Risk Assessment & Actions to Prevent Infections during Renovation & Construction

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Background

Hospitals are “always” being renovated

- complex structures with heating, cooling, ventilation needs to maintain or update
- growing patient volume
- inefficiencies realised
- patient expectation
- For price, renovation generally preferred over construction

Construction and renovation allows for dispersal of airborne pathogens

- most relevant in a susceptible host (discussed this afternoon)
- most significant with high concentration of organisms in the air; esp fungi (surveillance)

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Background

ELSEVIER

Journal of Hospital Infection
Volume 63, Issue 3, July 2006, Pages 246-254

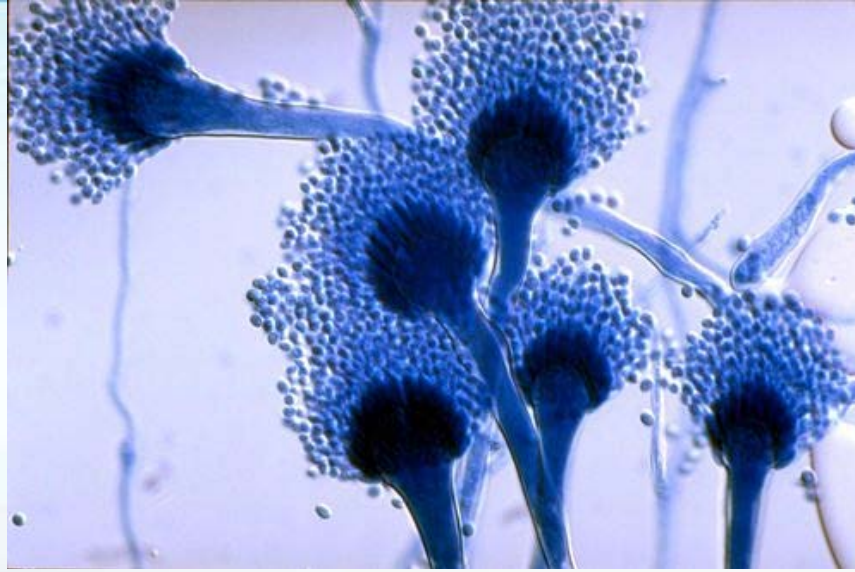
Review

Nosocomial aspergillosis in outbreak settings

R-P. Vonberg, P. Gastmeier

- 53 studies with 458 patients
- 356 patients (78%) lower respiratory tract
- Aspergillus fumigatus (154) and A. flavus (101)
- Underlying disease-haemotologic malignancies 299 (65%)
- Overall fatality rate in these 299 patients (57.6%)
- Construction or demolition probable/possible source in 49%;
- virtually all outbreaks attributable to airborne source, usually construction

Background; Aspergillus



- Aspergillus spores are ubiquitous (soil, dust, decaying organic matter)
- Asexual spores (conidia) may travel long distances as airborne particles and are inhaled by humans (eg around 200/d on average)
- In most healthy persons, spores are removed by innate immune mechanisms (macrophages)
- Severely immunocompromised (IC) hosts (hematologic, solid organ transplant) a serious complication

Overview

Major considerations before initiating construction, repair or renovation

1.design and function of the new structure or area
2.assessment of environmental risks for airborne disease and opportunities for prevention, and
3.measures to contain dust and moisture during construction or repairs.

