

**PREVENTION OF INVASIVE
FUNGAL INFECTIONS
FOCUS ON CDC/HICPAC
RECOMMENDATIONS IN
CONSTRUCTION AND RENOVATION**

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CAUTION
**AREA UNDER
CONSTRUCTION**



**AUTHORIZED
ENTRY ONLY
CONSTRUCTION
HAZARDS**

LECTURE TOPICS

- **Examples of outbreaks**
- **Construction and renovation guidelines**
- **Infection prevention's role in construction and renovation**

INVASIVE FUNGAL INFECTIONS

- Outbreaks occur in healthcare settings
- Commonly amongst immunocompromised patients
- Outbreaks related to construction and renovation in reported in literature
- Outbreaks not related to construction reported in literature
- Mortality related to construction related fungal infection is approximately 50%
- Commonly causes pulmonary infection, but can cause other infections

UNDERLYING CONDITIONS IN PATIENTS WITH HEALTHCARE ASSOCIATED ASPERGILLOSIS

	No. of Patients	Mortality (%)
Hematologic malignancy	299	57.6
Solid organ transplant		55.9
<ul style="list-style-type: none"> ● Renal transplant ● Liver transplant 	36 8	
Other immunocompromised		52.3
<ul style="list-style-type: none"> ● High-dose steroid therapy ● Neonates ● Other malignancy ● Chronic lung disease ● ICU patients ("high-risk") ● No exact classification possible 	15 5 4 2 2 49	
Patients without severe immunodeficiency		39.4
<ul style="list-style-type: none"> ● Thoracic surgery ● Cataract surgery ● ICU patients ("low risk") ● Other surgery patients 	25 5 5 3	
TOTAL	458	55.0

EXAMPLES OF OUTBREAKS

Year-Author	Organism	Population	Epidemiologic Factors	Remedial/ Preventive Measures
2008, Garner & Machin	Mucormycosis	Pediatric oncology units (2 patients 0% mortality)	Leak in shower near linen room closest to where both infected patients were housed	Leak fixed; mold remediation; prophylaxis for 15 high risk patients
2014, Duffy et al.	<i>Rhizopus</i> – cutaneous infections	Pediatric hospital (5 patients 100% mortality)	After very exhaustive investigation, only common exposure was hospital linen; <i>Rhizopus</i> was recovered from 42% of environmental samples	Linen supply company changed; delivery site changed for clean linen; sterilized linens used for very high risk population for short period of time (neonates, extreme prematurity)
2015, Cheng et al.	<i>Rhizopus microsporus</i>	HSCT patients (pulmonary & cutaneous) (6 patients 50% mortality)	Linen was implicated	Changed laundry providers

EXAMPLES OF OUTBREAKS RELATED TO CONSTRUCTION/RENOVATION

Year-Author	Organism	Population	Epidemiologic Factors	Remedial/ Preventive Measures
1990, Fox et al.	<i>Penicillium</i> sp. <i>Cladosporium</i> sp.	OR	Ventilation duct lined with contaminated fiberglass insulation	Decontamination of HVAC ductwork; filter replacement
1992, Hruszkewycz et al.	<i>Penicillium</i> sp. <i>Aspergillus</i> sp.	Laboratory pseudo-outbreak	Improper airflow during renovation near lab; false ceiling	Sealed ceilings; proper use of hoods and appropriate airflow controls
1994, Iwen et al.	<i>Aspergillus</i> sp. Mixed fungi	BMT unit	Improper airflow; suspected infiltration from windows	Sealed windows and balanced airflow; replaced HEPA filters
1995, Anderson et al.	<i>Aspergillus</i> sp.	Pediatric oncology unit	Improper airflow from clinical waste disposal room	Sealing of disposal room and use of HEPA filtered vacuum cleaners

TYPICAL CONSTRUCTION/RENOVATION SITE



RELEVANT GUIDELINES

- 2003: Guidelines for preventing health-care-associated pneumonia (HICPAC)
- 2003: Guidelines for environmental infection control in health-care facilities (CDC, HICPAC)
- 2000: Guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients (CDC, IDSA, ASBMT)
- Guidelines for design and construction of Health Care Facilities. The Facility Guidelines Institute (FGI), 2010
- Construction and Renovation, 3rd Edition, and Infection Prevention for Construction DVD, Association for Professionals in Infection Control and Epidemiology, 2007
- APIC Text of Infection Control and Epidemiology, 3rd ed. Association for Professionals in Infection Control and Epidemiology, 2009.
- ASHRAE - American Society of Heating, Refrigeration and Air Conditioning Engineers

