Construction Management and Infection Control

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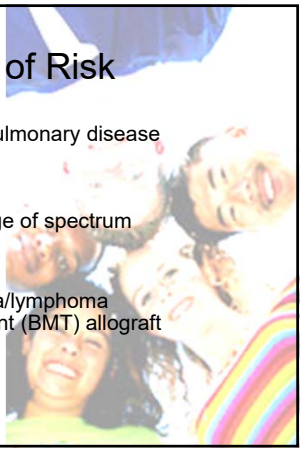
Objectives for Infection Control during Construction in Healthcare Facilities

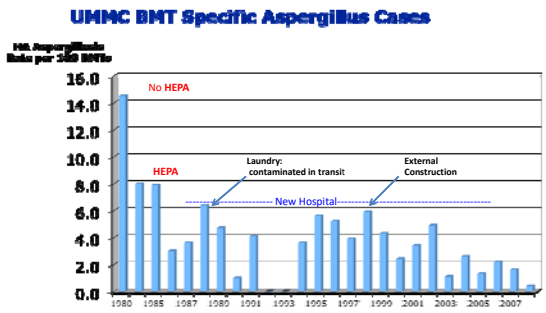
- Respectful of patients
- Control aerosols
- Maintain a clean environment
- Prevent water damage
- Respond to emergencies
- Provide documentation
- Be trained & communicate

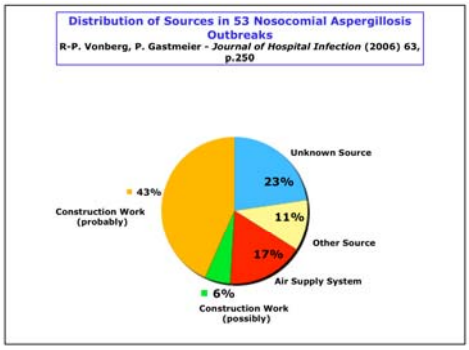
Levels of Risk

Healthy person
- Chronic obstructive pulmonary disease
- Diabetes
- Steroids
- Cancer - solid tumor
- HIV infection-end stage of spectrum
- Organ transplant
  - Kidney/heart
  - Lung/liver
- Malignancy - leukemia/lymphoma
- Bone marrow transplant (BMT) allograft

