New Codes and Standards 2023
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Andrew Streifel
Hospital Equipment Specialist,
University of Minnesota, (retired)
St.Paul, MN
strei001@umn.edu

Infection Control Principals for Health Care Construction

Course Number: AHCA 2023.09
Credit Designation: 1 LU/HSW
AIA CES Provider Number: E240

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1 OBJECTIVE

Understand why training is necessary to ensure a patient safety

2 OBJECTIVE

Understand what factors in a construction zone are necessary for patient safety .

3 OBJECTIVE

Know when to stop work if needed when verifiable parameters are exceeded

4 OBJECTIVE

Assure identified safety measures are in place during construction phases.

Environmental Infection Control Principals

Andrew Streifel, MPH, REHS
Hospital Environment Specialist
Retired

- 45 years service at U of Minnesota infection prevention.
- Visited over 400+ hospitals & assisted in IAQ infection issues.
- Technical expert for ASHRAE, CDC, FGI & other organizations.
- Provides evidence-based training for prevention of infections during water quality, construction & maintenance practice.
- Provides guidance for infectious disease prevention with design concepts.

Principals for Environmental Infection Control

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Objectives for Infection Control during Construction in Healthcare Facilities

- Respectful of patients
- Control aerosols
- Maintain a clean environment
- Prevent water damage
- Respond to emergencies
- Provide documentation
- Be trained & communicate

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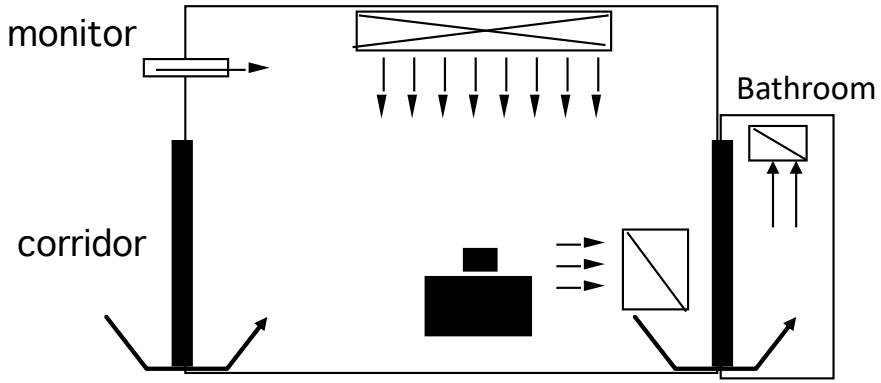
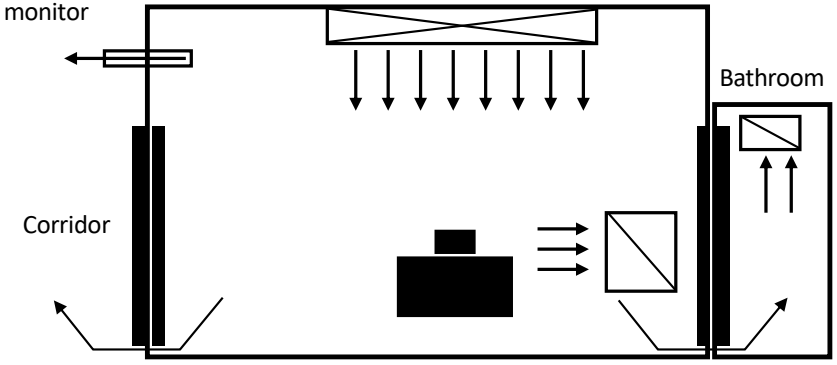
Negative Pressure Room for Airborne Infection Isolation



Positive Pressure Room for Protective Environment



CDC EIC MMWR JUNE 6, 2003

Table 6. Engineered specifications for positive- and negative pressure rooms*

	Positive pressure areas (e.g., protective environments [PE])	Negative pressure areas (e.g., airborne infection isolation [AII])
Pressure differentials	> +2.5 Pa§ (0.01″ water gauge)	> -2.5 Pa (0.01″ water gauge)
Air changes per hour (ACH)	>12	≥12 (for renovation or new construction)
Filtration efficiency	Supply: 99.97% @ 0.3 µm DOP¶ Return: none required**	Supply: 90% (dust spot test) Return: 99.97% @ 0.3 µm DOP¶ ⊥
Room airflow direction	Out to the adjacent area	In to the room
Clean-to-dirty airflow in room	Away from the patient (high-risk patient, immunosuppressed patient)	Towards the patient (airborne disease patient)
Ideal pressure differential	> + 8 Pa	> - 2.5 Pa

* Material in this table was compiled from references 35 and 120. Table adapted from and used with permission of the publisher of reference 35 (Lippincott Williams and Wilkins).

§ Pa is the abbreviation for Pascal, a metric unit of measurement for pressure based on air velocity; 250 Pa equals 1.0 inch water gauge.

¶ DOP is the abbreviation for dioctylphthalate particles of 0.3 µm diameter.

