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The Dirt on Construction
Infection Control During Construction/Renovation of HealthCare Facilities

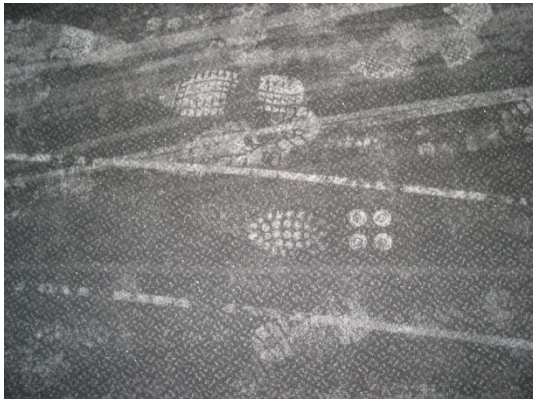

Image Source: PHO image library

Barb Shea, CIC, MLT, ART Microbiology
Public Health Ontario Central East RICN
For CHICA SWOICN June 20, 2013

Objectives

- Identify organisms of significance for construction and renovation associated infections
- Z317.13-10 highlights
- Surveillance and IPAC routines

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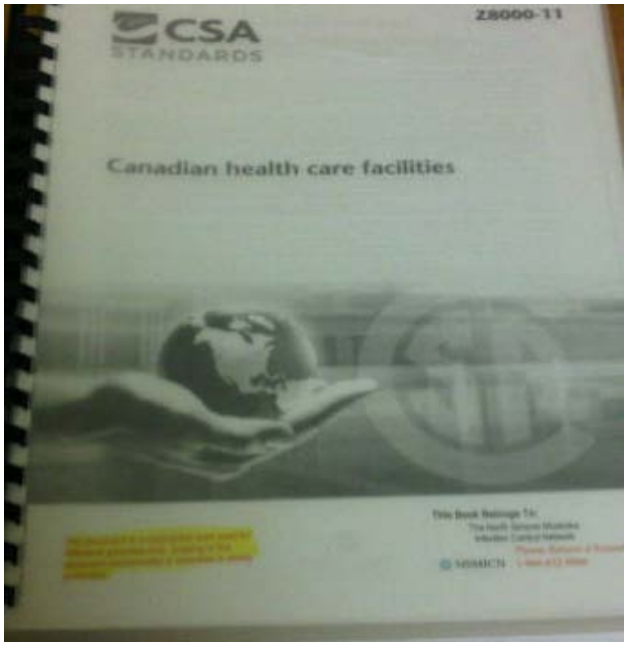
THE IMPORTANCE OF IPAC IN CONSTRUCTION RENOVATION AND MAINTENANCE



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What do we mean when we use the term "construction"?

- Includes demolish, build, renovate, maintain
- And anything that may create dust or disturb dust

OH&S Act reg. 213/91 defines construction and constructor

Historical Perspective

- Mid 1990's patient safety movement prominent in healthcare
- **2001 Health Canada – "Construction-related Nosocomial Infections in Patients in Health Care Facilities Decreasing the Risk of *Aspergillus,Legionella* and Other Infections"**

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Why do Infections Occur?

- Susceptibility of host
- Nature of the exposure
- Virulence of organism
- Inoculum

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Construction Issues

- Organisms can travel in dust and water
- Can cause invasive/superficial infections/aggravate conditions
- Patients are susceptible to infection
- High mortality in the immunocompromised
- Difficult to treat!
- Primary culprits… Legionella and Aspergillus
- Health hazards

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Patients at Greatest Risk for Construction Related Infections

- Immunosuppressed
- Oncology and haematology units
- Surgical (during and post – op)
- Dialysis
- Critical care
- Multiple Medical Conditions
- Underlying respiratory problems

Health Care Associated Infections

- Spread on hands of HCW's
- 4th leading cause of deaths in hospitals
- Preventable
- Numerous outbreaks have also been associated with construction and renovation activities