Greatest Risk

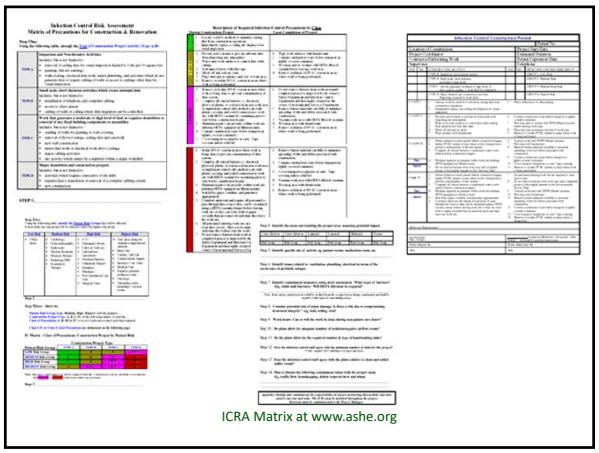




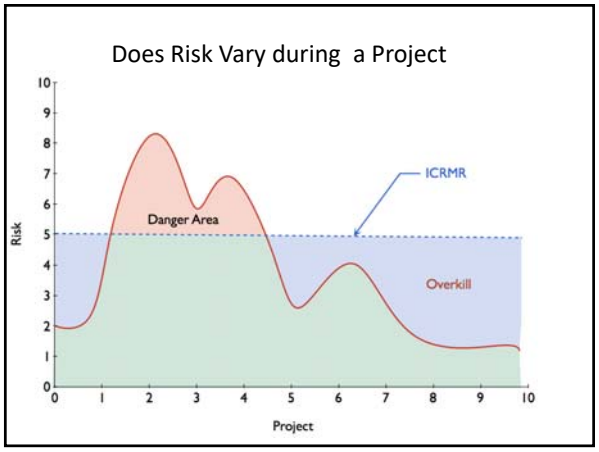


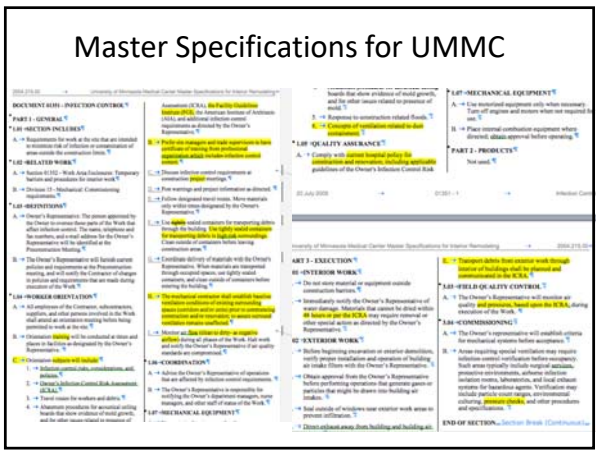
Nosocomial Aspergillosis Prevention Measures

- Minimize non-emergent infections patient admissions during heavy construction.
- Locate high-risk patients as far away as possible from construction/demolition.
- Seal off patient care areas with impermeable barriers.
- Keep doors and windows closed.
- Verify HEPA filtration and air exchange rates.
- Assure proper air pressure relationships:
  - Positive pressure in patient protective environment
  - Negative pressure in adjoining construction areas
- Provide treatment in patient's room when possible:
  - If patient transport is necessary, schedule for periods of minimal construction activity
  - Use appropriate patient face masks when transporting through potential contamination
- Wet-clean wards thoroughly without raising dust.
- Surveillance of infections in high-risk patients should be regularly performed.



ICRA Matrix at www.ashe.org





- INFECTION CONTROL GENERAL OUTLINE NOTES
- ALL BALANCING REPORTS WILL BE MADE AVAILABLE TO UMMC INFECTION CONTROL PERSONNEL ON REQUEST. SUBMIT THESE REPORTS DIRECTLY AFTER BEING REVIEWED BY THE ENGINEER OF RECORD.
- ALL CONTRACTORS AND SUBCONTRACTORS SHALL FOLLOW THE FUMC INFECTION CONTROL RISK ASSESSMENT (IRCA) AND AIA GUIDELINES THROUGHOUT THE CONSTRUCTION PROCESS. ALL CONTRACTED WORKERS MUST RECEIVE INFORMATION/TRAINING ON INFECTION CONTROL RISKS AND PRACTICES PRIOR TO STARTING ANY ON SITE WORK.
- ALL WORK OUTSIDE THE PROTECTED PROJECT BOUNDARIES ABOVE EXISTING CEILING SHALL BE COMPLETED WITH CEILING REPLACED IN THE SAME DAY UNLESS FULLY COORDINATED THROUGH INFECTION CONTROL.
- CEILING TILES WITH VISIBLE WATER DAMAGE SHALL BE SPRAYED TO DISINFECT AND ENCAPSULATE POTENTIAL MOLD PRIOR TO REMOVAL.
- CONTRACTOR TO INSTALL TEMPORARY BARRIERS FOR EACH PROJECT PHASE AND/OR AREA. THESE BARRIERS SHALL BE FULLY COORDINATED WITH UMMC AND IN MOST CASES CONTAIN SOME FORM OF AIRLOCK VESTIBULE PRIOR TO ENTERING THE CONSTRUCTION AREA.
- FLUTTER STRIPS OR AIR PRESSURE GAUGES SHALL BE PROVIDED AT THE ENTRANCES TO EACH CONSTRUCTION AREA. ALL CONTRACTED WORKERS SHALL BE TRAINED TO VISUALLY MONITOR THESE DEVICES FOR ADEQUATE NEGATIVE PRESSURIZATION AS THEY ENTER/EXIT THE CONSTRUCTION AREA. DAILY LOGS SHALL BE KEPT BY THE MECHANICAL CONTRACTOR TO INSURE CONSTANT PRESSURIZATION HAS BEEN MAINTAINED.
- PORTABLE HEPA FILTER UNIT SHALL BE UTILIZED WITHIN EACH CONSTRUCTION AREA. THESE UNITS WILL BE PROVIDED BY FAIRVIEW UNIVERSITY AND MAINTAINED BY THE MECHANICAL CONTRACTOR.
- NEGATIVE PRESSURIZATION SHALL BE MAINTAINED IN EACH CONSTRUCTION AREA. IF LOCATED ON AN EXTERIOR WALL, FANS SHOULD BE UTILIZED TO EXHAUST AIR DIRECTLY OUT A NEARBY WINDOW, TAKING PRECAUTIONS TO NOT INTERFERE WITH EXISTING BUILDING AIR INTAKES, PUBLIC AREAS, ETC. IF NO EXTERIOR WALL IS AVAILABLE THEN NEGATIVE AIR MACHINES WITH INTERNAL FILTRATION SHALL BE PROVIDED AND CONNECTION TO THE NEAREST EXHAUST OR RETURN DUCT AVAILABLE (CONTACT ENGINEER TO VERIFY EXISTING DUCTWORK CAPACITY PRIOR TO CONNECTION).
- COORDINATE DEBRIS REMOVAL WITH UMMC. IF AN ACCEPTABLE EXIT PATH IS NOT AVAILABLE FROM THE PROJECT SITE THEN AFTER HOURS REMOVAL OF DEMOLISHED MATERIAL WILL BE PERFORMED. COVER ALL CARTS WITH SEALED COVERS TO MAINTAIN DUST CONTROL.