** If the patient requires both PE and AII, return air should be HEPA-filtered or otherwise exhausted to the outside.

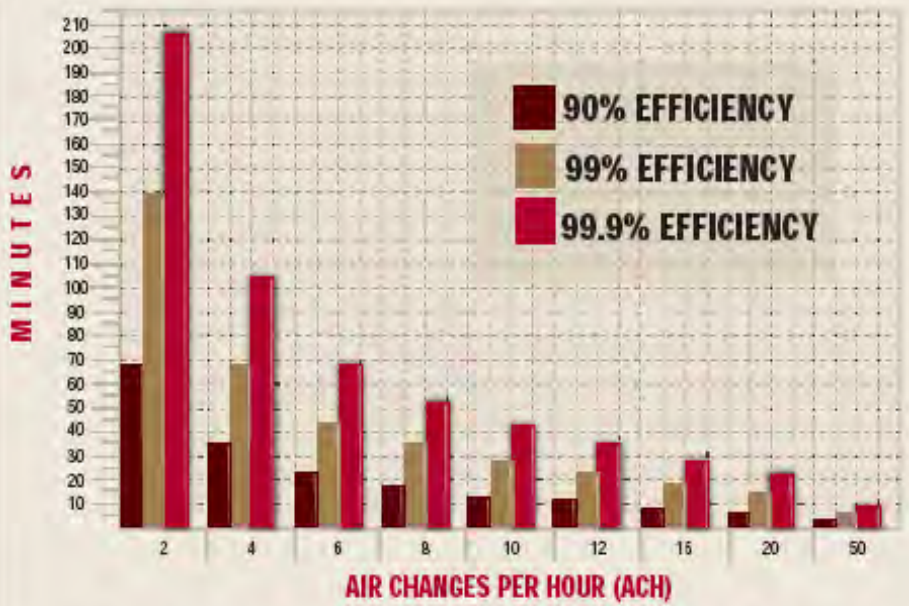
⊥ HEPA filtration of exhaust air from AII rooms should not be required, providing that the exhaust is properly located to prevent re-entry into the building.

AIA & ASHRAE DESIGN GUIDELINES FOR VENTILATION

Impact of Air Flow On Room Particle Contamination

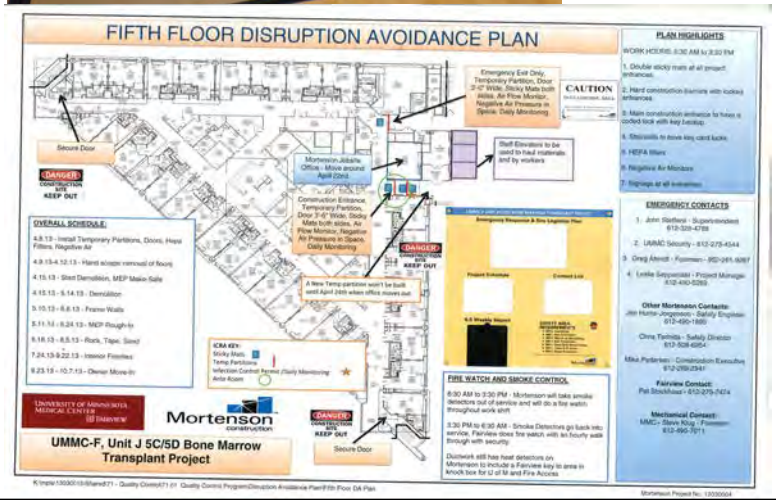
ACH	90% EFFICIENCY	99% EFFICIENCY	99.9% EFFICIENCY
2	69	138	207
4	35	69	104
6	23	46	69
8	17	35	52
10	14	28	41
12	12	23	35
15	9	18	28
20	7	14	21
50	3	6	8

Modified from Table B.1, CDC Guidelines for Environmental Infection Control in Health-Care Facilities, 2003.[5]



Perfect mixing of air is assumed. For rooms with stagnant air spaces, the time required may be much longer than shown. This is intended only as an approximation and is for ideal ventilation configurations.