ABBREVIATIONS

- **ANC: Absolute neutrophil count**
- **HICPAC: Healthcare Infection Control Practices Advisory Committee**
- **HSCT: Hematopoietic stem cell transplant (i.e. bone marrow transplant)**
- **IDSA: Infectious Disease Society of America**
- **PE: Protective environment**

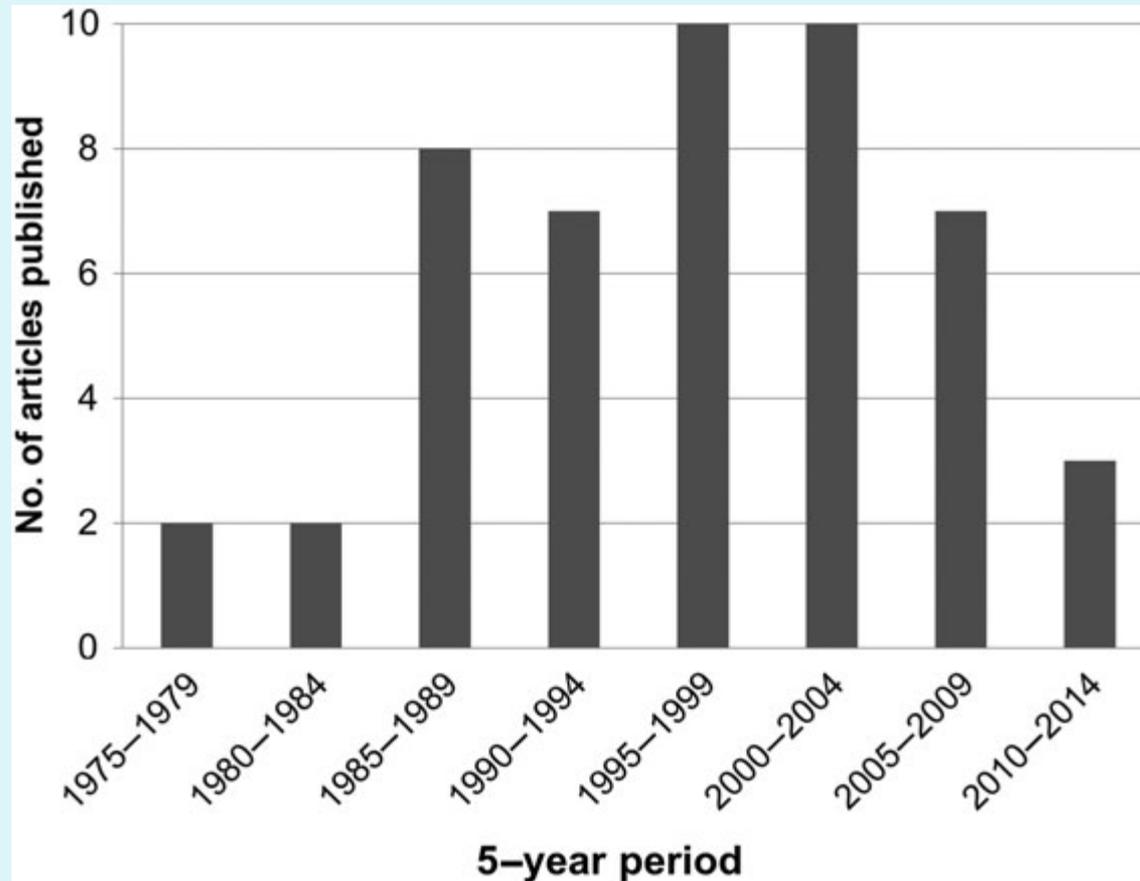
LIMITATIONS OF GUIDELINES

- Largely based on outbreak investigations
- Corollaries of above
 - Focus is on preventing epidemic infections (rather than sporadic infection)
 - Recommendations often not based on randomized clinical trials
 - Focus on preventing infection in HSCT patients in protected environment