"Construction –related Nosocomial Infections in Patients in HealthCare Facilities Decreasing the Risk of Aspergillus, Legionella and Other Infections and Other Infections" CCDR July 2001

Health Canada 2001 Report of Infections s

Construction Renovation

- Inside HC facility
- Adjacent to HCF

Ventilation Systems

- Malfunction
- Not maintained

Pseudo-outbreaks

- Contaminated Blood culture
- Contaminated bronchoscopy specimens

Construction Activity and Patient Related Outcomes

- Duct and false ceiling demolition , removal of glass fibre insulation and work on roller blinds : *A. fumigatus*

Perraud et al 1987

- Repair of false ceiling due to a water leak in a IC supply storage room- contaminated adhesive tape and arm boards

Grossman et al 1985

- 22 infected/colonized and 18 patients died on an oncology unit
- 6 leukemia patients infected and 2 died (also related to underlying illness)

A. flavus and *A. fumigatus*

- Fire in a nearby building and windows being repeatedly opened. Carpet in hall was contaminated – patients on BMT unit
- Connecting bridge between old and new unit allowed dust to circulate from nearby construction and air vent was not properly closed

- 13 infected or colonized patients on BMT unit and 5 of these patients died

Gerson et al 1994

- 3 patients on heart transplant unit infected/colonized with 2 deaths

Hospital IC 1990

Aspergillus and Zygomcetes

- Aspergillus infections on hematology oncology unit. Four cases prior to construction, 28 during construction and 4 after control measure implemented
- 36 infections and 17 deaths

  Loo et al 1996
- Aspergillus and Zygomcetes infections on pediatric oncology unit during extensive renovation and new construction- windows were opened and revers pressure system
- Five were infected and died

  Weems et al 1997

2004 Institute of Medicine (IOM)

Linked indoor exposure to mold with:

- upper respiratory tract symptoms
- cough, and wheeze in otherwise healthy people
- with asthma symptoms in people with asthma
- with hypersensitivity pneumonitis in individuals susceptible to that immune-mediated condition.

The Role of Infection Control During Construction in Health Care facilities, AJIC 2000

APIC State of the Art Report

- AIA requires an ICRA
- Early involvement (functional plan)
- Identify number and types of isolation rooms
- Mitigate sources of infection though design (separate patients, placement of hand hygiene facilities)
- Multidisciplinary team

Canadian Standards Association (CSA)

- Z317.13.12
- First released in May 2003 and revised in 2007
- Committee consisted of ICP's, Government , Microbiologists, Architects, Engineers , Facilities Engineers, Contractors

CSA Z317.13-12 Content Highlights

- Risk factors
- Sources of infections related to construction
- Construction materials
- IPAC procedures
- Key responsibilities
- Prevention measures (before during and after construction)
- Prevention for new construction projects
- Remedial measures
- Quality systems

