Infection Prevention during Demolition, Construction and Renovation

Don’t Let Your Barriers Down!

Mary Bertin BSN RN CIC
Picture of a Healthcare Worker!
Objectives

• Understand the risks to patients during construction activities

• Review steps in the infection prevention risk assessment

• Review key infection prevention risk reduction activities
What is the Major Infection Concern?

- Aspergillus and other fungi / moulds
- Naturally present in indoor and outdoor air
- Found in soil, dust, debris etc.
- Spread by aerosols of spores
- Can remain viable in dry locations
Small size of conidia allows spores to enter the lungs

specialized stalks called conidiophores

Average people inhale 40 conidia an hour
Aspergillus

- Aspergillus spores can be dispersed on dust or dirt particles when floors, walls, and ceilings are penetrated

- Spores are very small 2.5M

- Spores can remain suspended in air for prolonged periods of time
  - Increase chance of being inhaled
It’s just mold!

- Some molds have spores that are easily disturbed and waft into the air.
- Other molds have sticky spores that will cling to surfaces and are dislodged by brushing against them or by other direct contact.
- Spores may remain able to grow for years after they are produced.
Problems Caused by Molds

- Allergic Reactions
  - Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals
  - Allergic reactions to mold are common

- Reactions can be immediate or delayed
  - Hay fever-type symptoms,
  - Sneezing, runny nose, red eyes,
  - Skin rash (dermatitis)

- Repeated exposure has the potential to increase sensitivity
Problems Caused by Molds

- **Asthma**
  - Molds can trigger asthma attacks in persons who are allergic (sensitized) to molds

- **Hypersensitivity Pneumonitis (lung infection)**
  - May develop following short-term (acute) or long-term (chronic) exposure to molds
  - Resembles bacterial pneumonia
  - Can develop chronic disease

- **Irritant Effects**
  - Irritation of the eyes, skin, nose, throat, and lungs
  - Can create a burning sensation in these areas
Immunodeficiency

- Immune system’s ability to fight infection is compromised or absent
- Unusually acquired - some people are born with it
- Transplant patient’s medications suppress their immune system to prevent rejection
- Other medications can cause it
- A person with immunodeficiency is said to be immunocompromised
- An immunocompromised person is particularly vulnerable to infection
Persons at Risk for Aspergillus/Fungal Infection

- Any patient who is immunocompromised
  - Bone marrow and solid organ transplant
  - Chemotherapy
  - Prolonged steroid / antibiotic therapy
  - Dialysis
  - Immunodeficiency Diseases
- Mechanical ventilation
- Smoking
- Age (very young or elderly)
  - Healthy persons have a minute risk of infection
Invasive Pulmonary Aspergillosis: Cavitary Disease With Halo Sign
# Mortality Associated with Aspergillus Infection Outbreaks

<table>
<thead>
<tr>
<th>Underlying Disease</th>
<th># of patients</th>
<th>Mortality %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematology malignancy</td>
<td>299</td>
<td>57.6</td>
</tr>
<tr>
<td>Solid organ transplant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney</td>
<td>36</td>
<td>55.9</td>
</tr>
<tr>
<td>Liver</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Other immunocompromised patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-dose steroids</td>
<td>15</td>
<td>52.3</td>
</tr>
<tr>
<td>Neonates</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Malignancy</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>ICU patient (high risk)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>No exact classification</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Patients without severe immunodeficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thoracic surgery</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Cataract surgery</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>ICU patient (low risk)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Other surgical patients</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>458</td>
<td>55%</td>
</tr>
</tbody>
</table>

Sources of healthcare Acquired Aspergillus Outbreak Infections

- Construction work (probably), 23
- Construction work (possibly), 3
- Air supply system, 9
- Unknown outbreak source, 12
- Other source, 6

1/66-8/15/2005  53 outbreaks in Pubmed
Documented Source of Spores in Construction Settings

- False ceilings
- Insulating material
- Roller-blind casing
- Fire-proofing material
- Open windows/doors
- Contaminated carpeting
- Dust from construction site
- Dust from excavation site
Imperative That Construction Dust Is Contained!
Joint Commission Mandate

- Joint Commission standard 2002
- Hospitals required to perform a proactive risk assessment
  - Identify the hazards that can potentially effect patient care
- Establish type and location of barriers
- Surveillance for compliance and infection
Assessing the Risk

- Let Infection Prevention know BEFORE construction / renovation activity is planned
  - Will save you time and money in the long run

- Take a walk with your Infection Preventionist
  - Visualizing the activity/location will help determine risk
## What is the Type of Construction Activity Planned?

<table>
<thead>
<tr>
<th>Type</th>
<th>Construction Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Inspection, non-invasive (e.g., remove one ceiling tile, painting, minor plumbing)</td>
</tr>
<tr>
<td>Type B</td>
<td>Small scale, minimal dust (e.g., running cables)</td>
</tr>
<tr>
<td>Type C</td>
<td>Generates moderate to high levels of dust (e.g., sanding, minor demo)</td>
</tr>
<tr>
<td>Type D</td>
<td>Generates high levels of dust (e.g., major demo / remodel)</td>
</tr>
</tbody>
</table>
What is the Type of Construction Activity Planned?