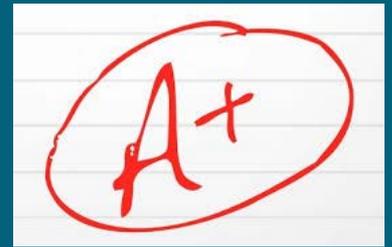
MOST COMMON PATHOGENS ASSOCIATED WITH CONSTRUCTION OR RENOVATION OUTBREAKS

- *Aspergillus* spp. (by far most important)
- Zygomycetes
- Other fungi
- Miscellaneous

TREND OF FUNGAL OUTBREAKS & INFECTIONS ASSOCIATED WITH CONSTRUCTION



CDC/HICPAC RECOMMENDATIONS: GRADING OF RECOMMENDATIONS



- **IA:** Strongly recommended for implementation and strongly supported by well-designed experimental, clinical, or epidemiologic studies
- **IB:** Strongly recommended for implementation and supported by some clinical or epidemiologic studies and by strong theoretical rationale.
- **IC:** Required for implementation, as mandated by federal or state regulation or standard.
- **II:** Suggested for implementation and supported by suggestive clinical or epidemiologic studies or by strong theoretical rationale.
- **No recommendation; unresolved issue:** Practice for which insufficient evidence or not consensus exists about efficacy

SURVEILLANCE¹



- Maintain a high index of suspicion for healthcare-associated pulmonary aspergillosis in severely immunocompromised patients (ANC $<500/\text{mm}^3$ for 2 weeks or $<100/\text{mm}^3$ for 1 week){IA}
- Surveillance cultures
 - Do NOT perform routine, periodic cultures of nasopharynx {IB}
 - Do NOT perform routine, periodic cultures of equipment or devices used for respiratory therapy, PFTs, or dust in rooms of HSCT recipients {IB}
 - NO recommendation for routine microbiologic air sampling before, during, or after facility construction or renovation {Unresolved}
- Perform routine surveillance of the ventilation status of PEs: room air exchanges, pressure relations, filtration efficacy {IB}

¹Tablan OC, et al. Guidelines for preventing health-care-associated pneumonia, 2003



CONSTRUCTION OR RENOVATION¹

- When planning construction, demolition, and renovation activities in and around the facility, assess whether patients at high-risk for aspergillosis are likely to be exposed to high ambient-air spore counts of *Aspergillus* spp., and if so develop a plan to prevent such exposure {IA}
- During construction, demolition, or renovation activities construct impermeable barriers between patient-care and construction areas to prevent dust from entering the patient-care areas {IB}
- Direct pedestrian traffic that come from construction areas away from patient-care areas to limit the opening and closing of doors or other barriers that might cause dust dispersion {IB}

¹Tablan OC, et al. Guidelines for preventing health-care-associated pneumonia, 2003



CONSTRUCTION OR RENOVATION¹

- Establish a multidisciplinary team that includes infection-control staff to coordinate demolition, construction and renovation {IB, IC}
- Educate construction and healthcare staff in immunocompromised patient-care areas regarding airborne infection risks associated with construction and preventive measures {IB}
- Incorporate mandatory adherence agreements for infection control into construction contracts {IC}
- Establish and maintain surveillance for airborne environmental disease (e.g., aspergillosis) as appropriate during construction {IB}

¹Guideline for environmental infection control in health-care facilities, 2003

BUNDLE OF KEY METHODS FOR PREVENTING FUNGAL INFECTIONS ASSOCIATED WITH CONSTRUCTION

- Notification of infection control by plant engineering prior to any renovation/construction activities in the healthcare facility
- Conduct an infection control risk assessment (ICRA) for all renovation/construction activities and implement recommended prevention strategies as guided by the ICRA
- Focus prevention efforts on control of airborne dissemination of fungal spores (e.g. barriers, containment, air handling, portable HEPA filters)
- Consider impact of construction on the involved hospital unit and adjacent units on the same floor and units on the floors above and below the construction activities
- Maintain surveillance for healthcare-associated filamentous fungal infections. Investigate any cases to see if they are related to construction and determine if prevention efforts need to be revised.
- Visit renovation/construction sites regularly to assure compliance with recommended prevention activities.