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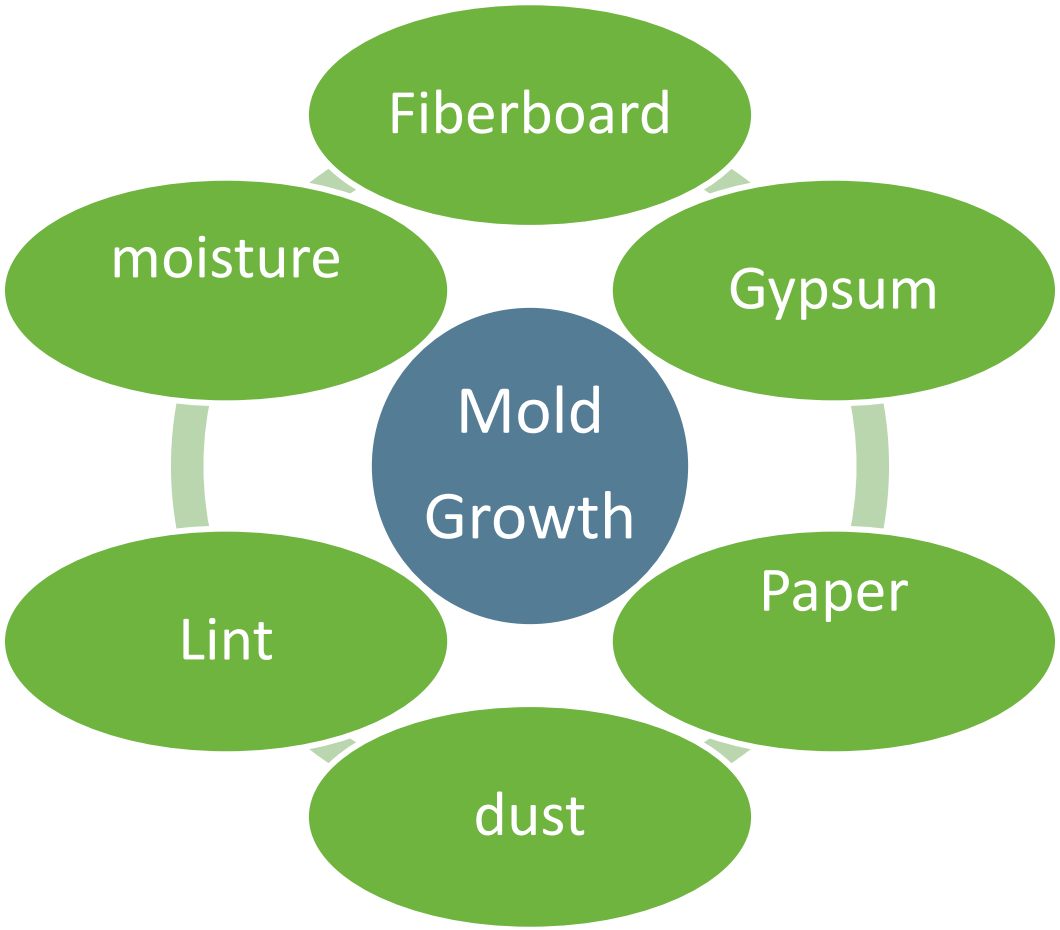
The Infectious Agent (The Suspects)

Image source: PIDAC Routine Practice and Additional Precautions In All Healthcare settings July 2011

- Fungi/Mould
  - Aspergillus
  - Penicillium
  - Candida
  - Zygomycetes
  - Fusarium
- Bacteria
  - Legionella
  - Bacillus
  - Nocardia
  - Mycobacteria

Molds like high cellulose low nitrogen materials



Aspergillus species

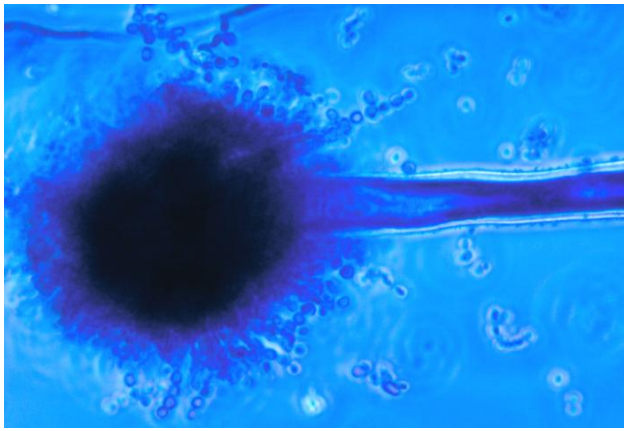


Image Source: CDC Public Health Library

Aspergillosis

- *A. fumigatus, A. flavus, A. niger*
- *Aspergillus* spores are small (2.5 μm-3.5 μm) and settle very slowly (0.03 cm per second), they can remain suspended in air for long periods
- Found in compost/decaying organic matter
- Infection caused by inhalation of spores/conidia
- Allergic aspergillosis, aspergilloma (hyphae ball), disseminated disease
- Fatality rate is greater than 50%

Aspergillus spp.

