

Infection Prevention during Demolition, Construction and Renovation

Don't Let Your Barriers Down!

Mary Bertin BSN RN CIC

Picture of a Healthcare Worker!



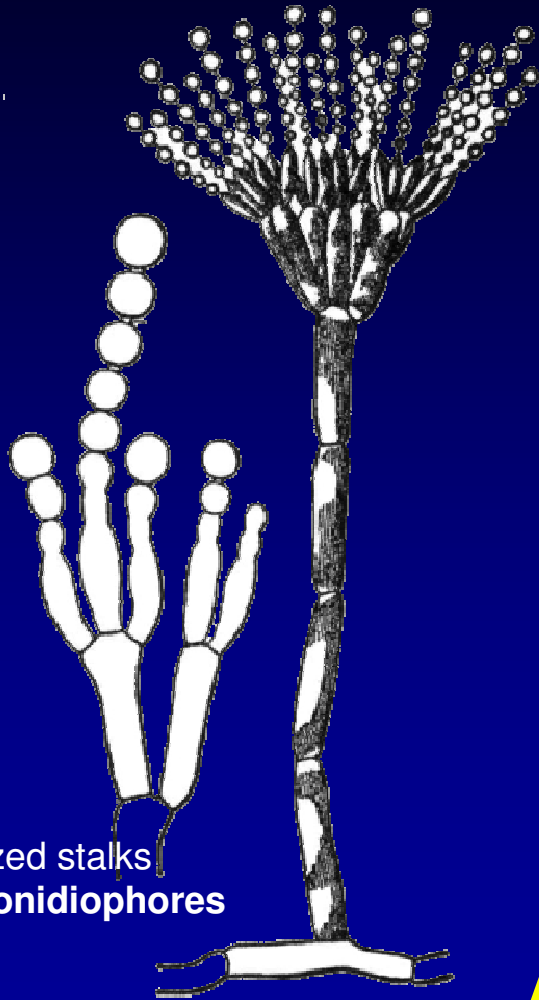
Objectives

- **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



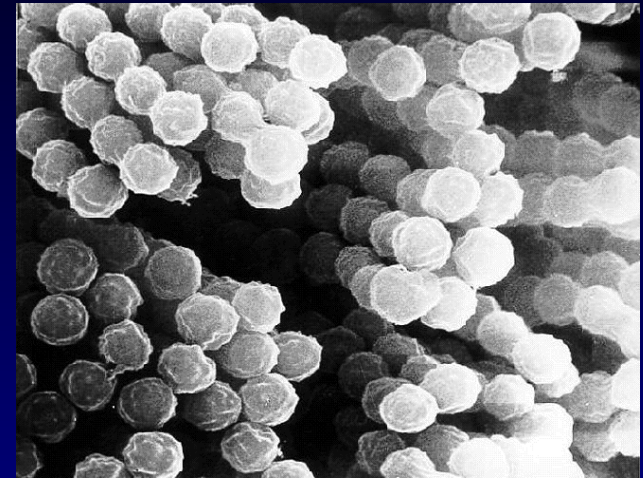
specialized stalks
called **conidiophores**



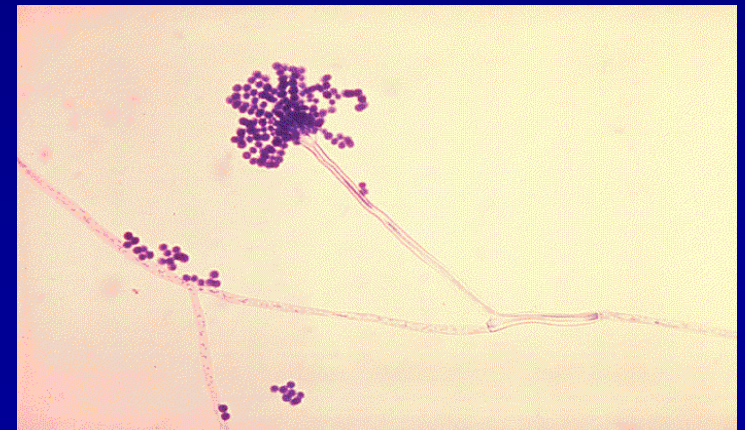
Average people inhale 40 conidia an hour