- The project may be small in scale but big in dust
- Painting a wall?
  - Dust free BUT- do you have to patch and sand the wall first?
- Pulling off wall covering?
  - Is there mold behind that?
- Pulling electrical cables?
  - How many ceiling tiles have to come out?
**What is the Population and Geographic Risk?**

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Location/Patient Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest Risk Group 1</td>
<td>Offices&lt;br&gt;Unoccupied wards&lt;br&gt;Public areas</td>
</tr>
<tr>
<td>Medium Risk Group 2</td>
<td>Outpatient clinics (exception: oncology/surgery)&lt;br&gt;Admission/discharge units</td>
</tr>
<tr>
<td>Medium to High Risk Group 3</td>
<td>ED&lt;br&gt;PACU&lt;br&gt;Laboratories wards&lt;br&gt;Peds&lt;br&gt;Long-term care</td>
</tr>
<tr>
<td>Highest Risk Group 4</td>
<td>ICU&lt;br&gt;L&amp;D&lt;br&gt;Transplant&lt;br&gt;Nurseries&lt;br&gt;Cath labs /endoscopy</td>
</tr>
<tr>
<td></td>
<td>OR&lt;br&gt;Oncology&lt;br&gt;Dialysis&lt;br&gt;Central inventory&lt;br&gt;Sterile processing</td>
</tr>
</tbody>
</table>
Risky Locations

- **Obvious**
  - Transplant units
  - ICUs
  - Operating Rooms
- **Less obvious**
  - Radiology
  - Many outpatient locations
  - Hallways used for transport of patients
  - Hallways used by outpatients / admissions
- **Other key sites**
  - Laboratory
  - Supply rooms
Location Risk

• Don’t be surprised if the Infection Preventionist considers your location a higher risk than you do!

• The number of immunosuppressed patients continues to expand into all areas of patient care

• May vary significantly from one hospital to another based on type of services offered
# Construction Activity and Risk Group Matrix

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>Activity Type A</th>
<th>Activity Type B</th>
<th>Activity Type C</th>
<th>Activity Type D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>I</td>
<td>II</td>
<td>II</td>
<td>III/IV</td>
</tr>
<tr>
<td>Group 2</td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
</tr>
<tr>
<td>Group 3</td>
<td>I</td>
<td>III</td>
<td>III/IV</td>
<td>IV</td>
</tr>
<tr>
<td>Group 4</td>
<td>I-III</td>
<td>III/IV</td>
<td>III/IV</td>
<td>IV</td>
</tr>
</tbody>
</table>

= Contact Infection Prevention
Construction Activity and Risk Group Matrix

- Don’t be surprised if infection prevention wants to know about all activities
  - Patient safety concerns
  - Litigation prevention

- Infection prevention may want to review and determine matrix levels for all activities
  - Specific to institution’s patient populations
Specifications

- Dust control / barriers
- Plumbing activities (Legionella)
- Ventilation / negative air / HEPA filtration
- Debris removal and cleanup
- Traffic control
Picture of a Healthcare Worker!
Demolition and Excavation

- Blowing up a building is faster and cheaper
  - Too much dust
  - Wrecking ball only near healthcare facilities
- Cover air intakes
  - Determine when to change filters
    - Increase in pressure differentials
    - Color?
    - Frequent and regular basis
- Recirculate air
Demolition and Excavation

- Identify all entrances to buildings
  - If possible, move entrance to location away from activity
  - Enclose entrance with mouth facing away from activity
  - Which way does the wind usually blow?

- Don’t use revolving doors
  - Pushes air into building

- Consider using an air curtain at inside entrance
  - Pushing air down from top to bottom
  - Ensures positive pressure relative to the outside
Demolition and Excavation

- Close nearby patios and outside seating
- Redirect receiving docks if too close to activity
  - Or time activity around receiving schedules
- Keep it wet!
  - Water soil in excavation site
  - Water rubble and debris in demolition
- Dusty workers should stay out of the hospital
Air Sampling

- Problematic
  - Amount of Aspergillus spores necessary to cause infection is unknown
  - No standardized guidelines on acceptable spore levels
  - Must assume that any concentration of airborne spores may be a threat for immunocompromised patients
- What / how will the data be used?
- Talk with Infection Prevention BEFORE you schedule air sampling!
If decision is made to sample air….

- Obtain baseline samples inside and outside
  - Select a typical day / typical conditions for location
    - Traffic patterns
    - Housekeeping activities
    - Maintenance activities
- Use slit samplers (not settle plates)
If decision is made to sample air….