When we find mold what should we do?
- Have a plan
- Use detergent and water spray
- Be careful not to disturb until misted wet down
- Remove spray & backside of material wet down
- Bag and be gone.
- Soap and water cleanup

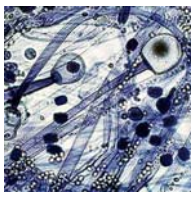
Is containment necessary?
- Depends on risk
- Portable filters always help dilute

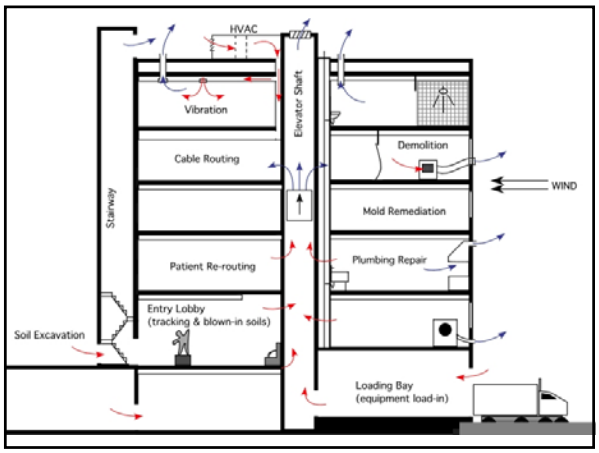
Aerodynamic spore
2-4µm diameter

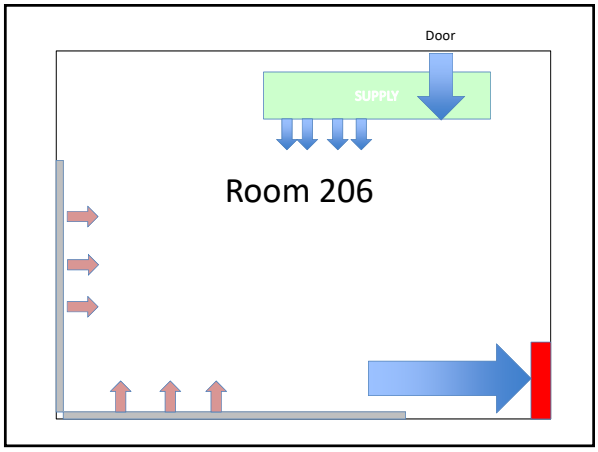
Aspergillus fumigatus
- prolific spore production

