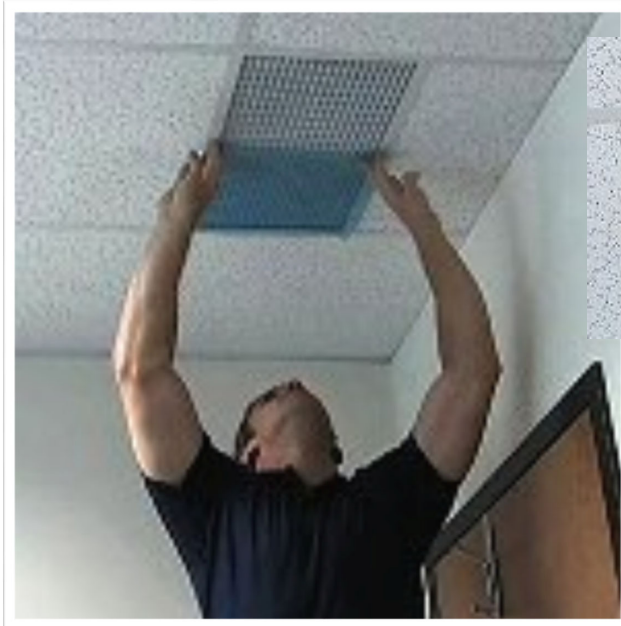






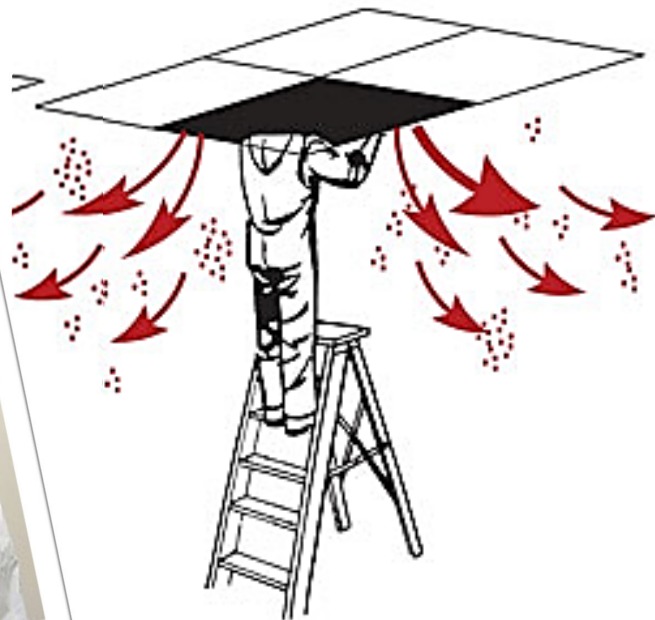






## Sealed Air Vents

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## MOBILE CONTAINMENT

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# EDUCATION AND TRAINING

Five groups for whom training is important

1. Construction company supervisory personnel
2. Construction workers
3. Hospital staff impacted by construction projects
4. Healthcare facility maintenance and engineering personnel
5. Healthcare project manager

The SPICE logo is located in the bottom right corner of the slide. It consists of the word "SPICE" in a bold, sans-serif font, followed by a stylized graphic of four arrows pointing outwards from a central point.

## EDUCATION

### ▶ Construction Workers:

- ▶ Adverse effects of construction dust on patients
- ▶ The ICRA process
- ▶ Specific facility rules, such as entry and exit from buildings
- ▶ Worksite containment
- ▶ Dust control measures
- ▶ Containment and transport of construction materials and debris (this would include use of elevator(s))

### ▶ Facility staff impacted by project:

- ▶ A review of the ICRA plan
- ▶ Appropriate signage at the worksite
- ▶ What proper barriers look like
- ▶ Proper above-ceiling dust control measures
- ▶ The importance of negative pressure
- ▶ Proper debris removal procedure
- ▶ Whom to notify about possible deficiencies.