Construction design and function considerations for environmental infection control (IPC checklist)

- Location of sinks and dispensers for handwashing products and hand hygiene products
- Location of fixed sharps containers
- Types of faucets (e.g. aerated vs. non-aerated)
- Appropriate materials for sinks and wall coverings
- Well-caulked walls with minimal seams
- Appropriate flooring (e.g. seamless floors in some areas)
- Sensible use carpeting (e.g. avoiding use of carpeting in clinical areas or areas likely to become wet)
- Types of surface finishes (e.g. porous vs. non-porous)

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Construction design and function considerations for environmental infection control (IPC checklist)

- Air-handling systems engineered for performance, maintenance and repair
- ACH and pressure differentials to accommodate special patient-care areas
- Location of adequate storage and supply areas
- Location of medicine preparations areas
- Location and type of ice machines
- Traffic flow (e.g. no “dirty” movement through “clean” areas)
- Isolation rooms with anterooms as appropriate
- Convenient location of soiled utility areas
- Properly engineered areas for linen services and solid waste management
- Location of main generator to minimize the risk of system failure from flooding or other emergency

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Risk Assessment

- Infection-control risk assessment should be conducted before initiating repairs, demolition, construction, or renovation activities
- identify potential exposures of susceptible patients to dust and moisture and therefore the necessary containment measures.
- Considers type and extent of the construction or repairs in the work area and adjacent patient-care areas, supply storage, and areas on levels above and below the proposed project.
- Knowledge of the air flow patterns and pressure differentials
- The type of barrier systems necessary for the scope of the project must be defined and patients may need to be relocated to other areas in the facility not affected by construction dust.
- Surveillance activities should augment preventive strategies during construction projects.

Construction Activity Types

Table1: Construction Activity Types

TYPE A	Inspection and/or non-penetrating of walls or ceiling. It includes, but not limited to: - • Removal of ceiling tiles for visual inspection limited to one tile per 5m²/50sq. ft • Painting (but not sanding) • Wall covering, electrical trim work, minor plumbing, and activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	Small-scale and/or short-duration (≤ 8 hours) activities that create minimal dust; include, but are not limited to: - • Installation of telephone and computer cabling • Replacement of ceiling boards (up to 1m² per cubicle) • Access to chase spaces for M & E services which includes behind walls or above ceiling • Cutting of walls or ceiling where dust migration can be controlled • Drilling works that generates dust
TYPE C	Work that generates a moderate to high level of dust or requires demolition of any fixed building components or assemblies; include, but are not limited to: - • Sanding of walls for painting or wall covering • Removal of floor-coverings, 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 work shift
TYPE D	Major demolition and construction projects; include, but are not limited to: - • Activities that require consecutive work shifts • Heavy demolition or removal of a complete cabling system • New construction

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http://www.premiersafetyinstitute.org/wp-content/uploads/ICRA-MatrixColorRevised-091109.pdf

Risk of exposed group

Low Risk	Medium Risk	High Risk	Highest Risk
▪ Office areas	▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy	▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Medical Units ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units	▪ 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