- Fungus found in soil, water, dust and organic
- Most common fungus associated with construction/renovation activities
- Rarely causes infection in healthy people except when exposed to large numbers of spores
- In immunosuppressed patients - small numbers of spores can cause progressive pneumonia leading to death
- Can invade other body tissues – abscesses , skin, ear and sinus infections

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Where is Aspergillus found in buildings ?

- During construction dust along with Aspergillus is disturbed and may become circulated in the air
- Ventilation systems
- Construction/ Demolition sites
- False Ceilings
- Air conditioners
- Moldy materials
- Fire proofing materials
- Insulations
- Like cellulose

Aspergillus pneumonia

Background

- A single case is hard to link to environment
- May be linked to environment during construction or renovation.
- Dust disturbance
- Mortality rate is 65-100%

Surveillance

- Prospective - look for other cases
- Retrospective Review
- Microbiology and Histology reports
- Alert clinicians of high risk patients

Bacillus

- Is it a pseudo (false) outbreak ?
- Is an organism ubiquitous in the environment
- Has caused infections in certain settings related to construction

Legionella spp

- found in cooling towers, air conditioners, spa equipment, fountains, humidifiers and showers, hot and cold water systems,
- oil/water emulsions used for lubricating lathes, misting devices, decorative fountains and water features,
- dentistry tools, TMV's (thermostatic mixing valves).
- mode of transmission is through inhalation of airborne droplets.

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Legionella pneumophila

Legionnaire's Disease

- Gram Negative bacteria naturally occurring in water
- Infection caused by aspiration/inhalation of bacteria
- Typically causes pneumonia/respiratory failure
- High case fatality rate- diagnosed by a urine culture for legionella antigen
- Found in stagnant water, poorly maintained water systems/cooling towers

Legionella pneumophila

- infects the lungs
- Can cause a sometimes fatal form of pneumonia.
- causative organism of Legionnaires Disease and Pontiac Fever
- symptoms like many other forms of pneumonia
- a high fever, chills and a cough.
- Some people may also suffer from muscle aches and headaches.
- These symptoms usually begin 2 to 14 days after being exposed to the bacteria

Legionella

- Outbreak in LTCH in 2005
- 135 people infected
- 70 residents
- 21 visitors
- 39 staff
- 5 community
- 23 residents died

Image :Permission Sue Cooper

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Legionella headlines

http://www.youtube.com/watch?v=JR2QKs8qy5s

http://www.thespec.com/news/local/article/673369--four-cases-of-legionnaires-disease-in-hamilton

http://www.cbc.ca/news/health/story/2012/01/11/legionnaires-disease-hospitals-water-features.html\

http://www.onconews.org/health/Legionnaires'_Disease.html

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ROLE AND RESPONSIBILITIES OF IPAC DURING CONSTRUCTION AND RENOVATION

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Role and Responsibilities of IPAC

Active Member of the Multi-disciplinary Construction / Renovation Team

- Communication
- Setting Standards
- Education and Resources
- Risk Assessment
- Surveillance
- Documentation

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Role and Responsibilities of IPAC

Key Players of the Construction/Renovation Team:

- Sr. Administrators
- Plant Operations Manager
- Housekeeping/Environmental Services
- User Groups/Healthcare Staff
- Occupational Health
- Design Professionals
- Constructors
- Communications

Image source: MS Office ClipArt

Role and Responsibilities of IPAC

Communication:

- Establish clear lines of communication between all involved in the project
- Ensure communication plan is followed during project
- Facilitate communication to maintain essentials for safe practice and IPAC *often* in the absence of clear-cut guidelines

Image source: MS Office ClipArt

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Roles and Responsibilities: Setting Standards

Policies and Procedures (P&P) are important!