INFECTION CONTROL RISK ASSESSMENT (ICRA)

- ICRA is an multidisciplinary, organizational, documented process that after considering the facility's patient population and program:
 - Focuses on reduction of risk from infection
 - Acts through phases of facility planning, design, construction, renovation, facility maintenance and
 - Coordinates and weights knowledge about infection, infectious agents, and care environment permitting the organization to anticipate potential impact



STEP 1: IDENTIFY TYPE OF CONSTRUCTION PROJECT

TYPE A	<p>Inspection and Non-Invasive Activities. Includes, but is not limited to:</p> <ul style="list-style-type: none">▪ removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet▪ painting (but not sanding)▪ wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	<p>Small scale, short duration activities which create minimal dust Includes, but is not limited to:</p> <ul style="list-style-type: none">▪ installation of telephone and computer cabling▪ access to chase spaces▪ cutting of walls or ceiling where dust migration can be controlled.

STEP 1: IDENTIFY TYPE OF CONSTRUCTION PROJECT

TYPE C	<p>Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies</p> <p>Includes, but is not limited to:</p> <ul style="list-style-type: none">▪ sanding of walls for painting or wall covering▪ removal of floorcoverings, ceiling tiles and casework▪ new wall construction▪ minor duct work or electrical work above ceilings▪ major cabling activities▪ any activity which cannot be completed within a single workshift.
TYPE D	<p>Major demolition and construction projects</p> <p>Includes, but is not limited to:</p> <ul style="list-style-type: none">▪ activities which require consecutive work shifts▪ requires heavy demolition or removal of a complete cabling system▪ new construction.

STEP 2: IDENTIFY PATIENT RISK

Low Risk	Medium Risk	High Risk	Highest Risk
<ul style="list-style-type: none"> ▪ Office areas 	<ul style="list-style-type: none"> ▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy 	<ul style="list-style-type: none"> ▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Medical Units ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units 	<ul style="list-style-type: none"> ▪ Any area caring for immunocompromised patients ▪ Burn Unit ▪ Cardiac Cath Lab ▪ Central Sterile Supply ▪ Intensive Care Units ▪ Negative pressure isolation rooms ▪ Oncology ▪ Operating rooms including C-section rooms

STEP 3: MATCH RISK GROUP WITH CONSTRUCTION TYPE

Patient Risk Group	Construction Project Type			
	TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that **Class III** or **Class IV** control procedures are necessary.

INFECTION CONTROL BY CLASS

	During Construction Project	Upon Completion of Project
CLASS I	<ol style="list-style-type: none"> 1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection 	<ol style="list-style-type: none"> 1. Clean work area upon completion of task.
CLASS II	<ol style="list-style-type: none"> 1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed. 	<ol style="list-style-type: none"> 1. Wipe work surfaces with cleaner/disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Upon completion, restore HVAC system where work was performed.

INFECTION CONTROL BY CLASS

During construction

1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system.
2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins.
3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
4. Contain construction waste before transport in tightly covered containers.
5. Cover transport receptacles or carts. Tape covering unless solid lid.

After construction

1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Department.
2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction.
3. Vacuum work area with HEPA filtered vacuums.
4. Wet mop area with cleaner/disinfectant.
5. Upon completion, restore HVAC system where work was performed.

CLASS III

INFECTION CONTROL BY CLASS

During construction

1. Isolate HVAC system in area where work is being done to prevent contamination of duct system.
2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins.
3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units.
4. Seal holes, pipes, conduits, and punctures.
5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site.
6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area.

After construction

1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Dept.
2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction.
3. Contain construction waste before transport in tightly covered containers.
4. Cover transport receptacles or carts. Tape covering unless solid lid.
5. Vacuum work area with HEPA filtered vacuums.
6. Wet mop area with cleaner/disinfectant.
7. Upon completion, restore HVAC system where work was performed.