http://www.health.state.mn.us/oep/training/bhpp/isolation.html

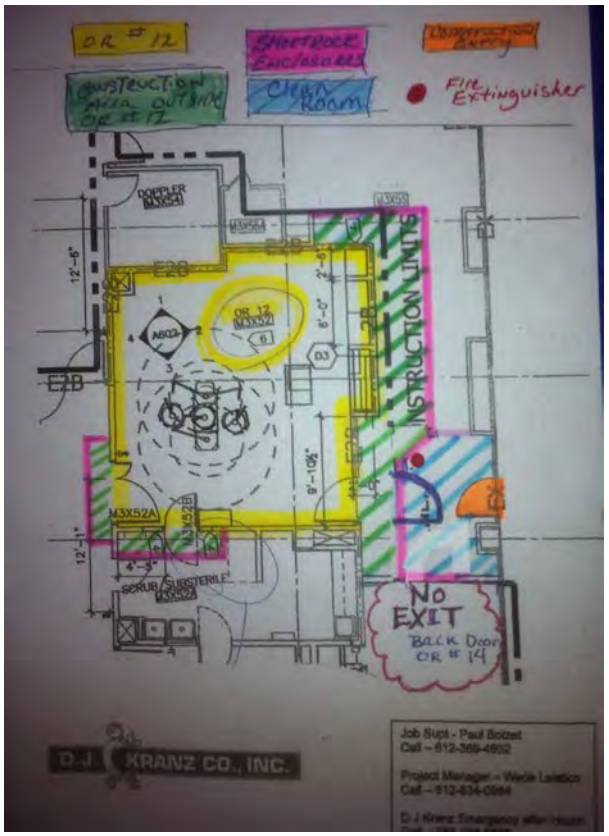


Disruption Avoidance through ICRA Mitigation Planning

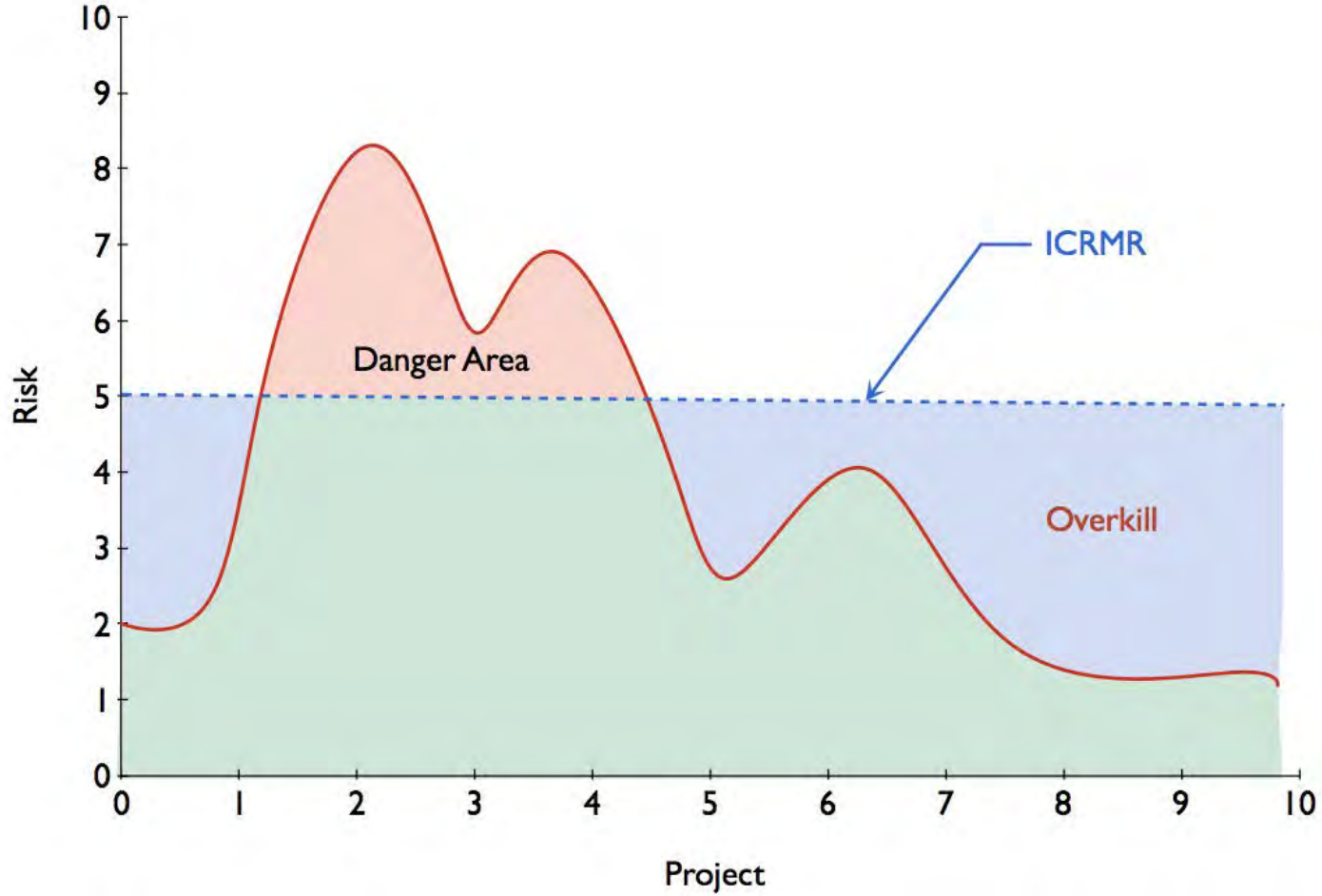
Knowing what to expect is key

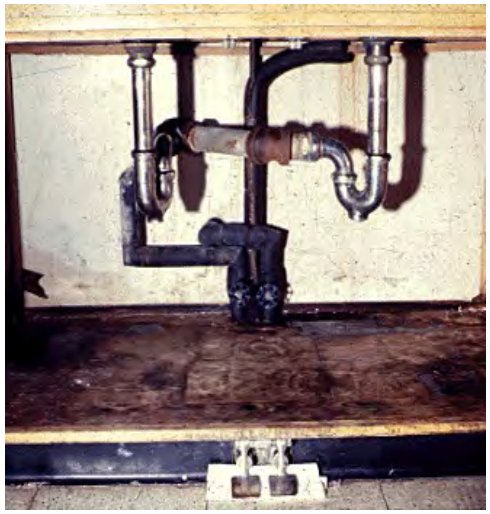
Example: repairing water damage begets mold

