



Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive



Health Protection Surveillance Centre

APPENDIX D

Sample Template of a Hospital Policy Document on
Infection Prevention and Control Recommendations
for the Prevention of Nosocomial Invasive
Aspergillosis during Hospital Construction or
Renovation

A Report of the Aspergillosis Subcommittee of the
Health Protection Surveillance Centre
Scientific Advisory Committee

January 2018

Appendix D

Sample Template of a Hospital Policy Document on Infection Prevention and Control Recommendations for the Prevention of Nosocomial Invasive Aspergillosis during Hospital Construction or Renovation

This template should be used in conjunction with the National Guidelines for the Prevention of Nosocomial Aspergillosis 2017, available at: <http://www.hpsc.ie/A-Z/Respiratory/Aspergillosis/Guidance/>

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Distributed to: Stakeholders (e.g. Chief Executive Officer/Manager, Nurse Managers, Department heads)

1.0 Introduction

1.1 *Aspergillus* species are ubiquitous fungi that commonly occur in soil, water, organically enriched debris and decaying vegetation. Many species of *Aspergillus* have been recognised in nature but only a few have been associated with human disease. *A. fumigatus* is the principal pathogenic *Aspergillus* species. *A. flavus*, *A. terreus*, *A. niger* and *A. nidulans* are relatively less common. *Aspergillus* spp. are responsible for a wide spectrum of human illnesses ranging from colonisation of the bronchial tree to rapidly invasive and disseminated diseases. Invasive aspergillosis (IA) is primarily an infection of severely immunocompromised patients i.e. patients with haematological malignancies undergoing intensive remission-induction chemotherapy, or haematopoietic stem cell transplantation, and solid organ transplant recipients and is difficult to diagnose and treat. However, over the last decade it has been increasingly recognised that immunocompetent patients who are critically ill or with severe chronic obstructive pulmonary disease (COPD) are at increased risk of IA. Mortality is still high despite new therapies, thus making prevention a high priority in the management of all at-risk patients.

Hospital acquired outbreaks of IA have become a well-recognised complication of construction, demolition or renovation work in or near hospital wards in which immunosuppressed patients are housed. *Aspergillus* spores are superbly adapted to airborne dissemination. These spores are passively liberated during construction/renovation activities and can be transported great distances as airborne particles by normal atmospheric conditions such as convection currents and wind. Airborne transmission is the principal route of transmission of *Aspergillus* within the hospital environment. The respiratory tract is the most common portal of entry and the small diameter of the spores (2.5-3.5 µm) permits them to reach the pulmonary alveolar spaces, where they may germinate to form hyphae.

1.2 The majority of the outbreaks reported were related to contamination of the hospital air as a result of the dust and dirt raised during construction, demolition or renovation projects within or adjacent to the health care facility. Specific construction/maintenance activities included:

(i) general construction and renovation work, (ii) disturbance of soil resulting from earth works associated with building construction and site development, (iii) removal of suspended ceiling tiles, (iv) removal of fibrous insulation material, and (v) opening up of service distribution shafts. Aspergillosis outbreaks have also been associated with improper operation and poor maintenance of sophisticated air ventilation systems.