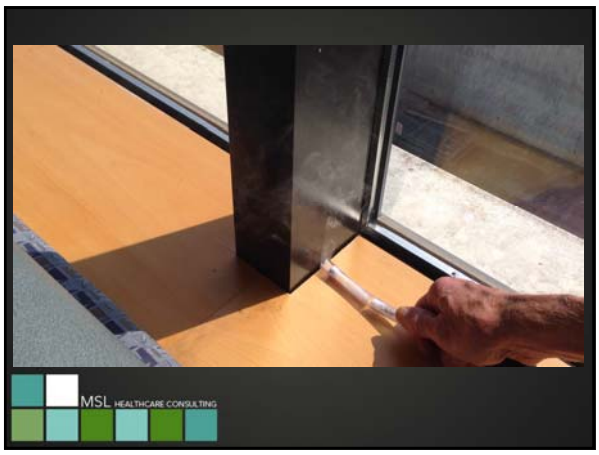
Changing fungal agents.

Mucor & Rhizopus can reproduce with mycelial fragments as well as with spores.
Often associated with dust

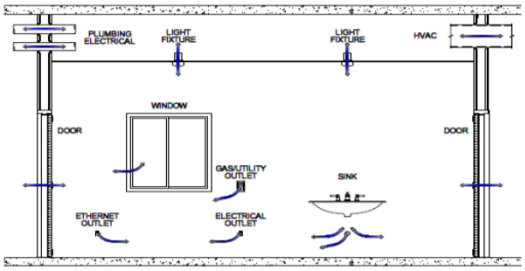



HVAC
Vibration
Elevator Shaft
Cable Routing
Demolition
WIND
Stairway
Mold Remediation
Patient Re-routing
Plumbing Repair
Entry Lobby
(tracking & blown-in soils)
Soil Excavation
Loading Bay
(equipment load-in)


Door
SUPPLY
Room 206


MSL HEALTHCARE CONSULTING

Patient Mock-up Room Leakage Application Overview



Why should we seal rooms anyway??

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

17

Ventilation:

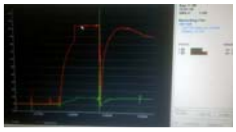
Mock Up Testing

Blower doors allow for leakage testing by applying pressure and using smoke stick to find leaks for sealing

18

Finding leakage points in rooms helps assure consistent pressure management

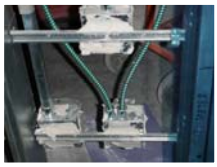


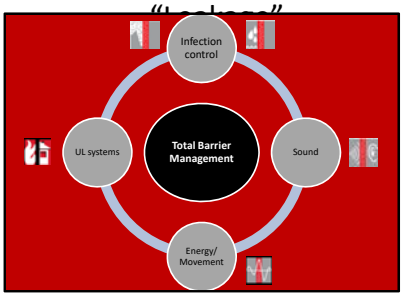
A sealed room has two advantages:
-controlled sound movement
-ventilation control for infectious disease management

Room Seal Necessary for Special Ventilation Management

- Cracks can result in room air leakage.
- Supply air volume differential allows for airflow direction control.
- Low pressure differential can result in airflow reversal.
- Substantial room pressure design should provide a sealed "vessel".
- Design criteria are necessary for control.