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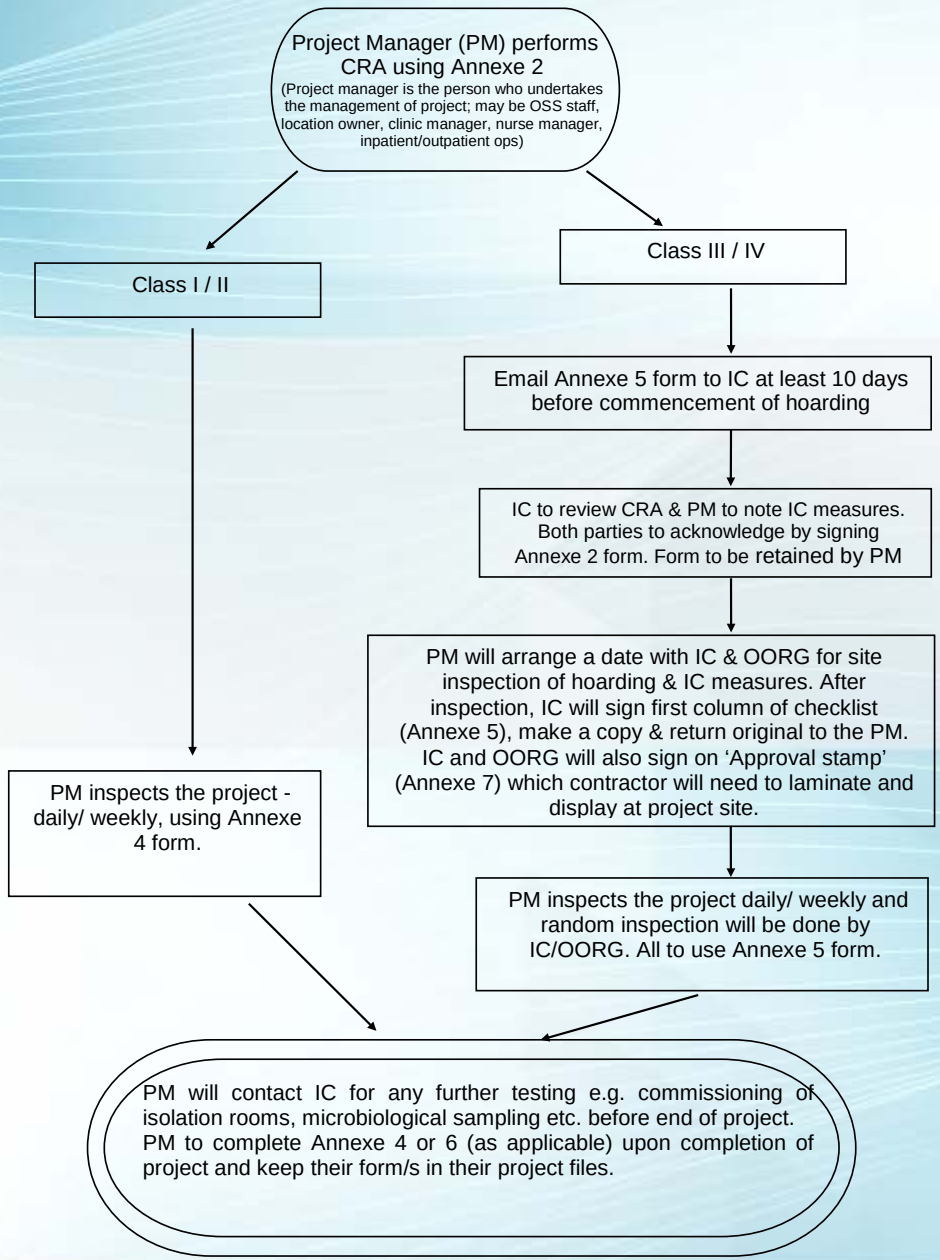
Matrix; Classifies the class of risk I to IV
(patient risk group and construction type)