1.3 Host immunity plays a major role in determining who may be at risk of developing IA.

2.0 Responsibility and Accountability

- 2.1** Compliance to this policy is monitored as part of the Infection Prevention and Control Team (IPCT) review of compliance to infection prevention and control aspergillois risk reduction guidance circulated to relevant stakeholders prior to the commencement of project following review of scope of works method statement.
- 2.2** The Hospital Chief Executive Officer/Manager has overall responsibility for the health and safety of patients, staff and visitors.
- 2.3** The IPCT should:
- communicate and provide advice regarding implementation of measures prior to and during construction/renovation phase to reduce the risk of IA
 - be consulted and involved at the design phase and throughout the project until completion and commissioning for all construction/renovation projects
 - monitor compliance to this policy with the Technical Services staff.
- 2.4** The Technical Services staff should:
- be aware of the risks posed by construction activity to at-risk patients
 - should consult with the IPCT in advance of all minor or major construction or renovation activities
 - monitor implementation of preventive practices and maintain records relating to fixed plant precautions and maintenance of *Aspergillus* protection systems. The use of an *Aspergillus* preventive measures compliance checklist is recommended to control such activities (Appendix I)
 - ensure details of all works and maintenance activities are communicated to the IPCT and the method statement provided to the IPCT.
- 2.5** The Planning Department must consult with the IPCT at the design phase and planning meetings for any construction/renovation projects.
- 2.6** Department Heads/Ward Managers are responsible for informing the IPCT if there is any breach in implementation of the guidance.
- 2.7** Hospital Chief Executive Officers/Managers should ensure that they are aware of construction/renovation activities external to but proximal to the hospital and institute precautionary measures to protect at-risk patients where appropriate, based on the findings of the risk-assessment.
- 2.8** Medical and nursing staff should be aware of patient populations at risk, potential hazards that construction/renovation projects pose to patients, and the preventive measures required. The IPCT should collaborate with medical and nursing staff to identify patients at risk, and to monitor the effectiveness of preventive measures taken throughout the project.

3.0 Key Statements

- 3.1** The key measures to minimise the risk of *Aspergillus* infection are:
- 1) minimise the dust generated during construction activity
 - 2) prevent dust infiltration into adjacent patient care areas.
- 3.2** Non-adherence to invasive aspergillois risk reduction guidance will result in cessation of project, convening of meeting by the Hospital Chief Executive Officer/Manager with the Project Team, Risk Manager, IPCT and other relevant stakeholders.

4.0 Infection Prevention & Control Measures

- 4.1** There is now an acceptance that IA can be linked to demolition, excavation, construction and refurbishment activities within or adjacent to the hospital site. Over the last decade the adoption of control measures by health care facilities has been successful and has facilitated extensive hospital building works without a significant increase in aspergillois. However, the variety of patients susceptible to IA has expanded and with advanced medical technology will become more extensive. It is imperative to plan and ensure that optimum protection is afforded to all patient groups, based on their perceived

risk. The preventive measures implemented will depend on the type of construction/renovation being undertaken in the hospital and the proximity of the at-risk patients to this site. This will be based on the results of a risk assessment.

4.2 A formal invasive aspergillosis risk assessment (IARA) should be performed by a multi-disciplinary team whereby the following are identified:

- (1) the scope and hazards inherent in the building project,
- (2) the patient groups 'at risk' and
- (3) the necessary safeguards.

Implementation of the recommended preventive measures is assigned to the appropriate groups that extend from ward level to the project manager.

There are **four steps** to the IARA process:

Step One: Consider patient risk factors and assign to correct group: 1-4. If more than one risk group is identified within a specific cohort, select the higher risk group (Table 1).

Step Two: Detail construction activity and assign type: A1, A2, B, C or D (Table 2).

Step Three: Determine the construction site preventive measures and assign class: 0-III (Table 3).

Step Four: Verify risk assessment by checking with matrix (Table 4).

Table 1. Classification of at-risk patients

At-risk patients may be categorised as outlined below. However, all patients should be individually risk assessed to determine if they are at risk of developing IA.