OTHER STEPS

- **Identify areas surrounding the project area, assess impact**
- **Identify the specific sites of activity (e.g., patient rooms)**
- **Identify issues related to: ventilation, plumbing, electrical in terms of possible outages**
- **Identify containment measures using prior risk assessment**
- **Consider possible water damage**
- **Work hours: Can work be done during non-patient care hours?**
- **Develop plans for the proper handwashing sinks**
- **Develop plans for use of clean and soiled utility rooms**
- **Communicate with project team: traffic flow, housekeeping, debris removal**

UNC HEALTH CARE PLAYROOM RENOVATION ICRA

Complete the Infection Control Matrix to Determine the Class of Precautions

Construction Activity

Type of activity: • TYPE C: Activity generates moderate to high levels of dust, requires greater than 1 work shift for completion

Infection Control Risk Group

Risk group: • GROUP 3: Medium/High Risk

Classification of Required Preventive Measures

Construction Activity

Patient Risk Group: • Class III = (Type B + Highest Risk), (Type C + Medium, High, Highest), (Type D + Low Risk)

CLASS III

- Execute work by methods to minimize raising dust from construction operations.
- Replace any ceiling tile displaced for inspection immediately when unattended if outside construction barrier.
- Construction workers should use elevators designated “for staff use.”
- Obtain signed risk assessment from Hospital Epidemiology before work begins.
- Provide active means to prevent airborne dust from dispersing into air. Complete all critical barriers before construction begins.
- Remove or isolate HVAC system in areas where work is being performed to prevent contamination of duct system. Negative or neutral pressure in work site is preferred.
- Block off and seal air vents. Seal unused doors with duct tape.
- Water mist work surfaces to control dust while cutting.
- **Contain construction waste before transport in covered containers.**
- Keep dust and accumulated dirt in the work site to a minimum. Use disinfectant to wipe soiled or dusty surfaces. Keep area around the site clean. Wet mop with disinfectant to minimize dust and debris in and around work site. Use HEPA filtered vacuum when vacuuming.
- **Place dust control mat at entrance and exit of work site, cover sufficient area so both feet contact the mat. Replace or clean when no longer effective.**
- Remove barrier materials carefully to minimize spreading dirt or debris from construction area.
- Environmental services performs final cleaning prior to job being turned over to owner.
- Class III projects lasting longer than 1 month require solid, not plastic barriers.
- Seal holes, pipes, conduits and punctures appropriately.
- **Maintain negative pressure within the work site and utilize HEPA equipped air filtration units.**
- If construction supplies or materials are visibly dusty, cover them during transport into the facility and work site.

PLANS



**CONSTRUCTION
AREA**

AUTHORIZED PERSONNEL ONLY

PROJECT NAME: *Play Atrium*
PROJECT MANAGER: *Mark Buckalew*
CONTRACTOR: *Lomax*

EMERGENCY NUMBERS

HOSPITAL POLICE 984-974-3686
ENVIRONMENTAL HEALTH & SAFETY 919-962-5507

PLEASE EXCUSE OUR PROGRESS

UNC HOSPITALS PLANT ENGINEERING

IF QUESTIONS OR CONCERNS, PLEASE CALL:

984-974-0320 7:00 AM - 4:00 PM
984-974-0300 ALL OTHER TIMES

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Notice:

pp. Secretary

TO BE MAINTAINED



The Play Atrium will be
CLOSED
for renovation through
March

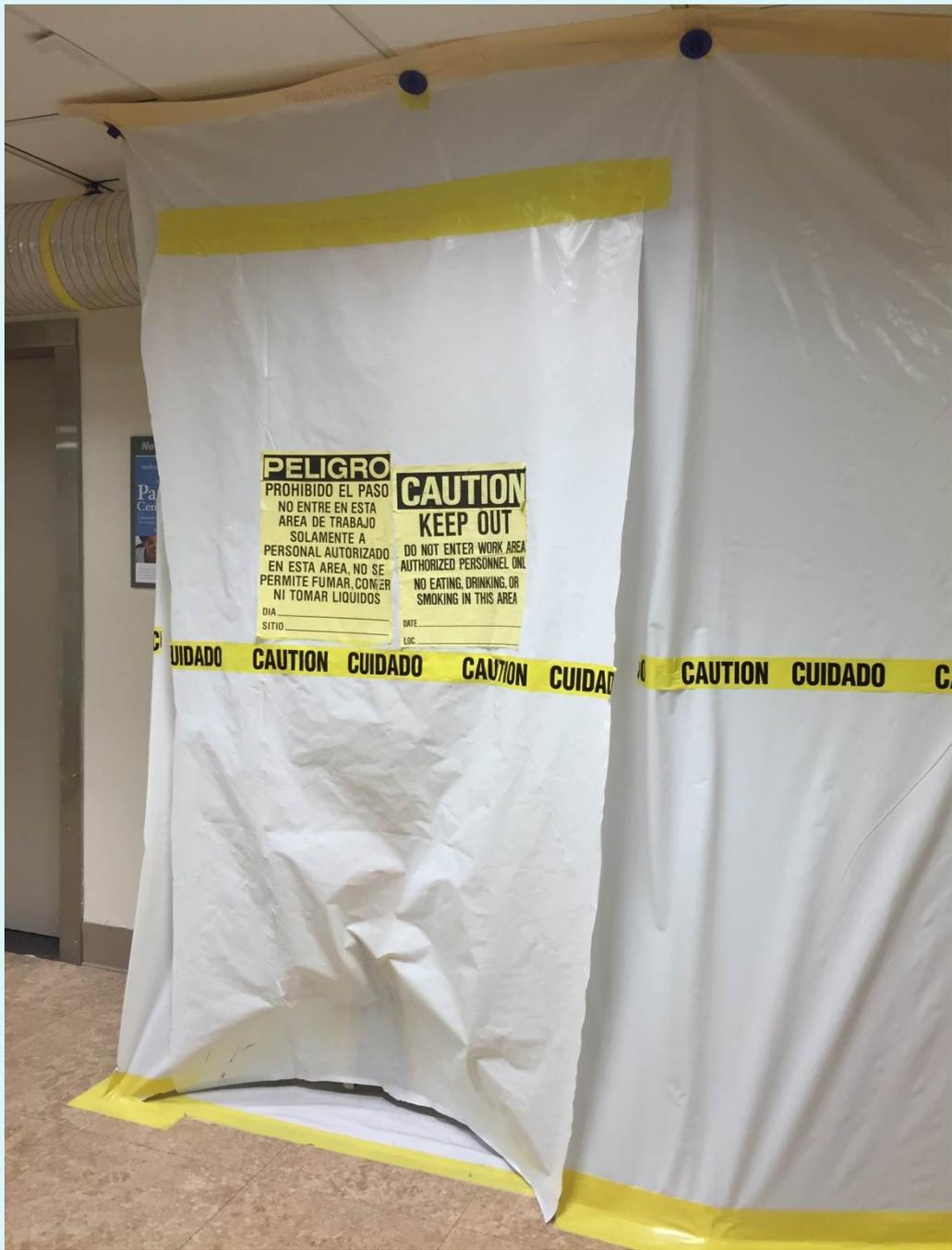
CONTROL ROOM
AREA
AUTHORIZED PERSONS ONLY
Please do not enter
without permission
PLEASE DO NOT ENTER

DO NOT ENTER
STOP
THIS ROOM IS CLOSED

PLAY
ATRIUM







PELIGRO

PROHIBIDO EL PASO
NO ENTRE EN ESTA
AREA DE TRABAJO
SOLAMENTE A
PERSONAL AUTORIZADO
EN ESTA AREA. NO SE
PERMITE FUMAR, COMER
NI TOMAR LIQUIDOS