Plan: be ready with mold training

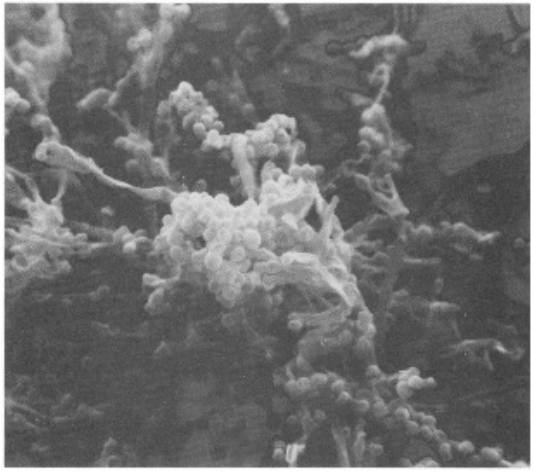


Does Risk Vary during a Project





Moldy sink



SEM wood surface

JOURNAL OF CLINICAL MICROBIOLOGY, Jan. 1987, p. 1–4
0095-1137/87/010001-04$02.00/0

Vol.

In-Hospital Source of Airborne *Penicillium* Species Spores

ANDREW J. STREIFEL,[1] POLLY P. STEVENS,[1]† AND FRANK S. RHAME[2,3]*

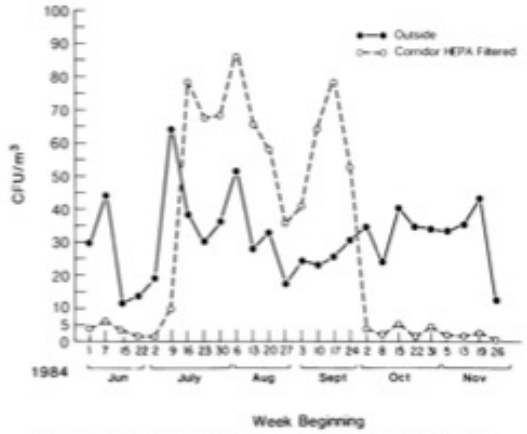
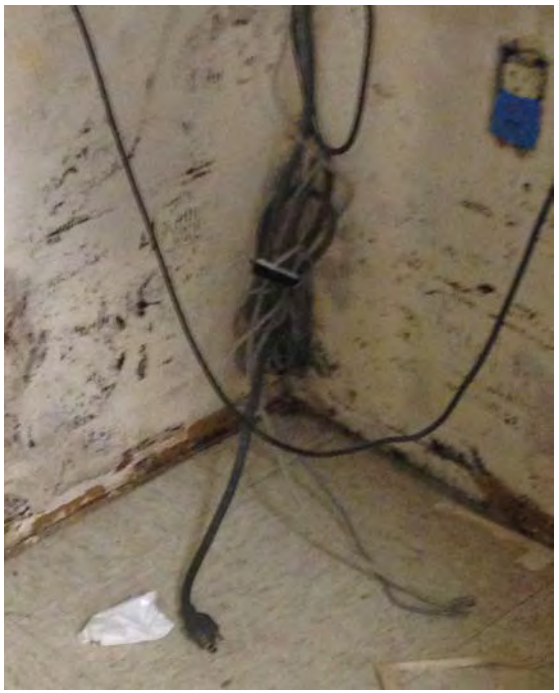


FIG. 1. Weekly mean total thermotolerant airborne fungi.

Sink passive eruption of spores at 5.5x10^5 cfu/m^6 per hour.

With protective isolation 1/109 nasal swab positive for fungal isolate

What do you do when you discover mold?



Hidden behind object that are not moved
Very often on the PCU

Dialysis cabinet in ICU

Pump with copper 8 quinolinolate

Know how to use ventilation

If a door or window is open it is hard to establish pressure and control airflow direction.

Negative pressure machine

A good idea may not work if the window is not sealed.

Exhaust systems need to reinforce
Flex duct to avoid pressure issues

Trust but Verify

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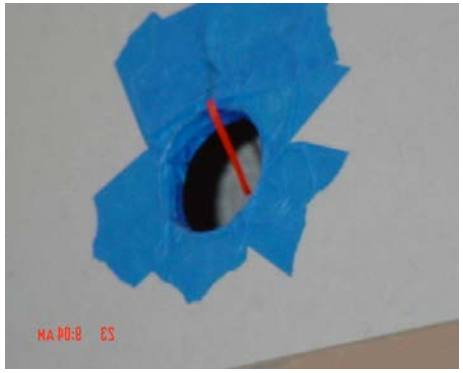
TOOLS OF THE TRADE

Air sampler

Simple Flutter Strip



Pressure gauge &
Particle counter




Barrier containment of sources


Table II Colony-forming units per cubic meter sampled from fan-specific locations (10 years)

Location (Fan #)	Samples (*N*)	Total fungal counts at 25° C			Total fungal counts at 37° C		
		Mean	Median	Range	Mean	Median	Range
Adult BMT (S-11)	122	18	11	0-320	3.2	1.4	0-25
Pediatric BMT (S-9)	127	22	14	0-158	16	2.8	0-784
Patient Care Area "B" (S-11)	123	46	27	2.8-1120	16	4.2	0-1008
Hospital lobby	126	97	66	7-582	21	11	1.4-428
Outdoors	129	848	406	17-5830	122	50	0-2540

Highlights-

-range of cfu from 0 to 1008 for 37C fungi.