Classification	Details
Group 1 - No evidence of risk¹	<ol style="list-style-type: none"> Staff members², service providers and contractors All patients not listed in Groups 2 – 4 below
Group 2 - Increased risk	<ol style="list-style-type: none"> Patients on prolonged courses of high dose steroids³ or tumour necrosis factor α (TNF-α) antagonists, particularly those hospitalised for prolonged periods Severely immunosuppressed AIDS patients Patients undergoing mechanical ventilation Non-neutropenic patients on chemotherapy⁴ Dialysis patients
Group 3 - High risk	<ol style="list-style-type: none"> Patients with neutropenia for less than 14 days following chemotherapy Adult acute lymphoblastic leukaemia patients on high dose steroid therapy³ Solid organ transplantation Patients with Chronic Granulomatous Disorder Neonates in intensive care units COPD patients meeting GOLD stage III and IV criteria⁵ and in intensive care or high dependency units Patients with extensive burns
Group 4 - Very high risk	<ol style="list-style-type: none"> Allogeneic haematopoietic stem cell transplantation⁶ <ol style="list-style-type: none"> during the neutropenic period with graft-versus-host disease requiring steroid \pm other immunosuppressive therapy Autologous haematopoietic stem cell transplantation⁶, i.e. during the neutropenic period Non-myeloablative transplantation Children with severe combined immunodeficiency syndrome (SCID) Prolonged neutropenia for greater than 14 days following chemotherapy or immunosuppressive therapy (including acute myeloid leukaemia) Aplastic anaemia patients

Note: Cystic fibrosis patients should also be considered. Each cystic fibrosis patient is assigned to one of the above four categories depending on the stage of his/her illness.

1 Assuming no known immunocompromise

2 Staff should be informed of pending construction projects, and staff concerned re immunocompromise should be referred to Occupational Health

3 Prolonged use of corticosteroids (excluding among patients with allergic bronchopulmonary aspergillosis) at a mean minimum dose of 0.3 mg/kg/day of prednisone equivalent for >3 weeks (De Pauw et al, 2008)

4 ANC count $>1 \times 10^9/l$

5 Furthermore, wards with a high occupancy of COPD patients (e.g. respiratory wards) meeting GOLD stage III and IV criteria should be risk assessed on the basis of the patients' levels of immunosuppression, and the threat posed to the patients by the construction activity. However, the guideline group recognise it is not possible to risk assess all COPD patients meeting GOLD stage III and IV criteria who are dispersed throughout the hospital.

6 Includes bone marrow transplantation patients

Table 2. Details of the type of construction project activity

Type	Description of the activity
TYPE A1	<p>Minor internal containable activities with no/minimal dust generation</p> <p>This includes, but is not limited to, inspection and non-invasive activities and small-scale activities that create minimal dust. These include, but are not limited to, activities that require removal of ceiling tiles for preliminary visual inspection (limited to 1 tile per 5m²), painting (no sanding), wall covering, electrical trim work, minor plumbing and other maintenance activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.</p>
TYPE A2	<p>Minor internal small-scale works with some dust generation that can be contained</p> <p>This includes, but is not limited to, minor works on a small scale where dust containment is achieved by using dust barriers and a HEPA-filtered vacuum.</p> <p>Activities that require access to conduit spaces, cutting of walls, woodwork or ceilings where dust migration can be controlled, for example installation or repair of minor electrical work, ventilation components, telephone wires or computer cables. It also includes minor plumbing as well as minor drilling to allow for the erection of brackets and shelving.</p>
TYPE B	<p>Major internal containable activities</p> <p>Any work that generates a moderate level of dust or requires demolition or removal of any fixed building components or assemblies (e.g. counter tops, cupboards, sinks). These include, but are not limited to, activities that require sanding of walls for painting or wall covering, removal of floor-covering, ceiling tiles and stud work, new wall construction, minor duct work or electrical work above ceilings, major cabling activities, and any activity that cannot be completed within a single work shift. This type of activity includes extensive plumbing work. It also includes demolition or removal of a complete cabling system or plumbing and new construction that requires consecutive work shifts to complete.</p>
TYPE C	<p>Minor external non–containable activities</p> <p>External construction activities that generate moderate levels of dust or minor excavations. Such activities include, but are not limited to, digging trial pits and minor foundations, trenching, landscaping, minor construction and demolition work.</p>
TYPE D	<p>Major external non–containable activities</p> <p>External construction activities that generate large levels of dust. Such activities would include, but are not limited to, major soil excavation, demolition of buildings and any other construction activity not covered under Type C.</p>

Table 3. Description of the required infection prevention and control precautions by class

Class 0 Preventive Measures

Dust Control

- Immediately replace ceiling tiles displaced for preliminary visual inspection

Cleaning

- Wet mop and vacuum area as needed and when work is completed
- Wipe horizontal and vertical work surfaces with hot soapy water

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity

Patient Risk Reduction

- Minimise exposure of patients in at-risk Group 2 to the construction/renovation area
- Minimise dust and increase cleaning in patient area

Note: Class 0 preventive measures do not apply to Groups 3-4 at-risk patients. For further details, please see matrix presented in Table 5.