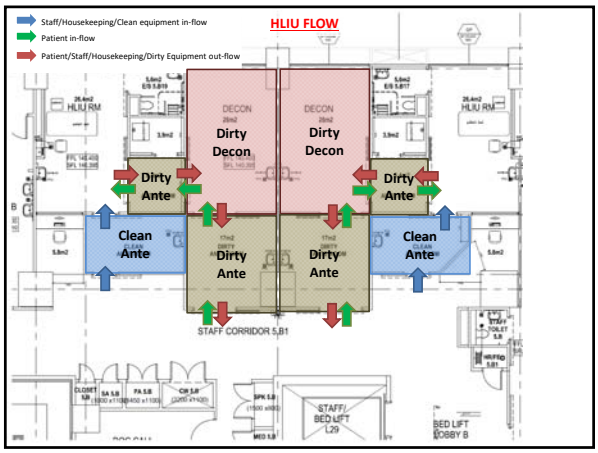



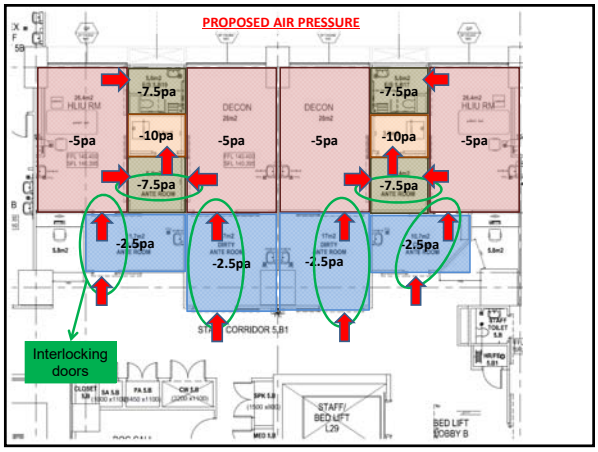
Case Study- Barrier Management "Leakage"

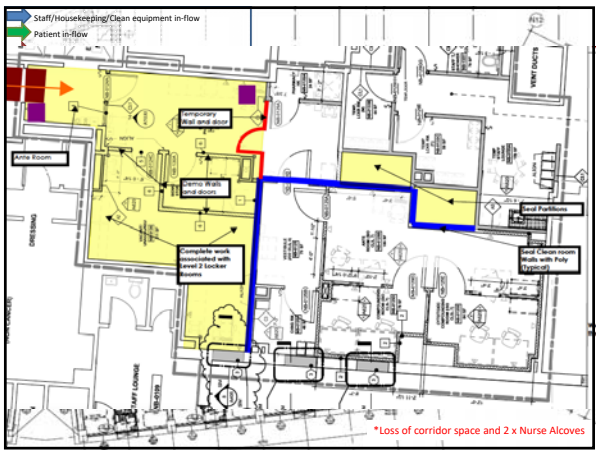


Total Barrier Management practices increase build integrity beyond UL systems with additional secondary attributes

DISCLOSURE HILTI SPONSORED STUDY


Staff/Housekeeping/Clean equipment in-flow
Patient in-flow
Patient/Staff/Housekeeping/Dirty Equipment out-flow
HLIU FLOW
Dirty Decon
Dirty Decon
Dirty Ante
Dirty Ante
Clean Ante
Clean Ante
Dirty Ante
Dirty Ante
STAFF CORRIDOR 5,B1


PROPOSED AIR PRESSURE
-7.5pa
-7.5pa
-5pa
-10pa
-5pa
-5pa
-10pa
-5pa
-7.5pa
-7.5pa
-2.5pa
-2.5pa
-2.5pa
-2.5pa
Interlocking doors
STAFF CORRIDOR 5,B1


Staff/Housekeeping/Clean equipment in-flow
Patient in-flow
*Loss of corridor space and 2 x Nurse Alcoves

Barrier containment variation

PRECAUTIONS DURING CONSTRUCTION

INDOOR PROJECTS (RENOVATION)	OUTDOOR PROJECTS (NEW)
Employee training	Employee training
Barrier management	Dust control
Water damage	Noise and vibration
Demolition precautions	Pest control
Dust migration and control	Building material storage
Debris and material transport	Water damage management
Access routes to work area	Sanitation and break areas
Outages (electrical and plumbing)	Tie in building issues
Portable filter usage	Commissioning-air & water
Noise and vibration	Shell spaced-build out
Sanitation and break areas	
Commissioning -air & water	
Communication	Communication
Emergency response	Emergency response
Water damage reporting	Water damage reporting
Changing work phases	Material crane location
ICRA precautions during occupancy	Changing ICRA precautions pre occupancy
Water Quality	Water Quality
Stagnant water flushing	Stagnant water flushing
Testing water requirements	Testing water requirements
Punch list	Punch list
Critical sinks drinking water	Critical sinks drinking water

DOODY MECHANICAL

Minaforce II HEPA Air Filtration System

Inspection, Cleaning, and Maintenance Procedure for the UMCHF Project

The Minaforce II HEPA Air Filtration System is a unit dedicated to hospital working environments only. The care, inspection, cleaning, and maintenance is integral to the function of this equipment.
**Please refer to the following pages for the manufacturer's owner's manual.

Inspection:

A visual inspection of the negative air machine (NAM) will be conducted prior to each use and prior to transportation entering and exiting the hospital environment.