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**



Electron microscopy of spores



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

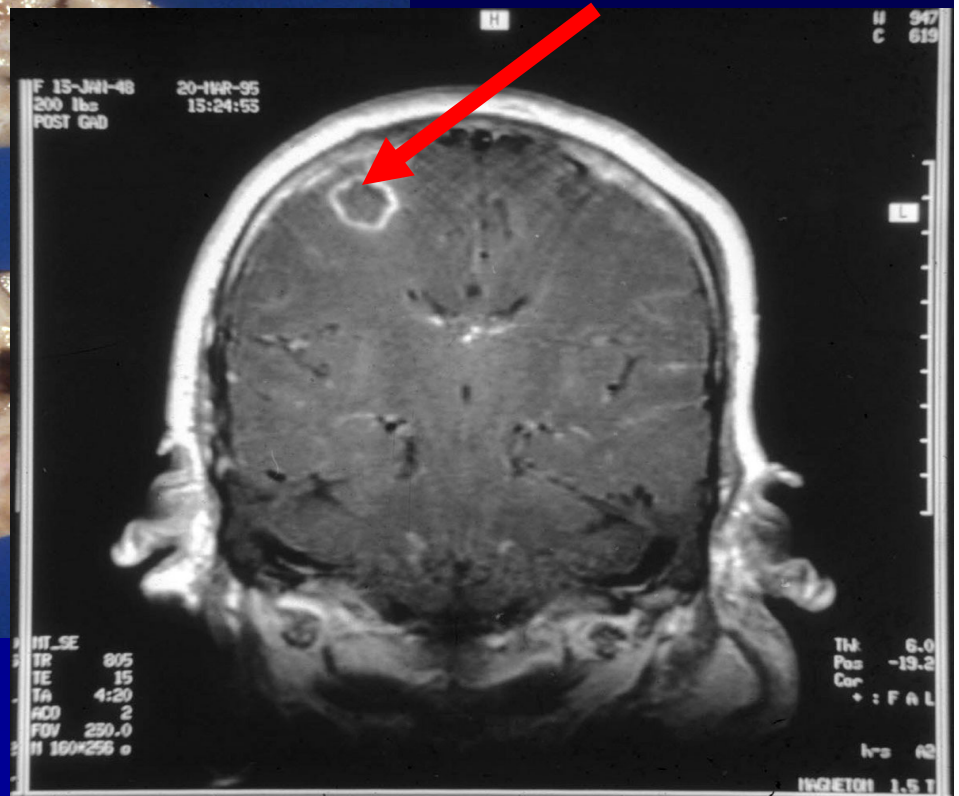
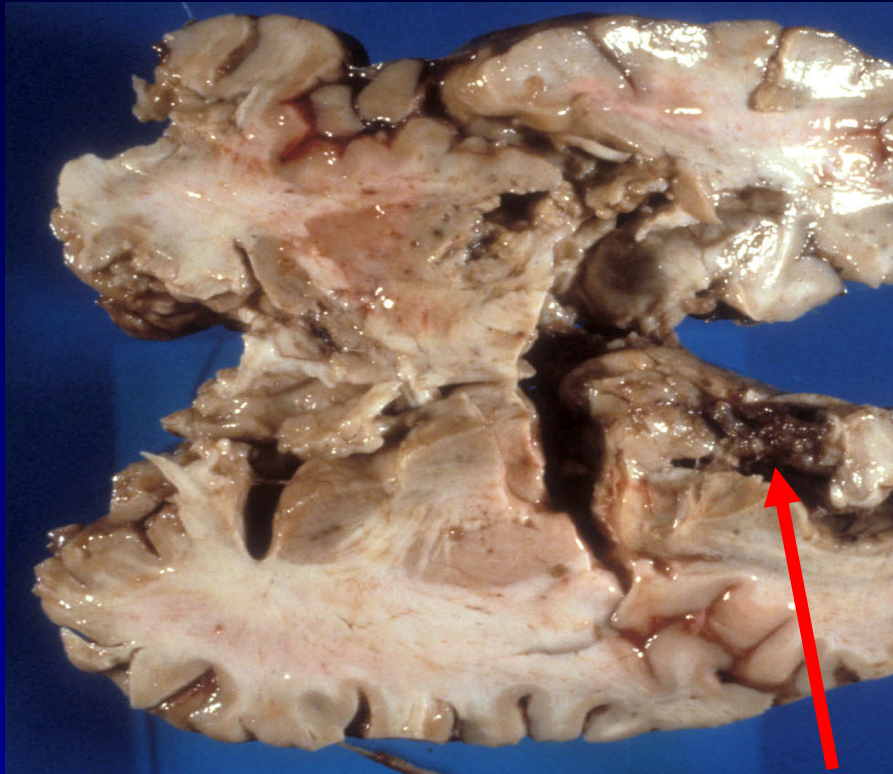
- **Immune system's ability to fight infection is compromised or absent**
- **Unusually acquired - some people are born with it**
- **Transplant patient's medications suppress their immune system to prevent rejection**
- **Other medications can cause it**
- **A person with immunodeficiency is said to be immunocompromised**
- **An immunocompromised person is particularly vulnerable to infection**