Class I Preventive Measures

Dust Control

- Immediately replace ceiling tiles displaced for visual inspection
- Execute work by methods to minimise dust generation from construction or renovation activities
- Provide active means to minimise dust generation and migration into the atmosphere

Cleaning

- Wet mop and vacuum area as needed and when work is completed
- Wipe horizontal and vertical work surfaces with hot soapy water

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity and the permit to be issued
- In collaboration with cleaners and technical services, ensure that the construction zone remains sealed and that the cleaning is adequate at all times

Patient Risk Reduction

- Move at-risk patients (Groups 2-4) away from construction zone. If it is not possible to move, for example ICU patients, an impermeable dust barrier should be erected around the construction zone
- Minimise patients' exposure to the construction/renovation area
- Minimise dust and increase cleaning in patient area

Class II Preventive Measures

Dust Control

- Execute work by methods to minimise dust generation from construction or renovation activities
- Erect an impermeable dust barrier from floor to slab/floor
- Ensure windows and doors are sealed
- A separate entrance away from patient traffic should be created for use by construction workers
- Protective clothing should be worn by construction workers and removed when leaving the construction site
- Dust barrier should not be removed until the project is complete

Ventilation of Construction Zone

- Seal windows
- Maintain negative pressure within construction zone by using a portable extract fan
- Ensure air is exhausted directly to the outside where feasible and away from intake vents or filtered through a minimum of an F9 filter
- Ensure the ventilation system is functioning properly and is cleaned if contaminated by soil or dust after construction or renovation project is complete

Debris Removal and Cleaning

- Contain debris in covered containers or cover with either an impermeable or moistened sheet before transporting for disposal
- Remove debris at end of the work day
- An external chute will need to be erected if the construction is not taking place at ground level
- Vacuum work area with HEPA-filtered vacuums daily or more frequently if required

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity and the permit to be issued
- In collaboration with cleaners and technical services, ensure that the construction zone remains sealed and that the cleaning is adequate at all times

Patient Risk Reduction

- Move all patients from within the construction zone
- If possible move at-risk patients (Groups 2-4) who are adjacent or near to the construction zone
- Ensure that patients do not go near construction zone
- All windows, doors, air intake and exhaust vents should be sealed in areas of the hospital containing patients who are classified as at increased risk (Groups 2-4), if the construction or demolition work is considered likely to result in *Aspergillus*-contaminated air entering these areas
- High and very high-risk patients (Groups 3-4) should preferably be treated in HEPA-filtered, positive pressure isolation rooms or facilities. Where such facilities are not available, the local IPCT should perform a risk assessment to identify alternative options. This may include neutral pressure isolation rooms (also referred to as a room with positive pressure ventilated lobby (PPVL)). Although these facilities have been validated from an engineering perspective they have not yet been clinically validated for the prevention of nosocomial aspergillosis among at-risk patients, see section 3.5.1 and 3.5.2 of the guideline document for more details.

Traffic Control

- In collaboration with the Technical Services Manager, designate a traffic pattern for construction workers that avoids patient care areas and a traffic pattern for clean or sterile supplies, equipment, patients, staff and visitors that avoids the construction zone
- A traffic path should be designated for the removal of rubble from the construction site which preferably is separate to and away from all hospital-related traffic.