# MOLD REMEDIATION

- ▶ Although molds can be found almost anywhere, they need moisture and nutrients to grow. The exact specifications for optimal mold growth vary by the species of mold. However, mold grows best in damp, warm environments. The availability of nutrients in indoor environments rarely limits mold growth because wood, wallboard, wallpaper, upholstery, and dust can be nutrient sources. When a hospital experiences water intrusion such as flooding or water leaks, resulting mold growth can seriously compromise the health of patients and others such as nursing staff and physicians

*Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods*  
*MMWR; June 9, 2006/Vol.55/No.RR8*

<https://www.cdc.gov/mmwr/PDF/rr/rr5508.pdf>



## NORTH CAROLINA GUIDELINES FOR MOISTURE MANAGEMENT AND MOLD REMEDIATION IN HEALTHCARE FACILITIES

These guidelines are a consensus document approved by the Association for Professionals in Infection Control (APIC-NC), the Statewide Program for Infection Control and Epidemiology (SPICE), the Public Health Institutional Task Force for Best Practices (PHIT Force), North Carolina State Division of Public Health, and the North Carolina Infectious Disease Society (NCIDS).

<https://spice.unc.edu/wp-content/uploads/2016/12/mold-2007-03-08-1.pdf>



## DETERMINING WHETHER A MOLD PROBLEM CURRENTLY EXISTS

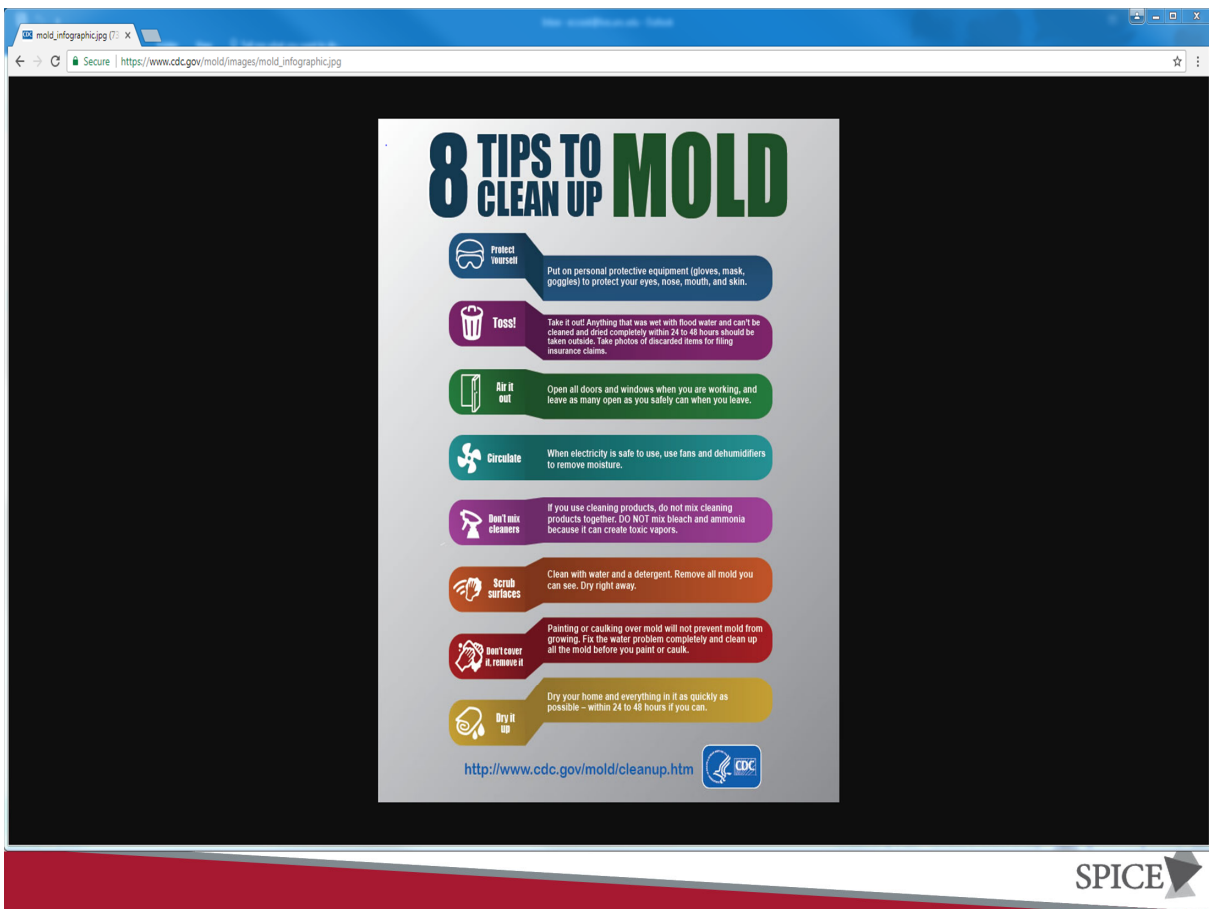
- ▶ Are building materials or furnishings visibly moisture damaged?
- ▶ Have building materials been wet more than 48 hours?
- ▶ Are there existing moisture problems in the building?
- ▶ Are building occupants reporting musty or moldy odors?
- ▶ Are building occupants reporting health problems that they think are related to mold in the indoor environment?
- ▶ Has the building been recently remodeled or has the building use changed?
- ▶ Has routine maintenance been delayed or the maintenance schedule been altered?