DIA _____
SITIO _____

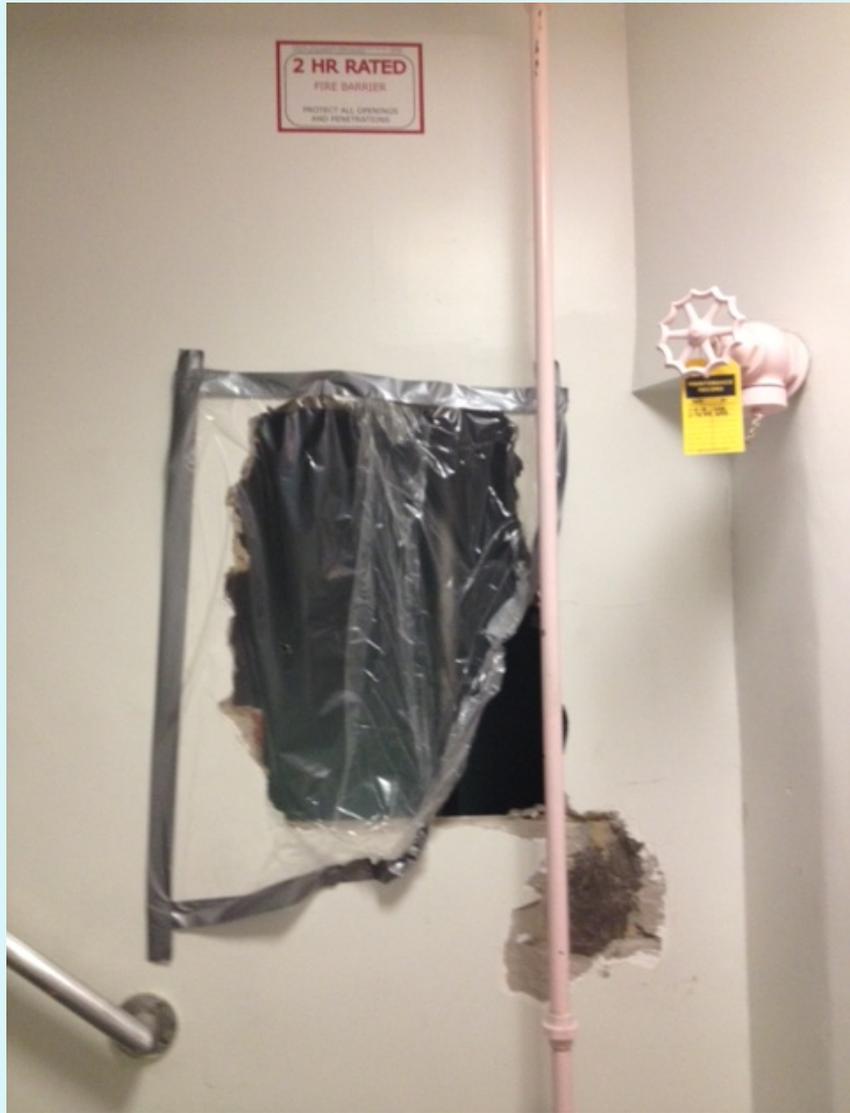
**CAUTION
KEEP OUT**

DO NOT ENTER WORK AREA
AUTHORIZED PERSONNEL ONLY
NO EATING, DRINKING, OR
SMOKING IN THIS AREA

DATE _____
LOC _____

CAUTION CUIDADO CAUTION CUIDADO CAUTION CUIDADO

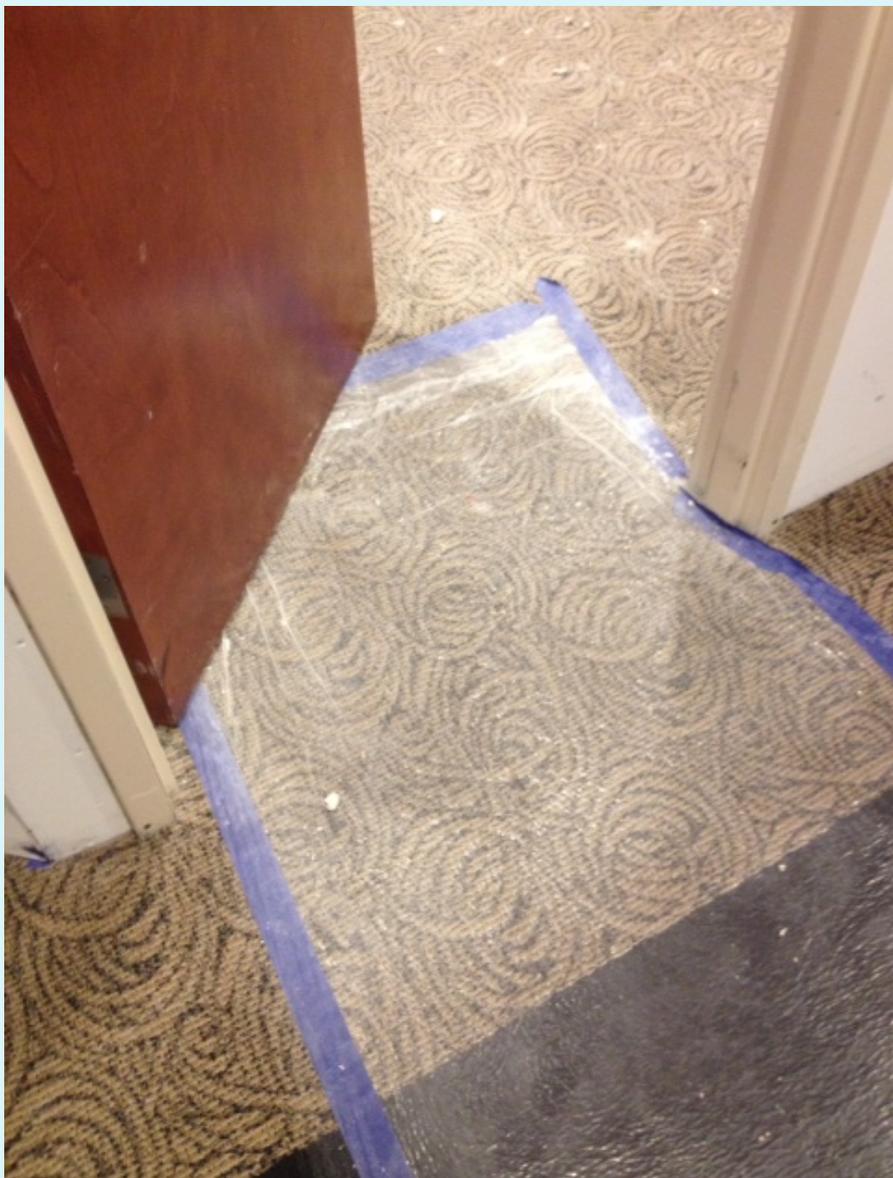




2 HR RATED
FIRE BARRIER
PROTECT ALL OPENINGS
AND PENETRATIONS

Fire Alarm Pull Station
Tag







“The Sky Is Falling!” Ceiling Openings and Infection Prevention Precautions

- Plant Engineering/Maintenance Department or contract workers occasionally must enter ceilings to perform repairs or maintenance.
- This process involves removal of ceiling tiles to gain access to the ceiling crawl space.
- The removal of such tiles has been documented as a risk factor for the acquisition of infection with fungal spores (i.e., *Aspergillus* sp., *Mucor* sp.) by immunocompromised patients.
- Such acquisition may lead to serious pulmonary and/or systemic infection.
- Hospital employees, unless on immunosuppressive medication, are at no increased risk.
- Investigations at UNC Hospitals have shown that removing our ceiling tiles leads to an increased number of fungal spores in the immediate environment.
- All individuals opening a ceiling must do so in accordance with these Infection Prevention guidelines to include:
 - Immediately prior to beginning ceiling work in a patient care area, the contractor should consult the charge nurse, so she/he can assess the potential impact of the work on immunocompromised patients in the area and ensure that patients are in their rooms and doors are closed.
 - No patients should be housed in rooms where ceiling work is being conducted or where ceiling tiles have been removed.
 - During the period in which tiles have been removed and work is being done, all immunocompromised patients should wear a tight-fitting surgical mask or N95 mask that covers the mouth and nose *when in the area of the ceiling opening*.