Persons at Risk for Aspergillus/Fungal Infection

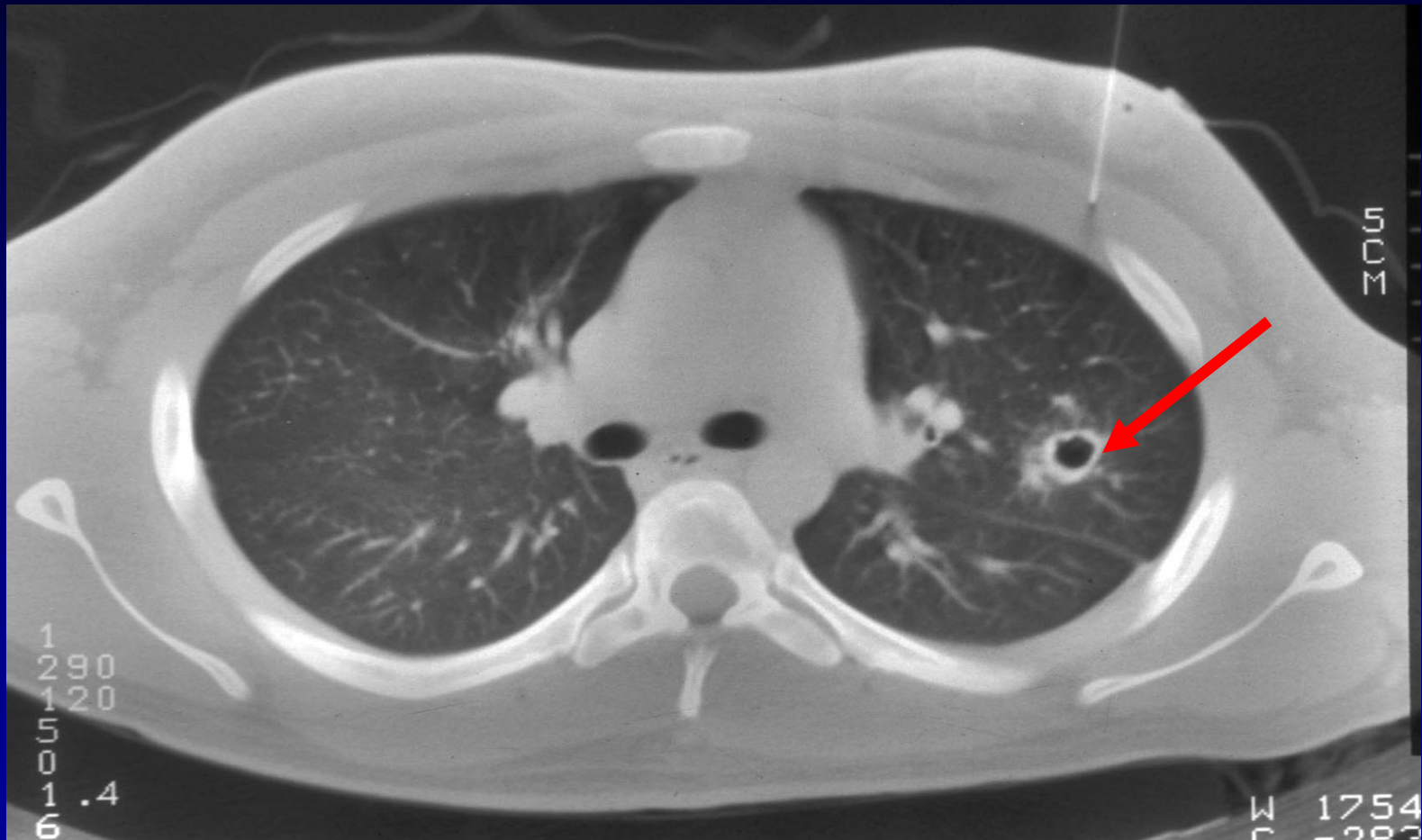
- Any patient who is immunocompromised
 - Bone marrow and solid organ transplant
 - Chemotherapy
 - Prolonged steroid / antibiotic therapy
 - Dialysis
 - Immunodeficiency Diseases
- Mechanical ventilation
- Smoking
- Age (very young or elderly)
 - Healthy persons have a minute risk of infection