They outline:

- What an organization wants done
- Why
- How it is done

They must:

- Be clearly written
- Current
- Communicated well
- Accessible in the organization

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Roles and Responsibilities: Policy and Procedure

Examples of policy and procedure documents for construction should include:

- Risk Assessment
- Tendering construction projects includes IPAC requirements
- Products and materials
- Use of barriers
- Cleaning
- Enforcement of IPAC safety measures
- Ensure IPAC Sign off on the project

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Role and Responsibilities of IPAC: Education and Resources

- Ensure Construction Committee/maintenance understand risks and importance of preventive measures
- *CSA standards require IPAC practices to maintain resident/staff safety*
- Acts as a role model wearing appropriate PPE, observing restrictions etc.
- Changes to IPAC measures should be made only *after* approval by the ICP

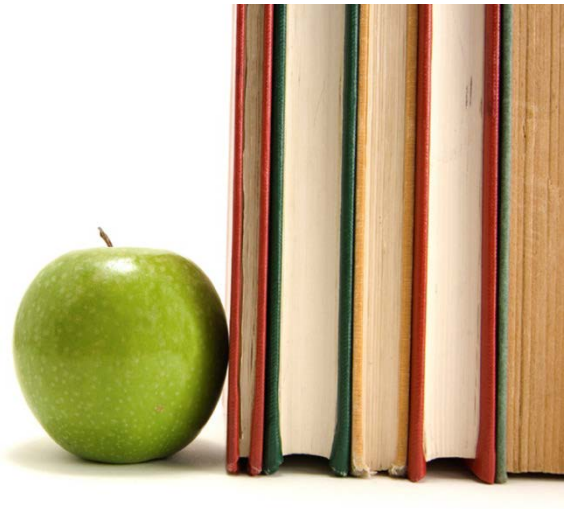

Image source: MS Office ClipArt

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Role and Responsibilities of IPAC

Risk Assessment

- The ICP should be involved in performing a risk assessment for any construction activity within the facility; including minor construction activities.
- Collaborate with medical/nursing staff to identify high-risk residents and move them *as needed* if they are within and/or adjacent to construction area.

Image source: MS Office ClipArt

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Role and Responsibilities of IPAC

ICP to make regular visits to the construction/renovation site to ensure

Image source: MS Office ClipArt

- Training of ICP to ensure they know correct procedure
- Measures are followed
- On-site changes are managed accordingly
- Cleaning is occurring
- Check area before residents return
- Communicate concerns and can shut down site if required

Roles and responsibilities: Surveillance

- Consider your risk matrix
- Are you seeing more respiratory illness in this population
- Review culture results
- Report to Infection Control Committee

  And Administration

Image source: MS Office ClipArt

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Role and Responsibilities of IPAC

Documentation

- All surveillance data collected during and after the project
- Site Audit reports
- All concerns from an IPAC perspective, related activities and problem resolution
- Share your data/concerns with the Construction Committee
- All Construction Committee meetings must have an agenda and detailed minutes

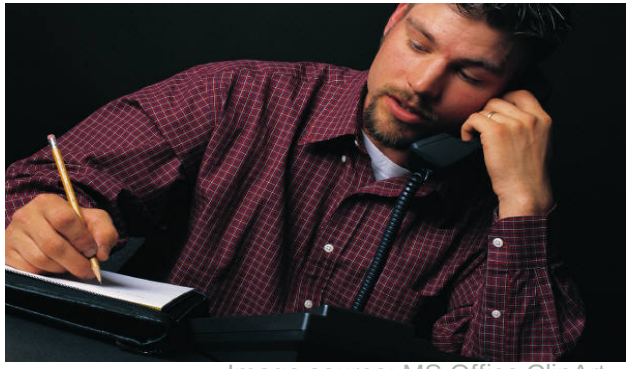

Image source: MS Office ClipArt

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CONSTRUCTION CLASSIFICATION FOR IPAC

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Construction

- Difference between new construction and renovation
- Phasing
- Decanting
- Commissioning
- Communication plan

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What is the Matrix for Classification?