- Collect air samples for 30 mins
- Collect various samples throughout the day
- Place at breathing height
  - Do not place on floor
- Request total spore & Aspergillus spore counts (in CFUs)
- Sample before, during and after construction
  - Infection Prevention to determine frequency of sampling based on risk assessment
- Compare results of target area to unaffected location for comparison?
Construction Near Elevator Shafts

• Need to ensure minimal dust near elevator shafts
• Pressure changes in the shaft as elevator moves up & down
• Shafts under negative air pressure
  - lobby air is rushed into the shaft
• Positive pressure in shaft
  - will push air out into floors
Waste Management

- A dusty trash cart pushed down a hallway will effectively undo your protective barriers
- Lids should be integral to the cart
  - No wet dirty sheets/blankets please!
- Wheels should be wiped free of dust before leaving the construction area
Dusty Workers

- Keep dusty workers inside the barriers
- FOOTPRINTS or wheel marks are a clear indicator of poor dust control
- Carpeted mats / tacky mats have limited use
  - May need shoe covers and/or overalls
How to Drive the Infection Prevention Nurse Crazy

- Project started and Infection Prevention had no idea
- Zip walls unzipped
- Incompletely taped or hanging Visqueen®
- Required negative air is not functioning
- Untacky tacky mats
- Foot prints / cart tracks down the hallway
Education

• Construction management of infection prevention is only as good as the understanding of the construction worker
• Do your workers understand the risks to patients?
• Taking short cuts can kill!
  - Deadly dust
Worker Education

• Instruct all workers on
  - Purpose of dust control
  - Acceptable traffic routes / elevators
  - When / how to wear protective clothing (e.g., booties)
  - Replacement of tacky mats
  - Keeping barriers sealed/closed
  - Maintaining negative air
  - Monitoring HEPA filters
Picture of a Healthcare Worker
Plan Ahead and Communicate
Failure to Protect
Infection Outbreak - excavation

- Toronto Hospital for Sick Children
  - March 1990 - February 1992
  - 8 cases of invasive fungal sinusitis
  - 5 deaths
  - Related to increased spore counts from soil excavation during hospital construction

5 cases of Aspergillus infection in patients on a burn unit, dialysis unit and oncology unit

Air intake vents not covered during demolition

Renal transplant ward

Aspergillus infection in 2 patients and colonized a third

Cases clustered during time when work overhead caused dust to filter down through pores in the acoustical tiles of the false ceiling

Air samples showed heavy contamination with Aspergillus at and below renovation site but not on 2 distant wards

Failure To Protect
Five patients with severe postoperative Aspergillus endophthalmitis
All five patients came from one hospital in January and February during a period of active hospital construction
All five patients were subjected to aqueous or vitreous tap
Three patients had removal of the vitreous gel from the middle of the eye
Final outcome in each patient was evisceration (removal of the eye’s contents) or enucleation (removal of eye), despite an intensive course of antifungal therapy.
Failure to Protect
Infection Outbreak – Supply Room

- 900-bed, tertiary-care hospital
- A cluster of four cases of surgical and burn wound aspergillosis
- Traced to the outside packages of dressing supplies, contaminated during construction in Central Inventory
- This resulted in patients with large exposed surface areas being inoculated directly with Aspergillus spores

Failure To Protect

Ripped Zip
Failure to Protect
Infection Outbreak - Radiology

- 6 immunocompromised patients housed in widely separated portions of a hospital campus developed aspergillosis during a single month
- Related to exposure in central radiology suite under construction

• 13 pediatric patients with positive fungal blood cultures during a 3-day period
• Microbiologic plates left open to air on the work bench
• Renovation immediately adjacent to the laboratory
• Airflow patterns suggested spread into the laboratory through an open door located near the implicated workbench station and a false ceiling above the workbench area.

**Legionella**
Another Construction Related Pathogen

- Found in water environments, soil, dust
- Aspiration of water, inhalation of water aerosols can cause Legionnaire’s disease in certain patients
Legionnaires Disease

- Can be mild flu-like illness
- More severe - progressive pneumonia
- Can lead to heart, kidney and GI involvement
- 14% mortality rate in health-care associated legionnaires disease
Patient Risk Factors

- Immunosuppression
- Advanced age
- Chronic pulmonary disease
- Smokers
- Alcoholics
- Surgery
- Diabetes
- Cancers
- Kidney or heart disease
Potential Legionella Reservoirs

- Cooling towers
- Evaporative condensers
- Heated potable water distribution systems
- Heating & air-conditioning systems
- Shower faucets
- Room-air humidifiers
Legionella

- Factors that enhance Legionella in water systems
  - Temperature 77-107.6 °F
  - Stagnant water
  - Scale and sediment
Contamination of Water Supply

- Descaling in water pipes during repressurization
- Soil entering the water supply system during construction
  - Infection Prevention must be notified for water shutdowns
  - Need to flush systems after maintenance / tie-ins etc
Failure to Protect
Legionella Outbreak

- 300 bed community hospital
- 5 patients with Legionella
- Same Legionella species cultured from tap water in patient care areas, hot water holding tank, and soil in an area of excavation and new construction
- Soil entered water supply during construction and installation of new plumbing

In Conclusion

- Partner with Infection Prevention at the start of project
- Work together as a team
- Assess the risk and determine prevention strategies
- Educate workers on infection risk and infection prevention
- Monitor for compliance
Partners In Patient Safety

Thank you for keeping patients safe!