-control of sources more effective than searching for burst.

-82% reduction of isolates growth between 25C and 37C

Ten-year air sample analysis of Aspergillus prevalence in a university hospital
D.G. Falvey*, A.J. Streifel Journal of Hospital Infection (2007) 1-7.

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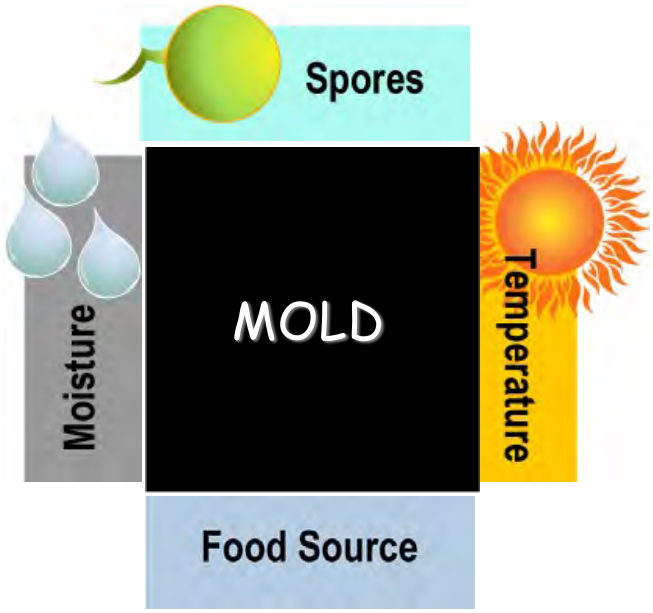
Water Damage Management

- Reactive
  - respond to water incident
  - determine extent of water damage
  - cut out or dry
- Proactive
  - water resistant material
  - preservative application
  - proper installation



Response after flooding:

-Stop water
-remove wet material
    1) to dry
    2) water damaged
-turn up temperature
    1) for 23F increase
    2) air hold 50% more water vapor
-move air to decrease RH
-dehumidify
    1) depends on outside humidity
    2) inside humidity level
-reduce to RH 30%
    1) seasonal issues
    2) climate issues
-environmental conditions
    1)growth = surface <20% water content
    2) RH < 95%

Mold Growth Management

- Mold growth
  - – about 4 hours with ideal conditions
  - –Mycelial growth
  - –Sporulation about 72 to 96 hours
  - –Dissemination of spores
- Mold Growth Conditions
  - –About 25% water content
  - –Approximately 95% relative humidity
- Interrupt growth
  - –Reduce moisture
  - –Resistant substrate

What happens when a sprinkler fails at midnight one week before occupancy?

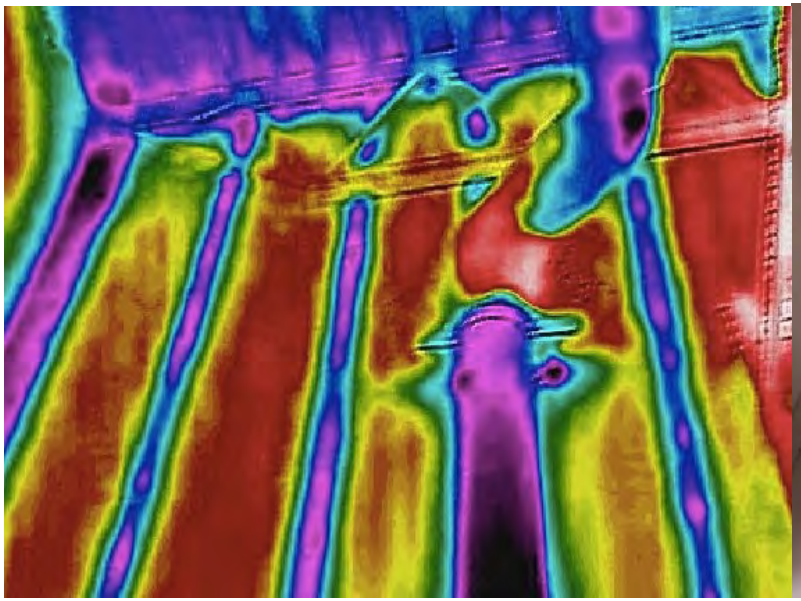
Serious flooding is a problem so can we prepare for the potential?

Being Prepared for Floods in Prudent Best Practice

Tools assembled for quick response

Transport gurney plus vacuum
And extension cords in waiting

Infrared camera reveals source of mold



Evaporative cooling shows up on colored display.

Real time analysis shows the extent of water damage

Floods happen for many reasons.

Broken pipe in CSP

Exansion joint leak

Building junction

Floods with water damage require immediate or measured response.

Or you may get this!!