Class III Preventive Measures

Dust Control

- Execute work by methods to minimise dust generation from construction or renovation activities
- Provide active means to minimise dust generation and migration into the atmosphere. During dry weather soil must be regularly dampened for the period involving any ground works

Debris Removal and Cleaning

- Contain debris in covered containers or cover with an impermeable or moistened sheet before transporting for disposal
- Ensure no increased dust within hospital, increased cleaning may be necessary

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity and the permit to be issued
- In collaboration with technical services ensure that dust is minimised from the construction site and that the construction site measures are being adhered to
- Ensure that cleaning is adequate to minimise dust within the hospital

Patient Risk Reduction

- No specific requirement for Risk Group 1
- If possible move at-risk patients (Groups 2-4) who are adjacent or near to the construction zone
- Ensure that patients do not go near construction zone
- All windows, doors, air intake and exhaust vents should be sealed in areas of the hospital containing at-risk patients (Groups 2-4), if the construction or demolition work is considered likely to result in *Aspergillus*-contaminated air entering these areas
- High and very high-risk patients (Groups 3-4) should be preferably treated in HEPA-filtered, positive pressure isolation rooms or facilities. Where such facilities are not available the local IPCT should perform a risk assessment to identify alternative options. This may include neutral pressure isolation rooms (also referred to as a room with positive pressure ventilated lobby (PPVL)), although these facilities have been validated from an engineering perspective they have not yet been clinically validated for the prevention of nosocomial aspergillosis among at-risk patients, see section 3.5.1 and 3.5.2 of the guideline document for more details.

Traffic Control

- In collaboration with the Technical Services Manager, designate a traffic pattern for construction workers, that avoids patient care areas and a traffic pattern for clean or sterile supplies, equipment, patients, staff and visitors that avoids the construction zone
- A traffic path should be designated for the removal of rubble from the construction site which preferably is separate to and away from all hospital-related traffic.

Table 4. Matrix of construction project activity type, patient risk group and class of required infection prevention and control precautions

This matrix was adapted from Infection Control Risk Assessment Matrix of Precautions for Construction & Renovation from the Association of Professionals in Infection Control and Epidemiology

Patient Risk Group	Construction Activity Type				
	TYPE A1	TYPE A2	TYPE B	TYPE C	TYPE D
Group 1 – No evidence of risk	0	I	I	III	III
Group 2 – Increased risk	0	I	II	III	III
Group 3 – High risk	I	I	II	III	III
Group 4 – Very high risk	I	I	II	III	III

Note 1: Engagement with the IPCT is required irrespective of type of construction activity.

Note 2: This is a guide and if specific risk issues are identified, an individual risk assessment of that issue may be required.

5.0 Construction and Ventilation Measures

5.1 A number of measures may be implemented by hospital construction designers and maintenance personnel to protect at-risk patients during building activities on hospital sites. The measures identified in the available literature on the subject vary from basic minimal precautions and good housekeeping to major mechanical services intervention involving dedicated high-efficiency particulate air (HEPA) filtered installation systems to protect the areas in which the at-risk patients are housed.

