Infection prevention and control during construction and renovation: toolkit

July 2018

Government of South Australia
SA Health

Contents

The toolkit has been adapted from:

1. Australasian Health Infrastructure Alliance (AHIA). 2012. Australasian Health Facility Guidelines – Part D Infection Prevention and Control. Available from: http://healthfacilityguidelines.com.au/guidelines.aspx
2. Country Health SA Local Health Network. 2013. Infection Control during Healthcare Facility Construction, Renovation and Maintenance Guideline.
3. Health Canada. Construction-related Nosocomial Infections in Patients in Health Care Facilities: Decreasing the Risk of *Aspergillus, Legionella* and Other Infections. Can Commun Dis Rep. 2001. July; 27 Suppl. 2:i-x, 1-42, i-x, 1-46.
4. Moon K, Hellsten J, Woodburn P. 2005. Infection Control Principles for the Management of Construction, Renovation, Repairs and Maintenance within Health Care Facilities - a manual for reducing the risk of health care associated infection by dust and water borne microorganisms. Loddon Mallee Region Infection Control Resource Centre, Victoria.

Introduction

Environmental disturbances which occur during construction or renovation projects pose both airborne and waterborne risks to persons with poorly functioning immune systems. Construction and renovation projects can generate large amounts of dust and debris. Activities that disrupt water supplies can introduce waterborne pathogens such as *Legionella* species. It is essential all key stakeholders are included in all stages of the project to minimise the risk of vulnerable patients acquiring a serious infection whilst in a healthcare setting.

How to use the toolkit

This toolkit should be used during the planning phase of the construction/renovation project by the multidisciplinary planning committee using the following process:

1. determine the construction type (Step 1)
2. determine the patient risk group (Step 2)
3. determine the class of precautions required by completing the risk matrix (Step 3)
4. determine the type of precautions that will be required (Step 4) according to the risk identified in Step 3.
5. complete the Construction and Renovation Risk Assessment Form (Step 5)

During the construction/renovation phase dust barriers and other protective measures should be regularly monitored. The frequency of monitoring depends on a risk assessment of the area involved, e.g. if high risk areas and patient groups are involved then daily monitoring should occur using the Environmental Monitoring Compliance Checklist.

Once the construction/renovation project is completed, and before occupation, all barriers should be removed, the area thoroughly cleaned and air handling and water systems tested. Prior to use, results must be within acceptable parameters - use Part A-Completion of Project Checklist as a guide.

Prior to use, a member of the multi-disciplinary planning committee should inspect the area to ensure it is fit for purpose using Part B of the Completion of Project Checklist.

Pre-construction and renovation assessment

Step 1 – Construction activity type

Construction activity type is defined by:

- the expected amount of dust generated
- duration of the involvement of the heating, ventilation and air conditioning (HVAC) systems

Type A	**Activities which do not generate dust: inspection and non-invasive activities** Includes but is not limited to: > activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection, e.g. painting, minor plumbing or electrical trim work.
Type B	**Activities which generate minimal dust** Includes but is not limited to: > installation of telephone and computer cabling > access to chase spaces > cutting of walls or ceilings where dust migration can be controlled.
Type C	**Activities which generate a moderate to high level of dust** Includes but is not limited to: > demolition or removal of built-in building components or assemblies > 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.
Type D	**Major demolition and construction projects** Includes but is not limited to: > heavy demolition > removal of a complete ceiling system > new construction.

> Note: for type B activities that are being undertaken in areas that house high risk patients, the level of dust containment will depend on the potential impact in patient care areas e.g. a cabling installation in a corridor adjacent to patient rooms may not require full sealing of the area and air-conditioning shut down etc. if patients can be moved, doors closed etc. this would mitigate the risk to these patients.

Step 2 – Identify patient risk groups

The patient risk group is defined by the project location.

Using the following table, identify the patient risk group. If more than one area will be affected, select the higher risk group.

Low risk	> office areas > public areas > unoccupied wards
Medium risk	> admission/discharge units > allied health areas > catering services (kitchens) > laundry services > mental health areas > outpatient clinics (except oncology/haematology) > all other patient care areas unless stated in high and highest risk groups
High risk	> dental clinics > echocardiography > emergency department > patient care laboratories e.g. pulmonary (respiratory) function, sleep > labour and delivery units (except operating room) > maternity/paediatrics > pathology laboratories > medical/surgical wards > nuclear medicine > radiology / magnetic resonance imaging (MRI)
Highest risk	> anaesthesia areas > cardiac catheterisation and angiography areas > cardiovascular/cardiology wards > day surgery units > dialysis units > endoscopy and bronchoscopy areas > haematology/oncology wards and outpatient clinics (including radiotherapy) > intensive care (adult, neonatal and paediatric) > high dependency units > operating theatres (including recovery) > pharmacy clean rooms > sterilising departments (including sterile stores) > transplant units

Step 3 – Determine the class of precautions

Match the **construction activity type** (A, B, C, D) determined in step 1 with the **patient risk group** determined in step 2 (low, medium, high, highest) to ascertain the **class of precautions** required (I, II, III, IV).