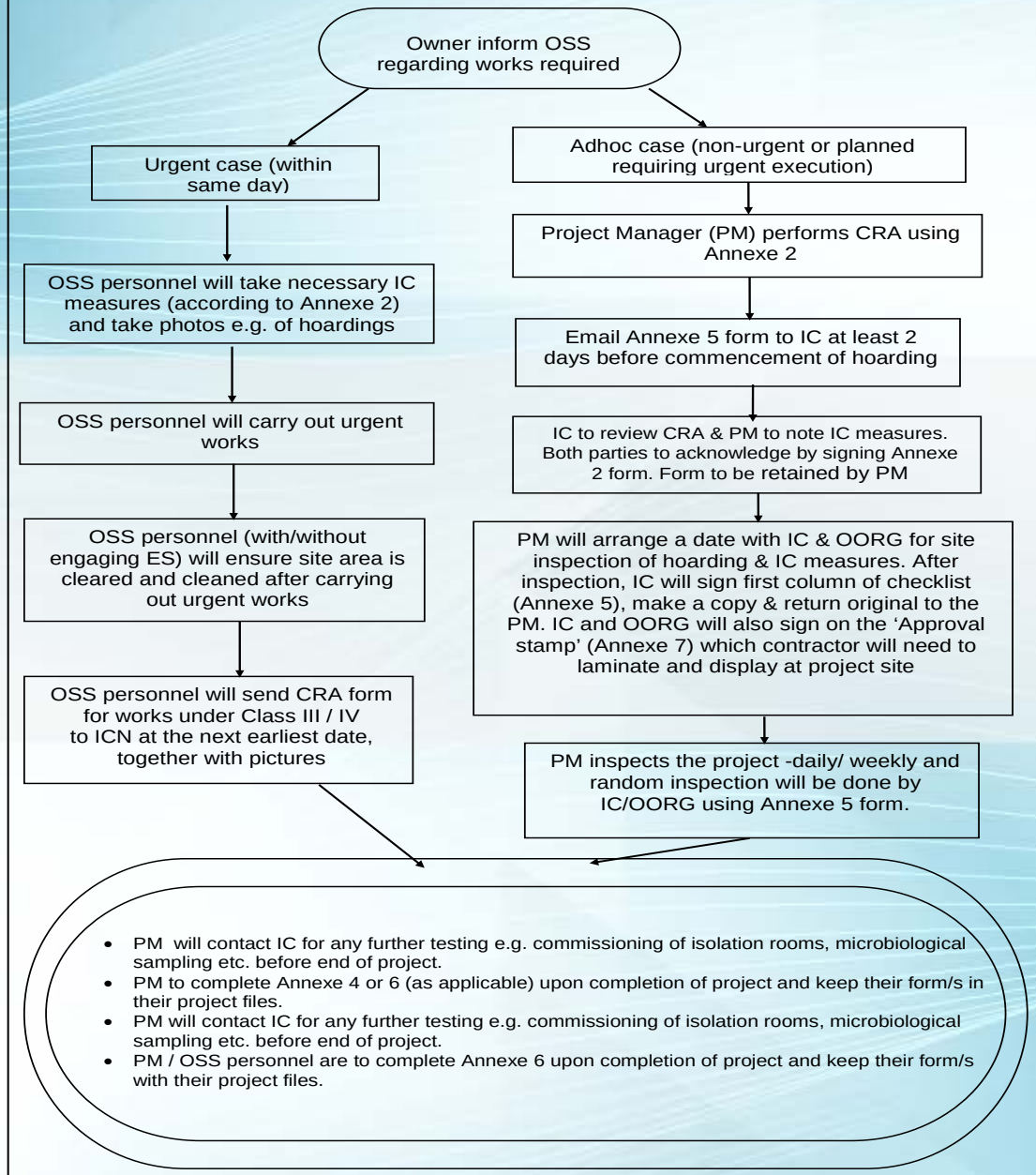
	Construction Project Type			
Patient Risk Group	**TYPE A**	**TYPE B**	**TYPE C**	**TYPE D**
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

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.

Construction and Renovation risk assessment (CRA) Process (Planned project)



Construction and Renovation risk assessment (CRA) Process (Ad-hoc & Urgent projects)



Following the Risk Assessment matrix (patient risk group and construction type)

- Identify the areas surrounding the project area, assessing potential impact
    - Below, Above, Beside, Behind, Front
- Identify specific site of activity e.g., patient rooms, medication room, etc
- Identify issues related to: ventilation, plumbing, electrical in terms of the occurrence of probable outages.
- Identify containment measures, using prior assessment. What types of barriers? (E.g., solids wall barriers); Will HEPA filtration be required?
- Consider potential risk of water damage. Is there a risk due to compromising structural integrity? (e.g., wall, ceiling, roof)
- Work hours: Can or will the work be done during non-patient care hours?
- Do plans allow for adequate number of isolation/negative airflow rooms?
- Do the plans allow for the required number & type of handwashing sinks?
- Does the infection prevention & control staff agree with the minimum number of sinks for this project?(Verify against FGI Design and Construction Guidelines for types and area)
- Does the infection prevention & control staff agree with the plans relative to clean and soiled utility rooms?

http://www.premiersafetyinstitute.org/wp-content/uploads/ICRA-MatrixColorRevised-091109.pdf

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INFECTION CONTROL BY CLASS

	During Construction Project	Upon Completion of Project
CLASS I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection	1. Clean work area upon completion of task.
CLASS II	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.	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.