- Systematic Tool
- Uses evidence to support planning
- Found in CSA Standard Z317.13-07

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The Role of Infection Control During Construction in Health Care facilities, AJIC 2000

APIC State of the Art Report

- AIA requires an ICRA
- Early involvement (functional plan)
- Identify number and types of isolation rooms
- Mitigate sources of infection though design (separate patients, placement of hand hygiene facilities)
- Multidisciplinary team

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Risk Assessment and Prevention Measures

Client Risk	List the Type of Activity			

REFERENCE TABLE 1 CSA Z317.13-10

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Risk Group 1: Low Risk

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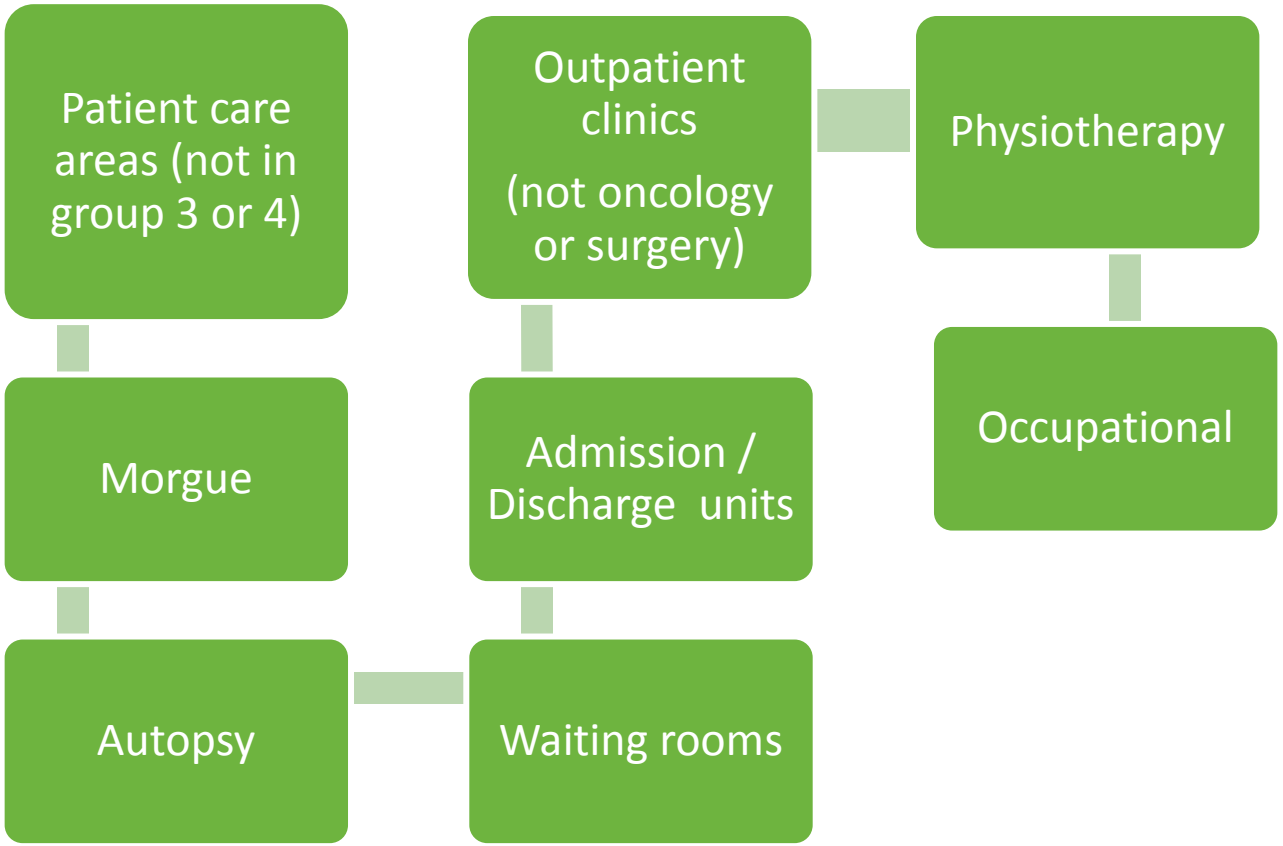
Risk Group 2: Moderate Risk