Patient risk group	**Construction activity type**			
	Type A	**Type B**	**Type C**	**Type D**
Low	I	II	II	III / IV
Medium	I	II	III	IV
High	I	III	III / IV	IV
Highest	I - III	III / IV	III / IV	IV

If staff are unsure how to determine the construction activity type or patient risk group, contact the infection prevention and control consultant for assistance.

Step 4 – Type of precautions required during construction or renovation project

Infection prevention and control staff (or designated responsible person) in liaison with the appropriate clinical manager will determine whether construction or renovation activity poses a sufficient increased risk to require patients be moved away from the construction/renovation area to an area of the healthcare facility where such activities are not occurring.

	Tasks	Check
Class I	1 Work in a manner to minimise generating dust from construction operations.	
	2 Immediately after visual inspection completed, replace any ceiling tile displaced.	
Class II	The following are to be considered in addition to Class I 1 Provide active means to prevent dust from dispersing into atmosphere (e.g. use of extractor fans).	
	2 Seal unused doors with masking tape.	
	3 Water mist work surfaces to control dust while cutting.	
	4 Isolate HVAC system in areas where work is being performed	
	5 Place dust mats at entrance to work area and replace or clean when no longer effective.	
	6 Contain construction waste before transport in tightly covered containers	
Class III	The following are to be considered in addition to Class I and II 1 Alter or isolate the air handling system in the construction activity area to prevent contamination of the entire duct system. Supply ducts and return air ducts should be covered to prevent dust contamination.	
	2 Where containment is possible, utilise building walls and close all doors (excluding construction access doors) and seal with duct tape to prevent escape of dust and debris.	
	3 In construction, demolition, or reconstruction projects where containment with existing building walls and doors is not possible, use one of the following: a) airtight plastic barriers (e.g. Zipwall system) extending from floor to ceiling decking or ceiling tiles (if not removed) b) plastic barriers with seams sealed with duct tape to prevent dust and debris escape c) drywall barriers with seams or joints covered or sealed to prevent escape of dust and debris.	
	4 Maintain negative pressure within work site, if necessary.	
	5 Direct pedestrian traffic from construction areas away from patient-care areas and limit opening and closing of doors (or other barriers) that may cause dust dispersion, entry of contaminated air, or tracking of dust to patient areas.	

	Tasks	Check
Class IV	The following are to be considered in addition to Class I, II and III	
	1 Place isolation barriers at penetration of ceiling envelopes, chases and ceiling spaces to stop movement of air and debris.	
	2 When openings are made into existing ceilings in clinical/ laboratory areas, where possible, a decontamination unit which will seal off openings and fit tightly from ceiling to floor should be used.	
	3 Construct an anteroom to ensure airflow from the clean area through the anteroom and into the work area. Require all personnel to pass through the anteroom whenever entering or exiting the construction/renovation site to put on or remove disposable coveralls or shoe covers.	

Step 5 - Construction and renovation risk assessment

A risk assessment following the steps detailed below must be undertaken by the designated responsible staff which includes (but not limited to) project manager, infection prevention and control, work health & safety, safety and quality, engineering services and the building contractor, before construction or renovation activities commence.

Guideline for infection prevention and control during healthcare facility construction, renovation and maintenance: RISK ASSESSMENT	
Project	
Date	/ /
Reviewer	
Planned date of commencement	/ /
Site	
Construction activity type	
Patient risk group	
Class of infection control precautions required	
Safety and quality notification	

A copy of this risk assessment must be forwarded to the responsible person nominated during the planning phase.

Environmental monitoring compliance checklist

Project _____ **Date** ____/____/____

Location of work _____ **Time** _____

Surveyor _____ **Department** _____

During the construction/renovation phase dust barriers and other protective measures should be regularly monitored depending on a risk assessment of the area involved, i.e. if high risk areas and patient groups are involved then daily monitoring should occur.

1. Construction barricade	**Answer (circle one)**		
> dust tight barricades sealed, no penetration	Yes	No	N/A
> dust mats at entrance/exit	Yes	No	N/A
> all access doors close and seal properly	Yes	No	N/A
> all access doors are closed to public	Yes	No	N/A
> ventilation ducts to building site covered	Yes	No	N/A
2. Adjacent areas with staff / patients access	**Answer (circle one)**		
> ceiling areas intact and dry	Yes	No	N/A
> floor areas clean with no dust tracked	Yes	No	N/A
> walls intact and dry	Yes	No	N/A
> horizontal surfaces dust free	Yes	No	N/A
> vents dust free	Yes	No	N/A
> all ventilation ducts from building site sealed	Yes	No	N/A
> no signs of pest infestation	Yes	No	N/A
3. Traffic flow	**Answer (circle one)**		
> building contractors accessing site through approved non-patient care areas	Yes	No	N/A
> waste covered and contained prior to removal	Yes	No	N/A
> routine and timing of waste removal as per agreement	Yes	No	N/A

Comments

Non-compliance issues

Issue	Report to	Date

Resurvey date ..... / ..... / ..... **Surveyor** ..... **Compliance achieved** (circle) **Yes** **No**

Further action taken:

.....