Moisture detectors are useful decision makers for water detection & drying

Keep moisture content <20% &<90%RH
Maintain air movement
Remove moisture physically or by evaporation

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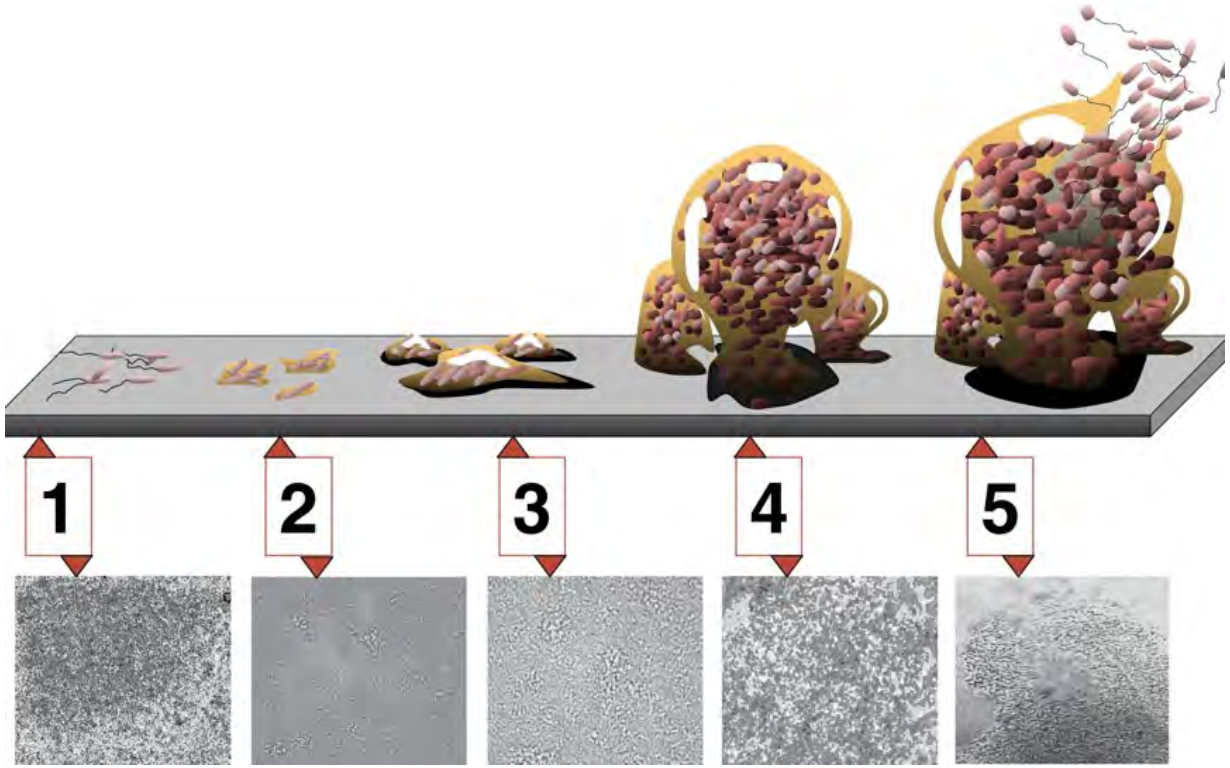
Biofilm development from planktonic to sessile colonies



Biofilm thrives in stagnant water

Biofilm Sources

Cardioplegia machine

Scrub sink faucet

Shower head reservoir

Ultrasonic cleaner

WATER FEATURES CAN BE THE SOURCE OF EXPOSURE

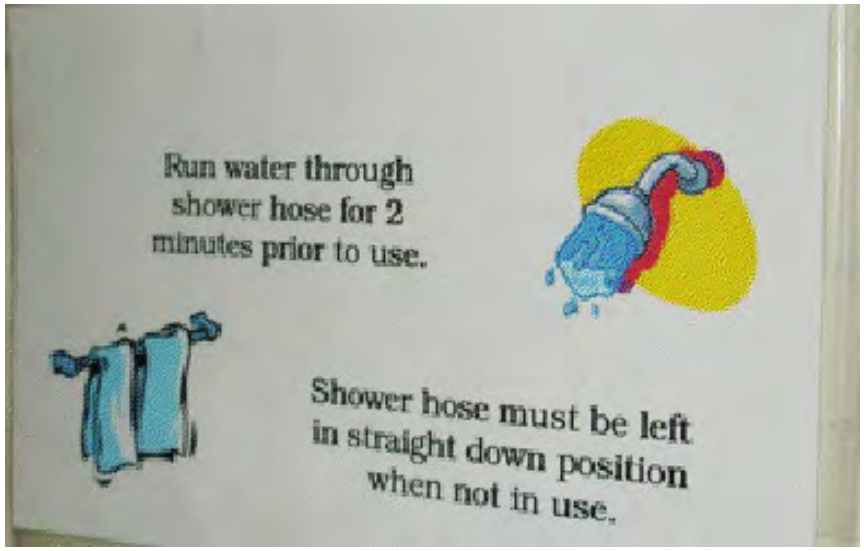
Biofilm development is enhanced when:

-temperature is >68F
-submerged lighting is present
-nutrients
-water feature materials support growth
-water flow slow or stagnant
-aerosol generation

Water treatment

-size of fountain
-ozone
-halogens
-chlorine dioxide
-UV

What to do about water in a clinical setting?