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Risk Group 3: Moderate to High Risk

Geriatrics	Paediatrics	Labour and Birthing rooms	Diagnostic Imaging
ER (Except Trauma)	LTC	Surgical Units	Respiratory therapy
Nuclear Medicine and Labs	Food prep, serving/ dining	Medical Units	Hydrotherapy, echocardiography

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Risk Group: 4 High Risk

- ICU, OP, PACU, Anaesthesia and storage areas
- Oncology IP and OP
- Transplant IP and OP
- IP and OP for AIDS, dialysis and immune deficient patients.
- Dialysis , NICU, L&D, OR rooms
- Endoscopy
- Pharmacy admixture rooms
- Sterile reprocessing rooms
- Sterile supply areas
- Burn care units, trauma rooms, tissue culture labs
- Bronchoscopy, cystoscopy
- Pacemaker insertion, dental procedure rooms, CPD

Type of Work To Be Done

Type A
Inspection Activities
Non-invasive Activities

Type B
Small Scale Activities
Minimal dust generated

Type C
High Level of Dust
Require Demolition
Removal of fixed component or assembly or can't be completed in one work-shift

Type D
High Levels of Dust
Major Demolition
Major Construction
More than one work-shift

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Prevention Measures

Construction Activity				
Risk Group	Type A	Type B	Type C	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

REFERENCE TABLE 1
CSA Z317.13-10

Prevention Measures Level I

Before:

- Very simple
- Project manager identifies the service disruptions
- May need to consider alternate water supplies
- Identify any high risk patients (HR) that may need to be moved
- Move HR patients if air quality is going to be reduced

Prevention Measures Level I

During:

- Replace tiles after work is completed
- Clean area with HEPA filter vacuum cleaner if necessary
- Protect patient care equipment and supplies from dust exposure

After:

- Debrief and evaluate prevention measures

Prevention Measures Level II

(include level 1 measures too)

Before

- Identify routes for transport of clean/sterile supplies and equipment
- Identify route for construction workers travel so they avoid patient care areas
- Obtain drawings and ensure exhaust is not recirculated to HCF (including designated elevator)
- Assess and identify plumbing lines affected by construction and either shut off or isolated by adding valves
- Determine water sanitizing and start-up policy (equipment, flow path, procedures)

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Prevention Measures Level II

During:

- Minimize and control dust (e.g. drop sheets, water misting, seal windows, air vents unused doors, plumbing penetrations & electrical outlets, waste removed in covered containers)
- Use walk-off mats and keep entrance to area clean
- Disable HVAC system in construction area or ensure engineering analysis is performed to ensure system not compromised.
- Establish negative air pressure that is exhausted outside
- Flush water lines before reuse
- Regular audits to ensure prevention measures in place

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Prevention Measure Level II

After:

- Review audit results with contractor to evaluate prevention measures
- Conduct final inspection:
  - ensure HVAC system is working properly
  - clean with HEPA filtered vacuum followed by hospital grade disinfectant

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Prevention Measures Level III

Before, During & After:

- Implement Measures I and II
- Meet with multidisciplinary team to determine IPAC measures according to Table 1 in Z317.13 document
- Minimize dust generation and dispersal: proper barriers used
- Ventilation systems: negative pressure
- IPAC responsibilities: cleaning, barrier integrity, traffic patterns


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Prevention Measure Level IV

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Before:

- Implement Measures I, II and III

During:

- Access construction area either from outside or through an anteroom if access is from inside

After:

- Use caution to remove barriers and prevent contamination of environment during removal, clean area, multidisciplinary team inspect using checklist, debrief and evaluate.