Visual inspection will verify:
- Appearance/external cleanliness of NAM is appropriate to enter and exit the hospital environment.
- Primary filter is clean, in order to limit dust exposure to the hospital environment.
- All other external components are clean, in order to limit dust exposure to the hospital environment.

Cleaning:

The NAM will be cleaned prior to transportation entering and exiting the hospital environment. All external components will be cleaned prior to transportation

Cleaning within the hospital environment:
- NAMs will only be cleaned within the temporary enclosure.
- NAMs and filters will be cleaned with HEPA Vacuums.
- NAMs will be cleaned with a non-bleach disinfectant agent (UMCHF encourages us to use their disinfectant).

Maintenance:

NAM maintenance will occur outside the hospital environment, within a temporary enclosure of the hospital environment, or a designated maintenance area approved by the hospital.

Filter Replacement:
- When filters are clean, the pressure gauge will indicate about 1" WC of vacuum. When the vacuum gauge reaches about 1.5" WC with a clean pre filter, the HEPA filter will need to be replaced.
- Due to differing work environments, the need to clean and/or change the pre filter and HEPA filter will be determined by the foreman and/or employees involved with the operation.

Filter Disposal:
- All used filters will be contained in a sealed bag and removed from the hospital facility.

This procedure is paid for by as part of the project for the mechanical contactor to properly maintain the portable filters during the interface of a tie in project.

Control Airborne-Projects

- Pressure management
  - Barrier airflow control
  - > 0.01"wg (>2.5 Pascals)
  - Ideal (btwn 5 - 8 Pascals)
- Transport
  - Personnel and materials
  - Track dirt
- Water damage protocols
  - Water resistant materials
  - Early detection
- Training
  - Supervisors and workers
  - Area tenants

AIHce 2004 - Streifel & Wideman

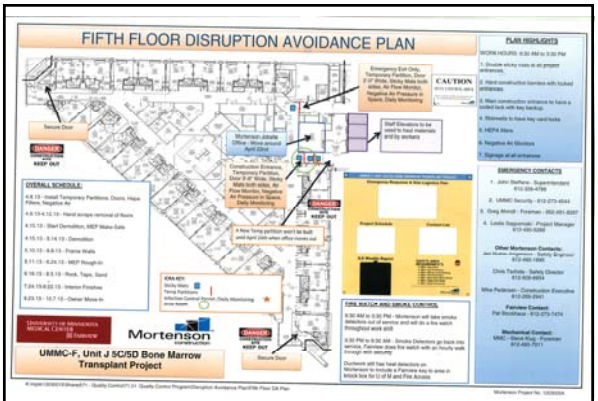
SOURCE MANAGEMENT

What do you do when you discover mold?

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

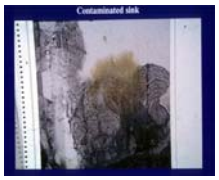
Dialysis cabinet in ICU

Pump with copper 8 quinolinolate



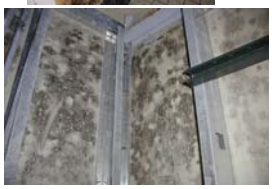
IC CONSIDERATION EXAMPLES

Cleanup Concerns



MOLD SOURCES
ARE COMMON

CONTROL PREVENTS
INFECTION &
OTHER ISSUES



HOW SHOULD A HOSPITAL MANAGE MOLD?

Managing aerosol presents challenges for construction in hospitals.

Routine cleaning helps maintain aerosol control necessary for safe patient care during construction.

New York City Guidelines for levels of mold management and PPE requirements

Level	Area type	Example	PPE requirements
1	Small isolated areas, 10 sq.ft. or less	Ceiling tiles,small areas on walls	N95 respirator, gloves, eye protection
2	Midsize isolated areas, 10-30 sq.ft.	Individual wallboard panels	N95 respirator, gloves, eye protection
3	Large isolated areas, 30-100 sq.ft.	Several wallboard panels	N95 respirator, gloves, eye protection
4	Extensive contamination, greater than 100 contiguous sq.ft. in an area	Faulty building designs, improper building material installation, condensation from high humidity environments, buildings affected by natural disaster	Full-face respirator with HEPA cartridges for mold, disposable protective clothing covering head, hands, and shoes

Portable containment on BMT unit

Portable HEPA unit

Protect floors and minimize track dirt

PORTABLE FILTERS CAN BE FUN?!?!!