Central Nervous System Infections

Aspergillus Infection



Invasive Pulmonary Aspergillosis: Cavitary Disease With Halo Sign

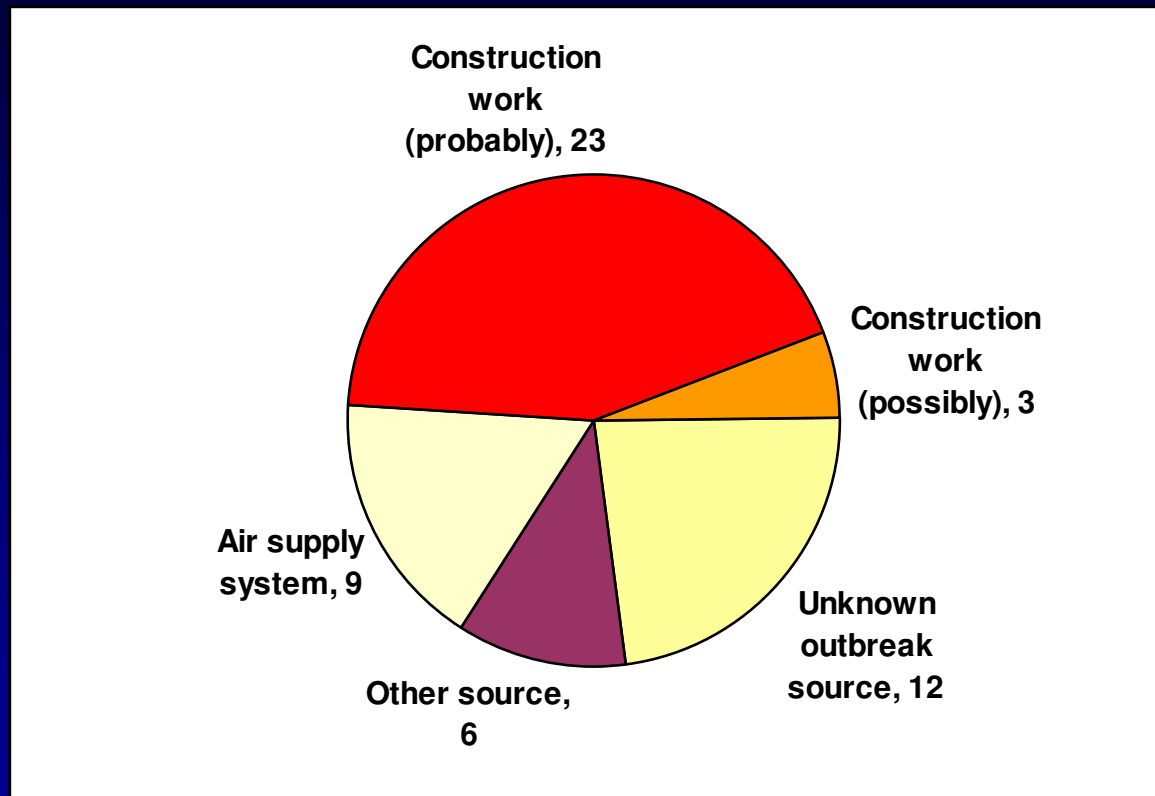


Mortality Associated with Aspergillus Infection Outbreaks

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

Vonberg, R.P & Gastmeier, P., Nosocomial aspergillosis in outbreak settings. J. of Hosp. Infection
2006 63,246-254 1996-2005 53 outbreaks in Pubmed

Sources of healthcare Acquired Aspergillus Outbreak Infections



Vonberg, R.P & Gastmeier, P., Nosocomial aspergillosis in outbreak settings. J. of Hosp. Infection 2006 63,246-254

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?

Type	Construction Activity
Type A	Inspection, non-invasive (e.g., remove one ceiling tile, painting, minor plumbing)
Type B	Small scale, minimal dust (e.g., running cables)
Type C	Generates moderate to high levels of dust (e.g., sanding, minor demo)
Type D	Generates high levels of dust (e.g., major demo / remodel)

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?