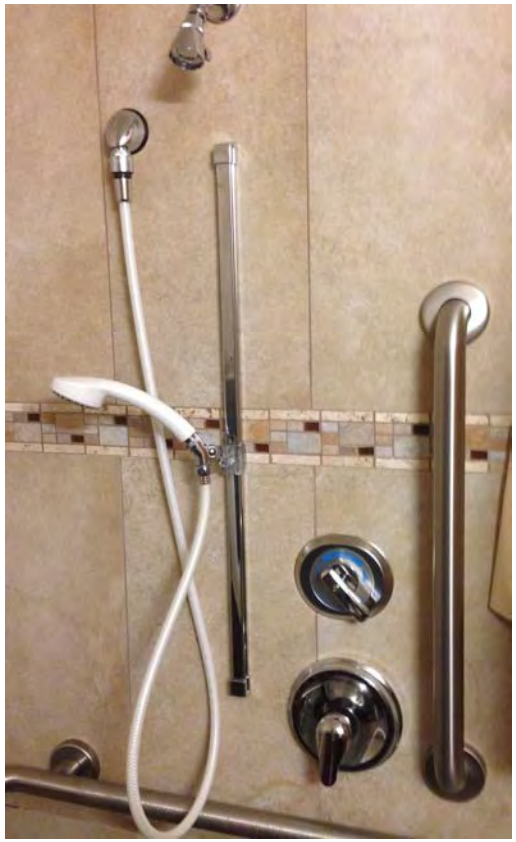


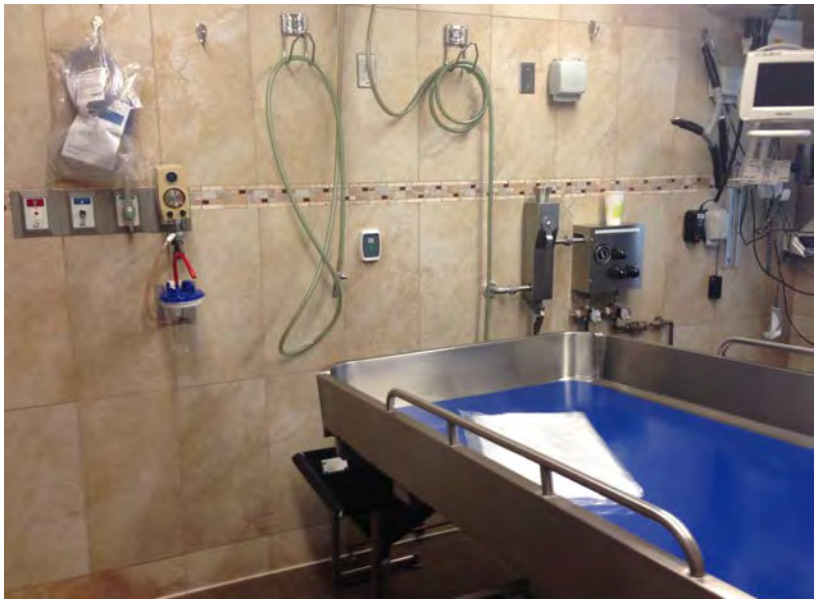
	Number of Samples	Mean (CFUs/ml)	Median (CFUs/ml)	Range (CFUs/ml)
Before Flush	16	49,471	25,050	110-196,000
After Flush	16	146	35	3-970

Ice Machines
Burn unit debridement hoses
Under sink filters
Endoscope cleaners

FLUSH

Water Bacteria in a Burn Unit





Stenotrophomonas maltopilia
Pseudomonas putida

Automatic Endoscope Reprocessing device after a backflow prevention device.

-should there be a flushing mechanism to cover periods of inactivity?

-should there be a way to disinfect this device?

PRECAUTIONS DURING CONSTRUCTION

INDOOR PROJECTS (RENOVATION)

Employee training

- Barrier management
- Water damage
- Demolition precautions
- Dust migration and control
- Debris and material transport
- Access routes to work area
- Outages (electrical and plumbing)
- Portable filter usage
- Noise and vibration
- Sanitation and break areas
- Commissioning -air & water

Communication

- Emergency response
- Water damage reporting
- Changing work phases

ICRA precautions during occupancy

Water Quality

- Stagnant water flushing
- Testing water requirements
- Punch list
- Critical sinks drinking water

OUTDOOR PROJECTS (NEW)

Employee training

- Dust control
- Noise and vibration
- Pest control
- Building material storage
- Water damage management
- Sanitation and break areas
- Tie in building issues
- Commissioning-air & water
- Shell spaced-build out

Communication

- Emergency response
- Water damage reporting
- Material crane location

Changing ICRA precautions pre occupancy

Water Quality

- Stagnant water flushing
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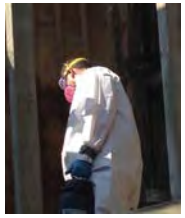
Awareness Factors by Trade