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INFECTION CONTROL BY CLASS

	During Construction	After Construction
CLASS III	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.	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.

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INFECTION CONTROL BY CLASS

CLASS IV

During Construction	After 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.	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.

Actions to prevent infections

- external demolition and construction

- Shroud the site if possible
- Ensure dust (and fungal spores) cannot enter buildings through doorways, windows or ventilation intakes
  - Seal off (or move) intakes
  - use mats with tacky surfaces at outside entrances.
- HVAC systems; look at recirculated air and keep facility positive compared to outside
- Review filters and change frequently
- Protect water utilities and pipes
- Protect medical gas piping (direct or via vibration)
- minimize dust e.g. misting the area with water)
- Immunocompromised patients use walk-ways protected from demolition/construction sites; avoid outside areas close to these sites
- Education and awareness
  - Encourage reporting

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https://www.cdc.gov/infectioncontrol/guidelines/environmental/

Actions to prevent infections - internal construction and repair

- Prepare for the project
  - Use a multi-disciplinary team approach inc infection control
  - Conduct the risk assessment and a preliminary walk-through with project managers and staff.
  - Educate staff and construction workers re IPC issues (training)
  - Hazard and warning notices, signages
  - Mark detours for pedestrians to
  - Relocate high-risk patients as needed (consider PPE if outside room)
  - Establish alternative traffic patterns for staff, patients, visitors, construction workers
  - Erect appropriate barrier containment
    - plastic sheeting for short-term projects that will generate minimal dust
    - Durable rigid barriers for ongoing, long-term projects
  - Establish proper ventilation
    - Shut off return air vents in the construction zone and seal around grilles
    - Exhaust air and dust to the outside
    - If recirculated air from the construction zone is unavoidable, use a pre-filter and a HEPA filter before the air returns to the HVAC system.
  - Provide temporary services (e.g. toilets, vending machines) in the construction zone

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Actions to prevent infections - internal construction and repair

- During the project
  - When work is being done that may dislodge dust in the ventilation system install filters on the supply air grilles
  - Set pressure differentials so that the contained work area is under negative pressure
  - Use air flow monitoring devices to verify the direction of the air pattern
  - Exhaust air and dust to the outside
  - Monitor temperature, air changes per hour (ACH), and humidity levels (should be <65%)
  - Use portable, industrial grade HEPA filters in the adjacent area and/or the construction zone for additional ACH
  - Keep windows closed
  - When replacing filters, place the old filter in a bag and dispose
  - Clean the construction zone at least daily
  - If the area is carpeted, vacuum daily with a HEPA-filtered–equipped vacuum.
  - Designate a removal route for small quantities of solid debris
  - Mist debris and cover disposal carts before transport
  - Designate an elevator for construction crew use
  - Schedule debris removal to periods when patient exposure minimal

Actions to prevent infections - internal construction and repair

- During the project
  - Make provisions for dry storage of building materials
  - Do not install wet, porous building materials (i.e., sheet rock)
  - Replace water-damaged porous building materials if cannot be dried in 72 hrs
  - Monitor the construction area daily for compliance with the infection-control plan
  - Workers remove protective outer clothing before entering clean areas
  - Use mats with sticky surfaces at the construction zone entrance
  - Damp-wipe tools if removed from the construction zone or left in the area
  - Ensure that construction barriers remain well sealed; particle sampling as needed.