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## THE REMEDIATION PLAN SHOULD INCLUDE

- ✓ Steps to permanently correct the water or moisture problem
- ✓ The use of appropriate personal protective equipment (PPE)
- ✓ Steps to carefully contain and remove moldy building materials in a manner that will prevent further contamination.
- ✓ Depending on the size and complexity of the job, allow for revision of the plan if circumstances change or new facts are discovered. The types of affected materials and pathways for exposure are important considerations in any remediation plan. Porous materials may need removal and semi-porous and non-porous materials may only need cleaning and drying.
- ✓ Evaluating patient or healthcare case workers' exposure to contaminated air and construction materials. Patients may need to be relocated if traffic flow of construction activity cannot be found through non-patient areas.

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## SUMMARY

The IP should be involved in all construction projects from planning to completion

Common challenge – Lack of engagement or support from administration and getting support for IP involvement in construction activities

- ▶ Need to comply with regulatory agencies (State, FGI and TJC)
- ▶ Demonstrate value of the program
- ▶ Demonstrate how IP input results in an enhanced outcome and/or where the lack of input resulted in adverse outcomes

*It is important for infectious disease physicians and infection preventionists in collaboration with building contractors and other associated departments to appropriately implement risk assessment and mitigation measures and prevent healthcare-associated fungal outbreaks and infections.*

*Review of Fungal Outbreaks and Infection Prevention in Healthcare Settings During Construction and Renovation  
Hajime Kanamori, William A. Rutala, Emily E. Sickbert-Bennett, and David J. Weber*



## Sources of Water in HC

Roof leaks

Leaking fire sprinkler

Steam leaks

Burst pipes

HVAC condensate pans

Sewage back-ups

Groundwater Infiltration



# Water Management Plan

**DATE:** June 02, 2017

**TO:** State Survey Agency Directors

**FROM:** Director  
Survey and Certification Group

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

Memorandum Summary

- **Legionella Infections:** The bacterium *Legionella* can cause a serious type of pneumonia called LD in persons at risk. Those at risk include persons who are at least 50 years old, smokers, or those with underlying medical conditions such as chronic lung disease or immunosuppression. Outbreaks have been linked to poorly maintained water systems in buildings with large or complex water systems including hospitals and long-term care facilities. Transmission can occur via aerosols from devices such as showerheads, cooling towers, hot tubs, and decorative fountains.
- **Facility Requirements to Prevent Legionella Infections:** Facilities must develop and adhere to policies and procedures that inhibit microbial growth in building water systems that reduce the risk of growth and spread of *legionella* and other opportunistic pathogens in water.