Risk Group	Location/Patient Population	
Lowest Risk Group 1	Offices Unoccupied wards Public areas	
Medium Risk Group 2	Outpatient clinics (exception: oncology/surgery) Admission/discharge units	
Medium to High Risk Group 3	ED PACU Laboratories wards Peds Long-term care	Radiology L&D General med/surg Geriatrics
Highest Risk Group 4	ICU L&D Transplant Nurseries Cath labs /endoscopy	OR Oncology Dialysis Central inventory Sterile processing

Risky Locations

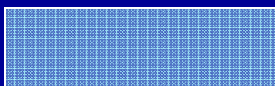
- **Obvious**
 - **Transplant units**
 - **ICUs**
 - **Operating Rooms**
- **Less obvious**
 - **Radiology**
 - **Many outpatient locations**
 - **Hallways used for transport of patients**
 - **Hallways used by outpatients / admissions**
- **Other key sites**
 - **Laboratory**
 - **Supply rooms**

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

Risk Group	Activity Type A	Activity Type B	Activity Type C	Activity Type D
Group 1	I	II	II	III/IV
Group 2	I	II	III	IV
Group 3	I	III	III/IV	IV
Group 4	I-III	III/IV	III/IV	IV



= Contact Infection Prevention

Construction Activity and Risk Group Matrix

- **Don't be surprised if infection prevention want's 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**

Lueg EA et al. Analysis of the recent cluster of invasive fungal sinusitis at the Toronto Hospital for Sick Children. *J otolaryngol* 1996; 25(6):366-70

Failure to Protect Infection Outbreak - Demolition

- **5 cases of Aspergillus infection in patients on a burn unit, dialysis unit and oncology unit**
- **Air intake vents not covered during demolition**

Failure to Protect Infection Outbreak – Vibration

- **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



Failure to Protect Infection Outbreak – Operating Room

- 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



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**

Hopkins CC et al. Invasive Aspergillus infection: possible non-ward common source with the hospital environment. J hosp Infect. 1989 Jan;13(10:12-25

Failure to Protect Pseudo-infection outbreak – Laboratory

- **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.**

Hruszkewycz V et al. A cluster of pseudofungemia associated with hospital renovation adjacent to the microbiology laboratory. *Infect Control Hosp Epidemiol.* 1992 Mar;13(3):147-50.

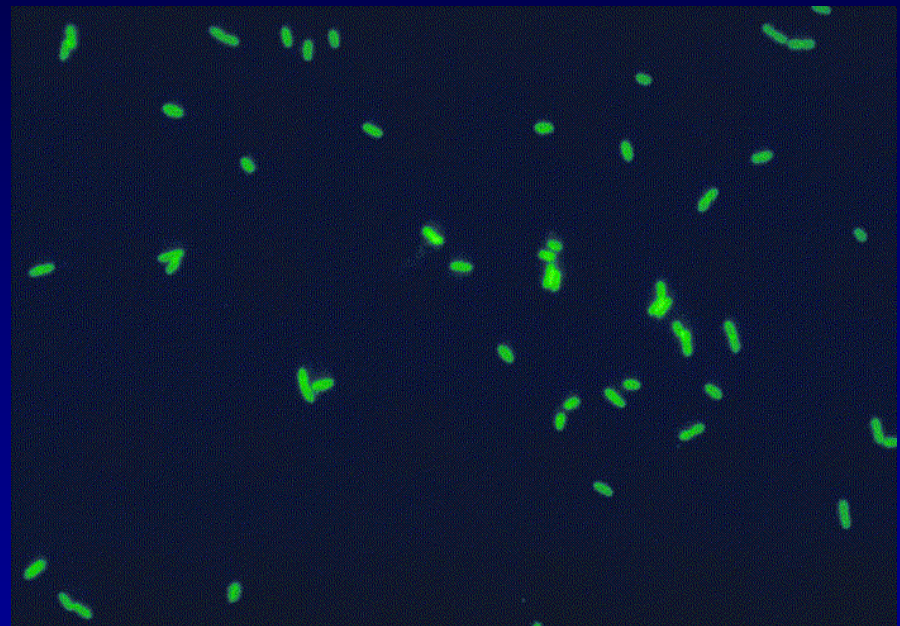
Failure To Protect



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**

Parry et al. Waterborne Legionella bozemanii and nosocomial pneumonia in immunosuppressed patients. Ann Intern Med. 1985 Aug;103(2):205-10.

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!**