ACCEPTABLE SOLID BARRIER

PROPER BARRIER FOR DUST CONTROL

PROPER BARRIER FOR DUST CONTROL

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USE OF COVERALLS DURING DEMOLITION

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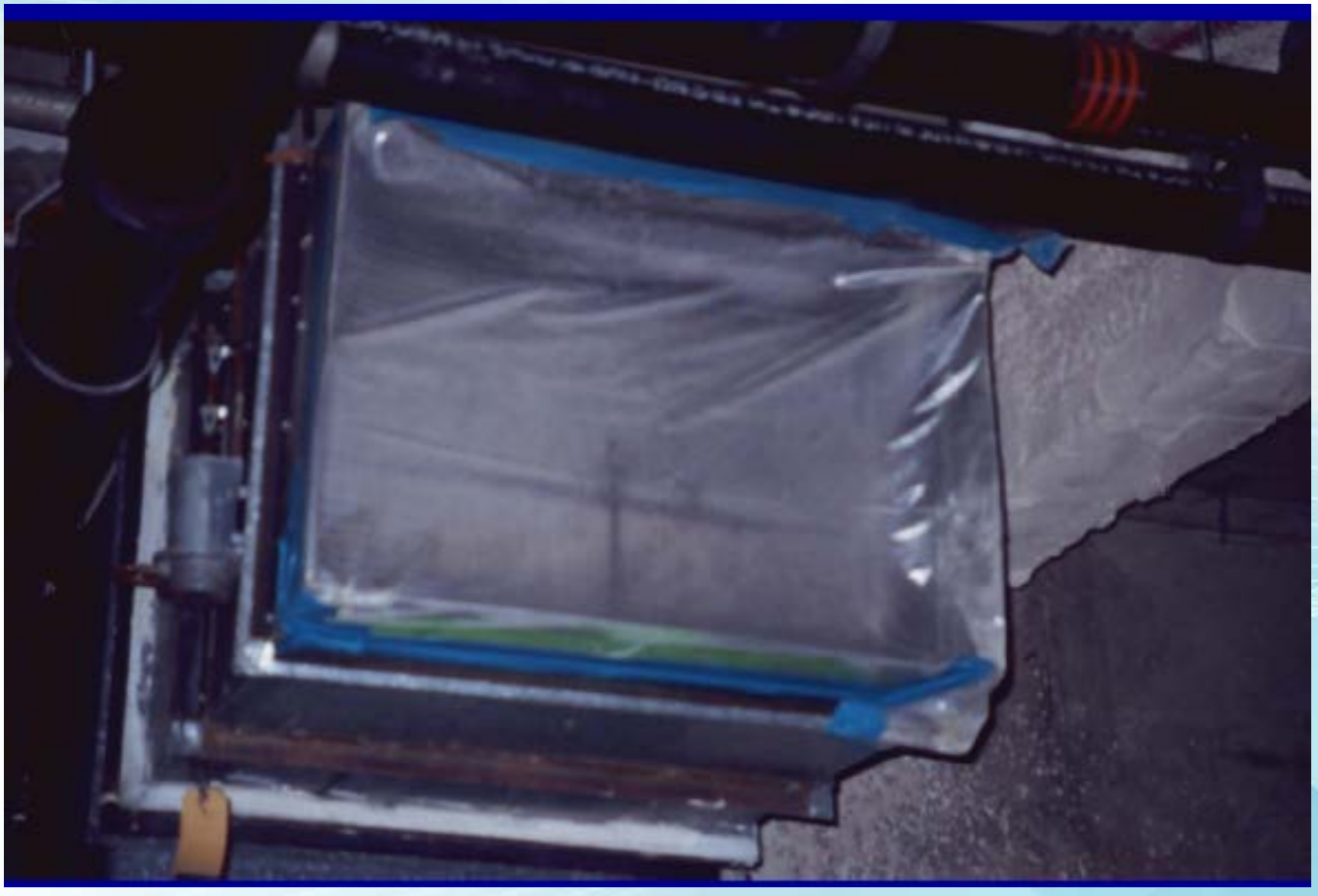
Isolate and seal all open construction area ducts

- ✓ Damper closed, plastic as extra for leaks



Seal above ceiling spaces

- ✓ plastic sheeting to prevent air leakage where there is a common ceiling return

COMMON CORRIDOR AREA MUST BE CLEAN

SAFE DEBRIS REMOVAL

- All debris removed from construction site **must be covered**
- Roll wheels over mat/wet towel to remove dust
- Follow path with **least** patient/visitor involvement

NOT ACCEPTABLE!!!