	Plumber	HVAC	Electrician	Painter	Laborer	IT Specialist	Riggers	Specialty Trade
Awareness Factors								
Water damage	x		x	x	x	x		x
Mold discovery	x		x	x	x	x		x
Outages	x	x	x					x
ICRA	x	x	x	x	x	x	x	x
Water event response	x				x			
Stagnant water	x							
Building material storage/stocking	x	x	x	x	x	x	x	x
Noise/vibration	x	x	x		x	x	x	x
Track dirt	x	x	x	x	x	x	x	x
Wall/slab penetrations	x	x	x		x	x		
Material transport	x	x			x		x	x
Biocide application				x	x			x
Room/wall seal application				x	x			



Obvious problems can be noticed visually. However, the nose knows when the mold is growing in a source such as a fan coil. When they dry they fly.

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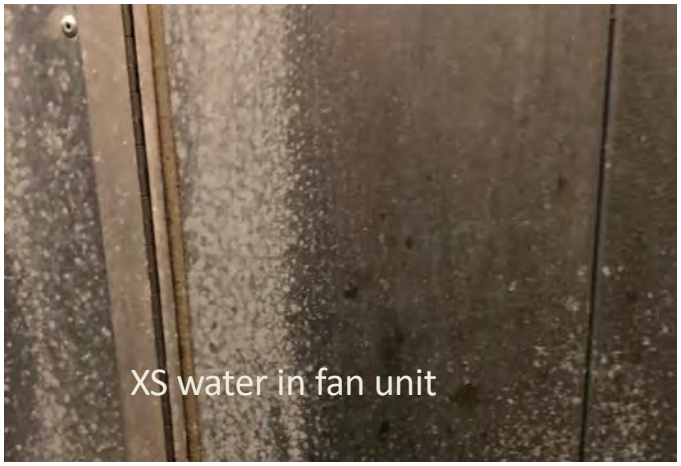

Questionwhat side of the filters is the mold

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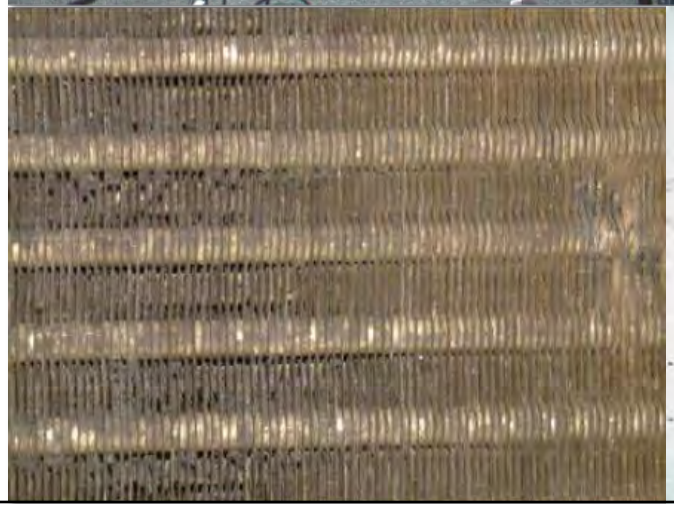

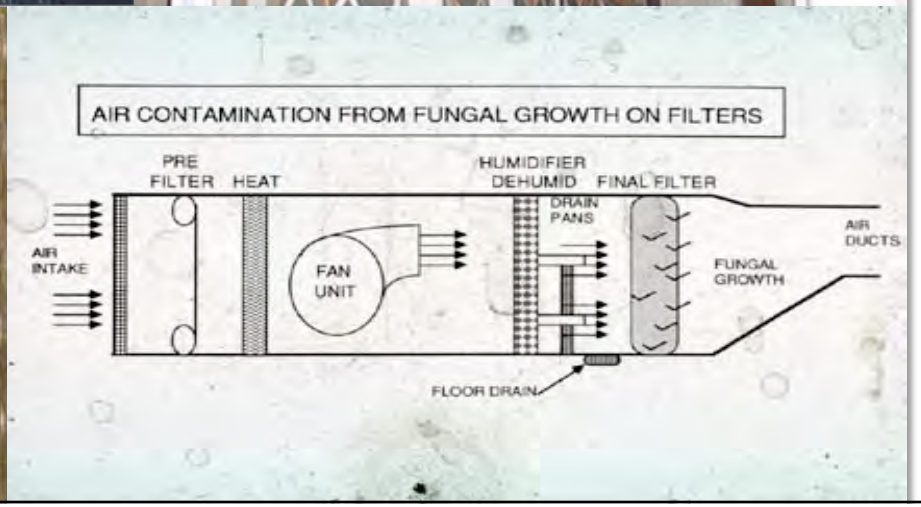
AIR CONTAMINATION FROM FUNGAL GROWTH ON FILTERS
PRE FILTER
HEAT
HUMIDIFIER DEHUMID
FINAL FILTER
DRAIN PANS
AIR INTAKE
FAN UNIT
FUNGAL GROWTH
AIR DUCTS
FLOOR DRAIN

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University of Minnesota Medical Center-1986

UMMC Children's Hospital-2011

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strei001@umn.edu

Thank you for your attention!