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Assessment and Ongoing Activities

Assessment and Ongoing Activities: Before Construction

- Workers and staff have IPAC education
- Patient exposure to construction area minimized, staff restricted
- Consider moving high risk patients away from the construction area
- Protect supplies
- Protect equipment
- Define cleaning responsibilities
- Contingency plans for service interruptions
- Traffic Patterns established
- Protect materials from moisture and inspect

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Before Work Begins

- Determine IPAC risk class and prevention measures
- IPAC requirements are in the work orders/tender documents
- Adhere to CSA standards
- ICPs are educated on construction/renovation and design issues
- ICP has a policy /protocol to enable a stop work order
- Clean up of work areas during all stages is clearly defined
- Engineering controls are in place to reduce airborne contaminants
- Remove hazardous materials e.g. sharps

Assessment and Ongoing Activities: During Construction

- Look for water leaks to walls building materials and supplies
- Water disruptions – schedule during low volume times
- Ensure access panels and ceiling tiles are replaced after inspection
- Seal windows and doors, plumbing penetrations, electrical outlets, intake /exhaust vents
- Monitor negative pressure and HEPA filtration
- Replace walk off mats as needed
- Clean area within the construction zone - wet mopped
- Vacuum with a HEPA filter
- Increase frequency of cleaning in areas adjacent to the construction zone
- Transport supplies and equipment in covered containers
- Remove debris at the end of the work day, or in low traffic times
- Cover debris in containers before transporting

Assessment and Ongoing Activities: After Construction

- Flush water lines prior to use
- Ensure proper water temperature
- Follow with environmental services clean
- Run the exhaust fans after the completion of the construction to remove airborne particulates
- Clean up area with HEPA vacuum
- Change air filters / clean as necessary in construction areas
- Ensure that the ventilation system is functioning properly in the construction area and adjacent areas
- Debrief/share results

Barriers

- Polyethylene plastic
- Drywall/Gypsum
- Seal at all edges
- Seal above the false ceiling

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Hoarding

Image Source : PHO Archive

Solid Hoarding – Ante rooms

Image Source : PHO Archive

Before Construction CHICA Audit Tools Combined*

- Workers and staff have IPAC education
- Patient exposure to construction area minimized, staff restricted
- Consider moving high risk patients away from the construction area

*These have been combined and you should consult tools for the specifics related to prevention matrix

- Protect supplies
- Protect equipment
- Define cleaning responsibilities
- Contingency plans for service interruptions
- Traffic Patterns established
- Protect materials from moisture and inspect

During Construction*

- Look for water leaks to walls building materials and supplies
- Water disruptions – schedule during low volume times
- Ensure access panels and ceiling tiles are replaced after inspection
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After Construction*

- Flush water lines prior to use
- Ensure proper water temperature
- Follow with environmental services clean
- Run the exhaust fans run after the completion of the construction to remove airborne particulates n
- Clean up area with HEPA vacuum
- Change air filters / clean as necessary in construction areas
- ensure that the ventilation system is functioning properly in the construction area and adjacent areas
- Debrief/publish results

Successful Surveillance

- Be visible
  - Inspect daily
- Communicate
- Focus on Safety
- Management support
- Education consider a program that includes OH&S and Fire Safety
- Be involved from functional design to cleanup

Lessons Learned

- Avoid making errors that others have made
- Who: define responsibilities, define populations at risk, utilize your network
- What: Use the standards and have a predetermined plan, tap into the experts,
- Where: assess interventions in all areas
- When: in doubt consult other experts, get involved at the functional plan phase
- How: microbiology reports, clinicians, retrospective and prospective case finding, permits , walkabouts
- Why: patient and staff safety, legal implications, reputation, financial

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Really important tools for the ICP to have:

- A hard hat - so you don't hurt yourself while banging your head against the wall
- Safety boots – to protect your feet when people are stepping on your toes
- A Flashlight – to light your way to the car because you are here again after dark
- A camera - because you can't rely on your memory

Quoted by J. Burt with permission

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- Thank you- Questions?

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