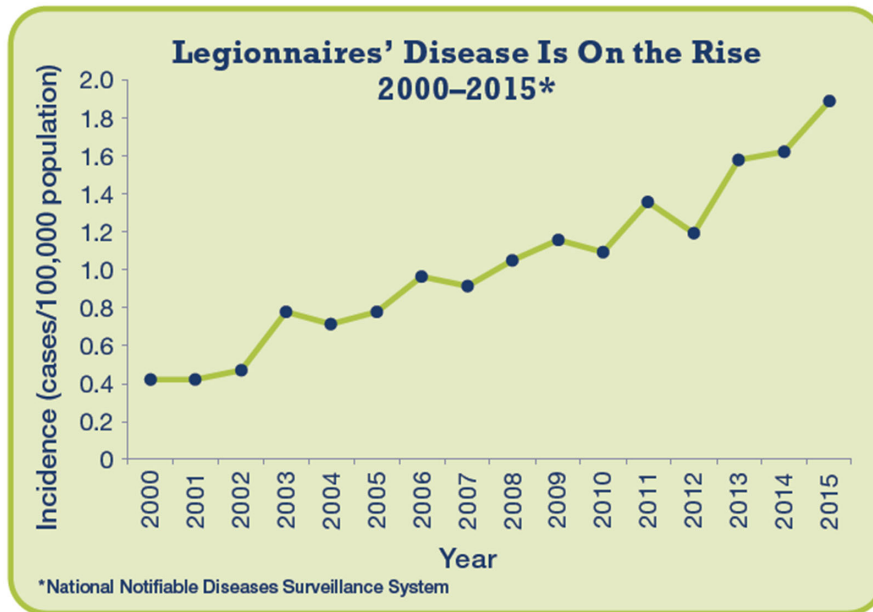
## Developing a Water Management Program to Reduce *Legionella* Growth & Spread in Buildings

A PRACTICAL GUIDE TO IMPLEMENTING INDUSTRY STANDARDS



<https://www.cdc.gov/legionella/downloads/toolkit.pdf>





In the United States, reported cases of Legionnaires' disease have increased by nearly four and a half times since 2000. More illness occurs in the summer and early fall but can happen any time of year.

## *LEGIONELLA PNEUMOPHILA*

- *Legionella* is found naturally in freshwater environments (lakes and streams) but generally does not lead to disease
- *Legionella* can become a health problem in building water systems
- *Legionella* first must grow...THEN
- Must be aerosolized so people can breathe in small, contaminated water droplets



# WHERE CAN *LEGIONELLA* GROW AND SPREAD ?

- Hot and cold-water storage tanks
- Water heaters
- Water filters
- Aerators Faucet flow restrictors
- Pipes, valves and fittings
- Electronic and manual faucets\*
- Showerheads\*
- Centrally-installed misters and humidifiers\*
- Eyewash stations\*
- Ice Machines\*
- Hot tubs\*
- Decorative fountains\*
- Cooling towers\*
- Medical Devices\*
  - CPAP machines, hydrotherapy equipment, bronchoscopes



## Factors Leading to Growth

### External Factors

- Construction
- Water main breaks
- Changes in municipal water quality



### Internal

- Biofilm
- Scale and sediment
- Water temperature fluctuations
- Water pressure changes
- pH
- Inadequate disinfectant
- Water Stagnation



# 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<sup>†</sup> 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)?

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**Devices in buildings that can spread contaminated water droplets should have a water management program even if the building itself does not. If you answer **NO** to all of questions 1 through 4 but **YES** to any of questions 5 through 8, you should have a water management program for *that device*.**

Yes \_\_\_ No \_\_\_ 5. Does your building have a cooling tower\*?

Yes \_\_\_ No \_\_\_ 6. Does your building have a hot tub (also known as a spa) that is not drained between each use?

Yes \_\_\_ No \_\_\_ 7. Does your building have a decorative fountain?