IMPROPER DUST BARRIER

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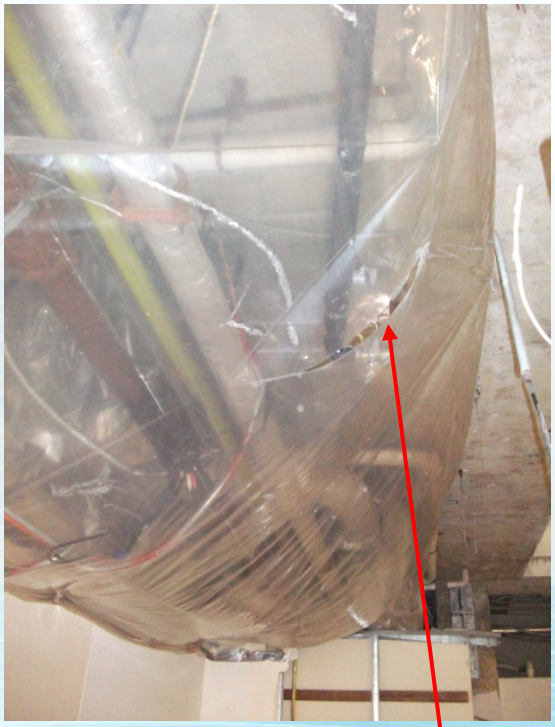
UNACCEPTABLE BARRIERS

UNACCEPTABLE BARRIERS

AIRCON X ISOLATED

IMPROPER TRASH REMOVAL

To close this hole/gap



To change the torn plastic sheet

Sticky tape loose to paste over the gap

To close this hole/gap

Need to close the hole/gap
to prevent dust travel to other room

Construction site door did not close & no plywood or plastic to seal area

Dirty sticky mat

Joint Inspection & Approval

Annexe 7

Infection Control and OORG Approval Stamp

Certified approved by Infection Control

Name:

Date:

Certified approved by Office of Operations Risk Governance

Name:

Date:

Plastic Sheet Hoarding (Ad-hoc works)

Plastic sheet hoarding up to false ceiling

Plastic sheet

Sealed with cloth tape (on all edges of hoarding) – ensure air tightness

Physical Barrier Hoarding
(short-term project/ minor project – 1 to 4 weeks)

Plastic sheet hoarding above ceiling*

Sealed with cloth tape (on all edges of hoarding) – ensure air tightness

Non-combustible hoarding up to false ceiling

Self closing door closer

Door latch & lock (internal & external)

P-pet or carpet

Sticky mat (at entrance within work site)

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*subject to above ceiling site work/constraint

Physical Barrier Hoarding (long-term or major A&A – Addition & Alteration works project* – > 4 weeks)

Plastic sheet hoarding above ceiling*

Non-combustible hoarding up to false ceiling

Additional plastic sheet protection

- ✓ - Self closing door closer
- ✓ - Door latch and lock (internal & external)
- ✓ - P-pet or carpet
- ✓ - Sticky mat
- ✓ (at entrance within work site)
- ✓ **- Ante Room require**

Sealed with cloth tape
(on all edges of hoarding) – ensure air tightness

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subject to above ceiling site work/constraint

In conclusion

Major considerations before initiating construction, repair or renovation

1.design and function of the new structure or area
2.assessment of environmental risks for airborne disease and opportunities for prevention, and
3.measures to contain dust and moisture during construction or repairs.