.....

.....

.....

Surveyor's signature .....

Completion of project

The tasks listed in Part A & Part B of the 'Completion of project checklist' must be undertaken upon completion of any construction or renovation project.

Part A - To be completed by the contractor or as determined by the multi-disciplinary planning committee

	Tasks		Check
Class I	1	Clean work area upon completion of the task. This includes all horizontal and vertical surfaces to ensure all dust and debris has been removed.	
Class II	1	Contain construction waste before transport in tightly covered containers.	
	2	Clean work surfaces with water and detergent/disinfectant.	
	3	Wet mop and / or vacuum with HEPA filtered vacuums before leaving the work area.	
	4	Remove isolation of HVAC system in areas where work is performed.	
Class III	1	Do not remove barriers from work area until completed project has been inspected by Workforce and Infection Control staff; and thoroughly cleaned by Housekeeping staff.	
	2	Contain construction waste before transport in tightly covered containers.	
	3	Remove barrier materials carefully to minimise spreading of dust and debris associated with construction.	
	4	Clean work surfaces with hot water and detergent/disinfectant.	
	5	Vacuum work area with HEPA filtered vacuums.	
	6	Wet mop area with hot water and detergent/disinfectant.	
	7	Remove isolation of HVAC system in areas where work is performed.	
Class IV	1	Do not remove barriers from work area until completed project is inspected by Workforce and Infection Control staff; and thoroughly cleaned by Housekeeping staff.	
	2	Contain construction waste before transport in tightly covered containers.	
	3	Remove barrier material carefully to minimise spreading of dust and debris associated with construction.	
	4	Cover transport receptacles or carts. Tape down covering unless solid lids are in use.	
	5	Clean work surfaces with hot water and detergent/disinfectant.	
	6	Vacuum work area with HEPA filtered vacuums.	
	7	Wet mop area with hot water and detergent/disinfectant.	
	8	Remove isolation of HVAC system in areas where work is performed.	

Additional comments

Part B - Prior to handover and before patient occupation. It is the responsibility of the multi-disciplinary planning committee to ensure the area is fit for purpose.

Project _____

Review date ____ / ____ / ____

Infection control measures	Answer (tick one) Yes	No	Not applicable
> The area has been thoroughly cleaned. This includes all horizontal and vertical surfaces to ensure all dust and debris has been removed.			
> The area has been vacuumed with a HEPA filter vacuum			
> The area has been wet mopped with detergent / disinfectant			
> When commissioning a new or refurbished operating theatre or pharmacy clean room check air sampling and particle counts have been performed and results are within acceptable limits. > Air conditioning is working correctly and within recommended parameters as per engineering and building services and / or the Contractor > HEPA filters and laminar/clean flow systems (where installed) have been recertified			
> If the water supply has been disrupted: maintenance/contractor has flushed water through all taps and water sampling has occurred (as per the *Guidelines for the Control of Legionella* (2013), as necessary, with results within acceptable levels (<10 cfu/ml)			
> Sinks and plumbing fixtures are suitable for the task and properly located (as per relevant Standards)			
> Air intake and exhaust outlets are located and working properly			

Comments

Appendix 1: Microbiological air sampling: indication and methods

The transmission of infectious diseases through the air can be minimised by the application of appropriate air handling systems.

In critical environments, such as operating theatres and protective environments for severely neutropenic patients, the quality of the air supply is important in reducing the potential for infection with airborne microorganisms. Microbiological sampling of the air supply has been suggested as one way of ensuring air quality, but this is a controversial and not universally accepted practice.

When should air sampling be performed?

There are no nationally agreed standards on when to undertake microbiological sampling in the operating theatre or protective environments for severely neutropenic patients, or on the interpretation of sampling results. However, there is sufficient evidence to support microbiological air sampling in the following circumstances:

- as part of the commissioning of a new or refurbished operating theatre or pharmacy clean room
- after any major structural refurbishment of the operating theatre suite, particularly involving the air handling system
- as part of an investigation of a cluster of fungal infections in immunosuppressed patients.

Specialist microbiologist and/or infection control advice must be sought prior to undertaking air sampling, due to the large number of factors that affect microbial air sampling results, including indoor traffic, temperature, humidity, time of day or year and the performance of the air handling system. Air sampling will only measure indoor air quality at a single point in time.[1]

What method should be used?