Employee training & understanding important to avoid exposure to airborne opportunistic microbes.

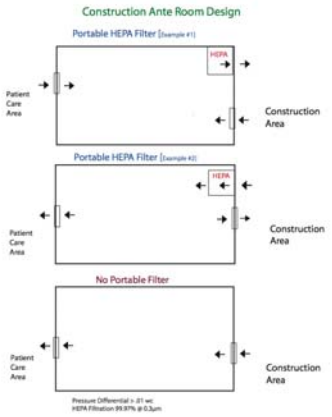
HOW NOT TO USE THE PORTABLE HEPA MACHINE

Criteria for Portable Filter Certification

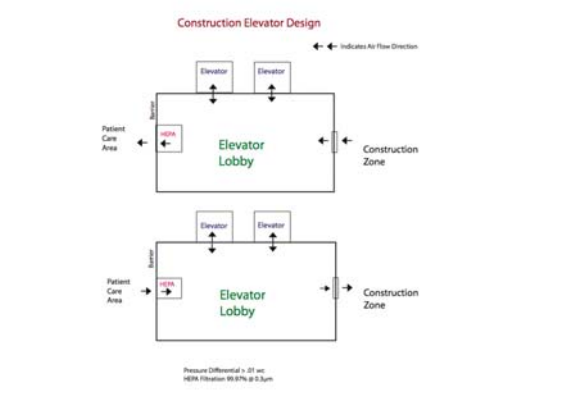
- Policies and Procedures for usage
  - -discharge of air modes
    - outside, inside adjacent & recirculate in room
- portable filters should be routinely evaluated
  - -volume output should be determined
    - Q=VA
  - -leak check for filter
    - 16 locations over output area
  - -criteria for filter change
    - pressure differential or volume of filter output
  - -maintenance
    - storage, pre filter change & cleaning

ISOLATION OF A SUITE OF ROOMS FOR AIRBORNE ISOLATION

Parts of hospitals are set aside for construction or infectious patients when needed.



Ante Room usage is useful when pressures are hard to control due to circumstances.



Managing aerosol presents challenges for construction in hospitals. Noise and vibration are also a major concern in healthcare construction.

Routine cleaning helps impress cleanliness necessary for safe patient care during construction.

Exhaust systems need to reinforce
Flex duct to avoid pressure issues

What method is best for exhausting air from a construction zone.

The ducted exhaust advantages
*control
The direct exhaust advantages
*no duct loses

Disadvantages
No one is paying attention!

Have you seen this before?

•air handler door propped open
•what does this do to the air supply?
•what might this indicate as a problem?

Lots of Puddles!!

Best Practice

Consider code and noise issues with caulk under the gypsum board

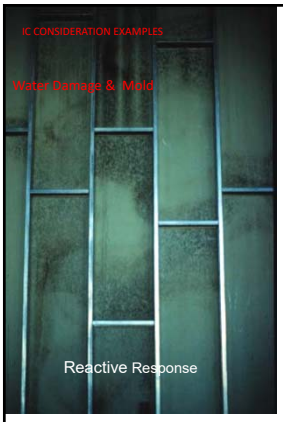
Keep the rock off the slab!

Specification:
•Do not install wet GB
•Protect GB from WD & Extreme climate

Storage of gyp board should provide protection from water damage

IC CONSIDERATION EXAMPLES

Water Damage & Mold



What is the difference in these shaft walls?

-Luck?
-Better materials?
-Construction Implementation?
-All of the above?

IC CONSIDERATION EXAMPLES

Construction Management Proactive Issues

Proactive and reactive response to water damage.

•Water & mold resistant gypsum board
•Sanitation
•Break areas

What can happen with these conditions?

Each condition by itself and combined can cause infiltration.

Storage of Debris and Building Material a Challenge

Shrink wrapping protects the air handling system components during transport to the job site.

When the wrapping is broken the material should be replaced to avoid dust buildup.