Yes \_\_\_ No \_\_\_ 8. Does your building have a centrally-installed mister, atomizer, air washer, or humidifier?

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# What Needs To Be Done?



Identify building water systems for which *Legionella* control measures are needed

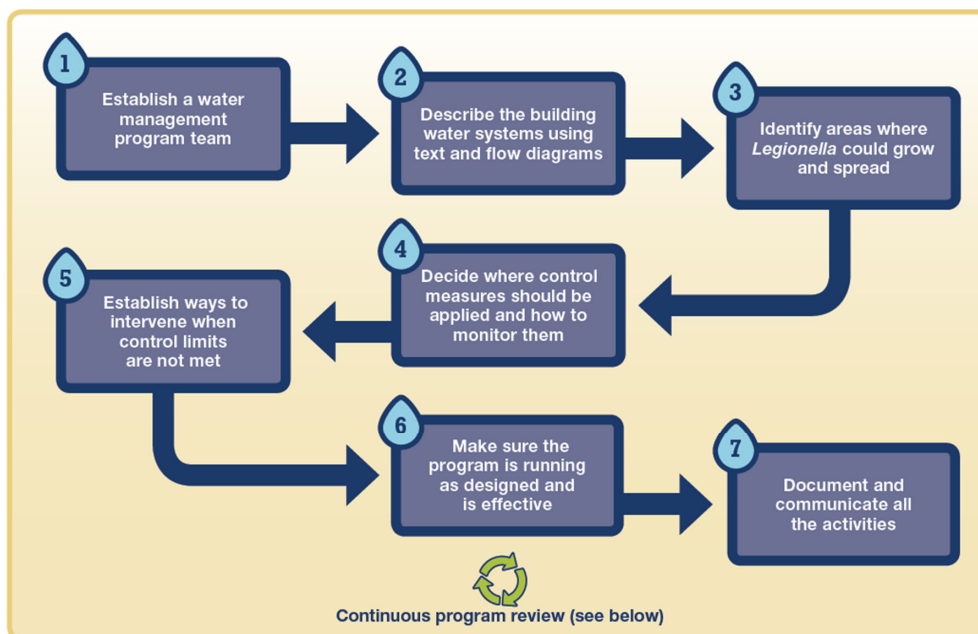
Assess how much risk the hazardous conditions in those water systems pose

Apply control measures to reduce the hazardous conditions, whenever possible, to prevent *Legionella* growth and spread