The preferred method of sampling, known as active sampling, uses a device that pumps or draws air through a metered orifice or sieve and deposits air directly onto the surface of a nutrient growth medium such as an agar plate. The medium is then incubated for a minimum of 48 hours and the results presented as the number of colony-forming units (CFU) per cubic metre of air. Active sampling using a specific device should be performed by a trained and experienced technician, such as a laboratory technician, NATA accredited consultant or pharmacist familiar with clean room sampling.

The optimum sampling volume is one cubic metre (1,000 L) of air. Duplicate samples should be taken from each sampling point. Samples should be collected from the centre of each operating theatre, sterile store room and any designated sterile set-up room. It is preferable to use a sampler with a remote control or delay timer to ensure enough time for any contaminants introduced by the operator during set up to disperse before sampling (usually about 15 minutes).[2]

Passive sampling consists of exposure of one or more agar plates in the open air to allow microorganisms to settle onto the plate surface due to gravity (settle plates). The agar plates are exposed for a prescribed time (e.g. one hour), incubated, and the results reported as total CFU/m^2/hr. The results from settle plates do not correlate well with results from active air sampling; therefore they have limited applicability. Settle plates are not recommended for commissioning of operating theatres due to a lack of sensitivity and the high risk of accidental contamination of the plates during set-up.[2] There are no applicable standards for settle plate sampling.

When to sample

The most appropriate time for microbiological sampling during commissioning of an operating theatre is shortly before it comes into use. All engineering checks should be completed and satisfactory prior to conducting air sampling. The theatre should have been thoroughly cleaned and remain empty with the air conditioning operating at normal flow rates for at least 24 hours prior to testing.

Air sampling can also be used to test the integrity of dust controls during construction or refurbishment activities close to clinical areas housing immunocompromised patients. Sampling for this purpose should always be done in consultation with a microbiologist and the infection control team as there are many factors to consider in the interpretation of results.

Result interpretation

Sampling results are highly variable due to the factors outlined above. Depending on the season, outdoor total fungal spore levels can commonly exceed 1,000 CFU/m^3. Levels of *Aspergillus fumigatus* spores in outdoor air average between one and 15 CFU/m^3. In an air conditioned building total fungal spore levels usually will be below 100 CFU/m^3.

The following is a guide to the acceptable levels of CFU/m^3 for active air sampling in operating theatres based on the UK Hospital Infection Society Working Party report on microbiological commissioning and monitoring of operating theatre suites (2002) and the NHS Estates Health Technical Memorandum (HTM) 03-01 (2007):[3]

Type of operating theatre	Expected result
Ultraclean operating theatre (HEPA-filtered, laminar flow)	< 0.5 CFU/m^3 air, or one bacterial or fungal colony for each 2 cubic metres air sampled.
Conventionally ventilated operating theatre or procedure room (may be HEPA-filtered, turbulent flow)	< 10 CFU/m^3 bacteria and/or fungi or not exceeding historical counts if these are lower.

Results that are outside of these limits should be discussed with a clinical microbiologist or infectious diseases specialist.

The operating room should not be used until the results of air sampling have been shown to be within the above limits. Heath facilities should be aware of the turnaround time for testing (up to 5 days) and plan accordingly.

References

1. Moon, K. (2003). Infection Control Principles for the Management of Construction, Renovation, Repairs and Maintenance within Health Care Facilities. Loddon Mallee Region Infection Control Resource Centre, Bendigo.
2. Hoffman, P. N., Williams, J., Stacey, A.*, et al.* (2002). Microbiological commissioning and monitoring of operating theatre suites. *Journal of Hospital Infection* **52**: 1-28.
3. Department of Health Estates and Facilities Division. (2007). Heatlh Technical Memorandum (HTM) 03-01: Specialised ventilation for healthcare premisis. Part A - design and validation. London: The Stationery Office, United Kingdom.

Other useful information can be found in:

Health Canada. (2001). *Construction-Related Nosocomial Infections for Hospitalized Patients: Decreasing the Risk of Aspergillus, Legionella and Other Infections*. Division of Nosocomial and Occupational Infections, Ottawa. Available from: http://www.abatement.com/pdf/canada-construction-guidelines.pdf

Centers for Disease Control and Prevention. (2003). *Guidelines for Environmental Infection Control in Health Care Facilities*. Healthcare Infection Control Practices Advisory Committee (HICPAC). Available from: http://www.cdc.gov/hicpac/pubs.html

For more information

Infection Control Service
Communicable Disease Control Branch
11 Hindmarsh Square
Adelaide, SA 5000
Telephone: 1300 232 272
www.sahealth.sa.gov.au/infectionprevention

Public-I1-A2

Government of South Australia
SA Health