 - Thorough cleaning following all work should be done by Environmental Services before patients are allowed to remove their masks.
 - If ceiling work involves construction or renovation, plastic barriers should be used.
- Prior approval by Hospital Epidemiology is necessary prior to any ceiling work within highest risk areas* or ceiling work in an occupied patient room (with a non-immunocompromised patient).
- Studies performed by Hospital Epidemiology have demonstrated that placing plastic barriers around workers entering the ceiling in hallways is not always necessary as long as: the patient room door is closed, the work does not involve destruction of materials and the work is performed with care, so as to minimize the dispersal of dust and debris.
- In highest risk areas, Hospital Epidemiology in collaboration with Plant Engineering and the nurse managers will assess the need for plastic barriers prior to beginning the ceiling work.

*Highest risk areas: Any inpatient area housing immuno-compromised patients (i.e., BMTU, all ICUs, burn floor [5 East], solid organ transplant floors [CTSU, SWST, ISCU], Oncology [4ONC], Pediatric Oncology [5CH]), Step-down Units, Cardiac Cath Lab, VIR, Dialysis, Central Processing, Negative pressure isolation rooms, Operating rooms, PACU, Transplant Clinic, BMTU Clinic

SUMMARY

- Outbreaks of aspergillosis and other fungi continue to occur in US healthcare facilities
- Highly immunocompromised patients are at highest risk
- Most are related to construction and renovation
- Appropriate implementation of CDC/HICPAC guidelines can prevent healthcare-associated infection
- Use of ICRA is a logical method to plan for construction and renovation projects

THANK YOU