Make sure the program is running as designed and is effective



## Elements of a WMP



Annual Review

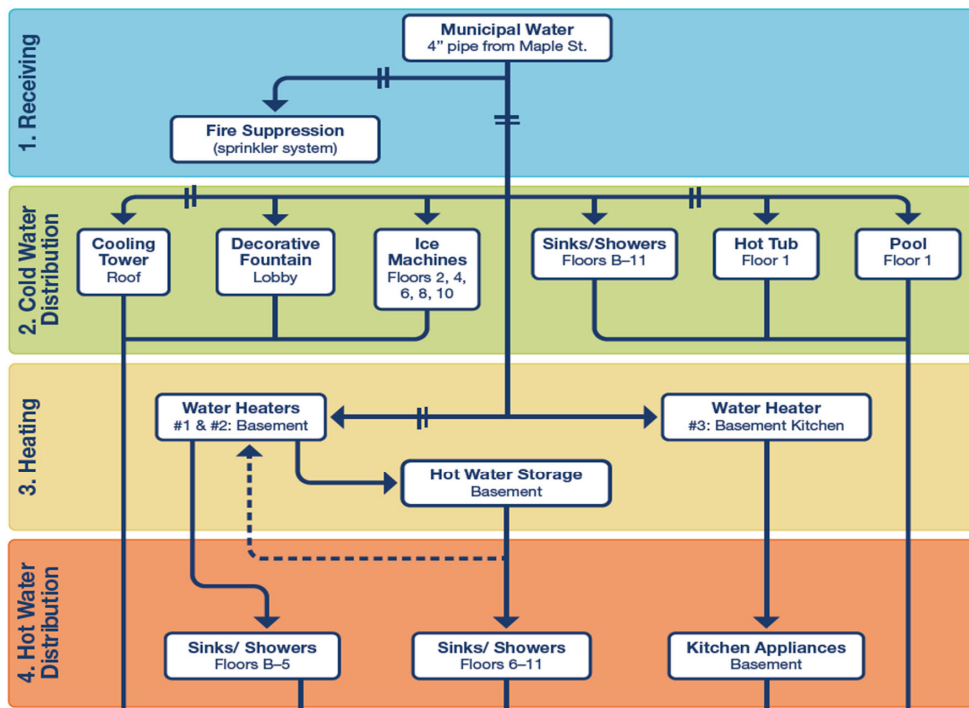


# Water Management Team

- Administrator
- Maintenance or engineering
- State/local health officials
- Infection preventionist
- Medical director
- Risk/Quality management staff



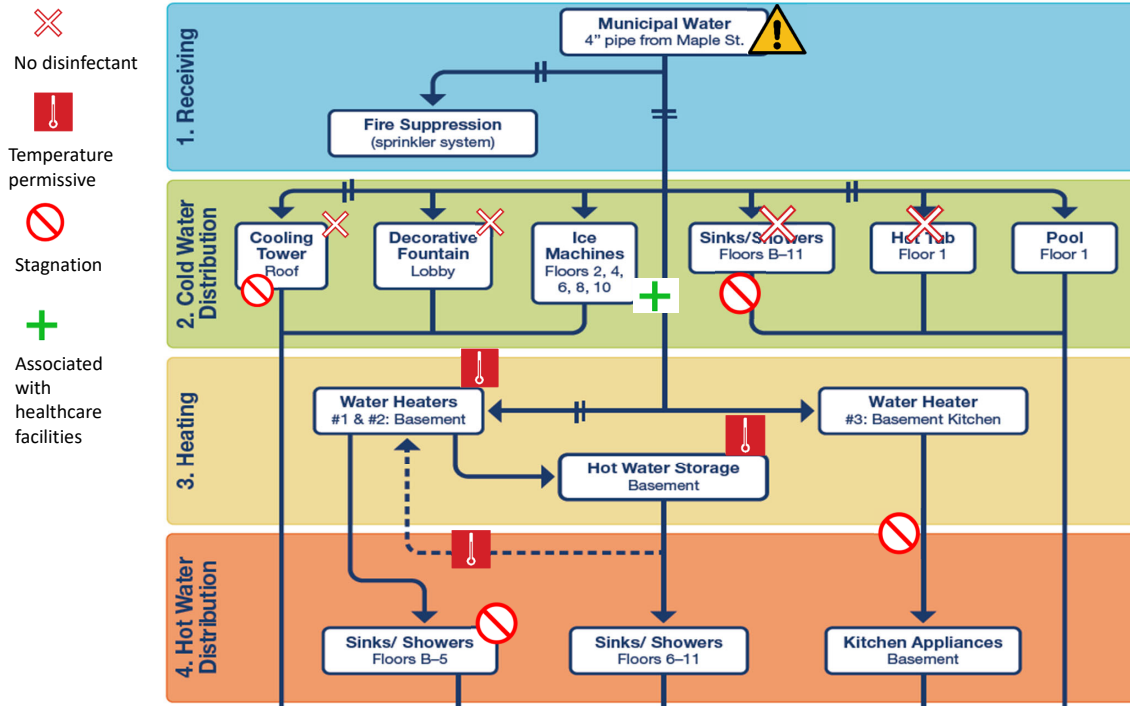
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## Describe Your Building Water Systems

Develop a written description of your building water systems in addition to a process flow diagram.

Understood easily by all members of your WMT.



Areas Where *Legionella* Could Grow and Spread

## Additional Elements of a WMP

1. Describe control measures and how monitored
2. Ways to intervene when control limits not met
3. Make sure program is running as designed
4. Document and communicate