5.2 These measures may be divided into:

5.2.1 Measures to reduce dust emission from construction zone

5.2.2 Measures to physically protect at-risk patients

5.2.1 Measures to reduce dust emission from construction zone

- a. The construction zone should be sealed fully during the construction period. A dust barrier should be created from the floor to the slab/floor and edges sealed.
- b. For short-term minor projects, this may be plastic sheeting, however for more long term projects this should be a solid sealed barrier. It may be necessary to create a lobby (anteroom) if the barrier is the entrance/egress for construction workers.
- c. Dust-proof barriers should be inspected at least daily by the contractors to ensure that the seals are intact.
- d. All windows, doors, vents, plumbing penetrations, electrical outlets and any other sources of potential air leak should be sealed in the construction zone.
- e. Air pressure in the construction zone should be negative compared with adjacent areas. An extract fan may be used for this purpose. Air from the construction zone should be exhausted directly to the outside and this is the most appropriate option. If this is not possible then the air should be filtered through HEPA filters (that have been properly fitted and strictly monitored) before being re-circulated to the hospital.
- f. Dust reduction techniques should be used for cutting and hole boring.
- g. Debris should be removed from the construction zone at the end of each working day. Debris should be removed in covered containers preferably through window openings. A chute may be necessary if the construction is above ground floor level. In addition, normal good housekeeping procedures should prevail during the operation in particular, holding skips and other containers should be kept moistened and/or covered. The construction zone should be vacuumed on a daily basis or more frequently if required, to maintain an environment as free from dust as possible.
- h. A sticky/tacky mat or moist carpet should be placed inside the exit from the construction zone to trap dust. This should be vacuumed/changed daily or more frequently when visibly soiled.
- i. Construction workers should wear protective clothing, which should be removed before leaving the construction zone.
- j. The measures implemented to reduce dust emission from the construction zone will vary depending on the construction/renovation activity (Table 2). The measures required for the various types of construction activity are outlined in Table 3 and in the Sample Construction Permit (Appendix II)

5.2.2 Measures to physically protect at-risk patients

- a. Patients who are at risk should be moved to an area away from the construction zone if the air quality cannot be guaranteed during construction.
- b. At-risk patients (Groups 2-4) should wear protective masks if it is necessary to transport them through a construction zone. These masks should be capable of filtering *Aspergillus* spores such as particulate-filter respirators which give a >95% filtration efficacy of 0.3 µm particle size and are used in association with the National Institute for Occupational Safety and Health (NIOSH) regulations.
- c. All windows, doors (apart from essential access points) and vents should be sealed in areas of the hospital containing patients who are most susceptible (Groups 2-4), if the construction or demolition work is considered likely to result in *Aspergillus*-contaminated air entering these areas. If the area is not served by a ventilation system, these precautionary measures may result in unacceptable environmental conditions within the area involved. Any fresh air introduced into this area must be HEPA filtered. If the area is connected to a central ventilation system, it is important that prior to construction works, the ventilation should be thoroughly checked and if it is to remain functional, it should be fitted with HEPA filters if air from the construction zone may be drawn into the system.
- d. For high and very high-risk patients (Groups 3-4), it is recommended that an environment that is fully HEPA filtered and at positive pressure is provided. This involves the installation of dedicated remote air handling systems, which are ducted through supply systems to the at-risk area. The intake air handling unit is fitted with a combination of coarse bag and panel filters and finally a HEPA filtered section which is the only filter capable of trapping the 2.5 to 3.5 µm size of the *Aspergillus* spore. Typically, these dedicated ventilation/filter units should provide an air exchange rate of 10-12 air changes per hour within the at-risk areas and a pressure differential for positive pressure areas of + 10 Pascals relative to the corridor.
- e. A sticky/tacky mat should be placed at the entrance to the patient care area. This should be changed daily or more frequently when visibly soiled.

6.0 Dust containment

6.1 The objectives of dust containment measures are:

- To minimise the dust generated during the work activity
- To prevent dust infiltration into adjacent patient care areas.
- The categorisation of the construction activity in conjunction with its geographical location will determine the controls required to achieve these objectives (Tables 2-4). The use of a construction permit will also assist in achieving compliance with the requirements (Appendix II).

7.0 Cleaning

7.1 In addition to minimising dust through measures outlined in this document, increasing the existing cleaning regimes to prevent dust accumulation on surfaces, ceilings and air duct grills will be necessary. As the quantity of dust generated will vary depending on the type of building activity, the increased cleaning regimes need to be adjusted accordingly to minimise dust accumulation. Damp dusting not dry cleaning is recommended. Air filtration systems must be regularly checked. Where vacuum cleaners are used, in areas where high-risk and very high-risk patients (Group 3-4) are cared for and in adjacent areas, these should be equipped with HEPA filters and appropriately maintained to minimise dust dispersal. Filters in the air filtration systems and the vacuum cleaners need to be changed regularly and a record/ log should be kept of these changes.

7.2 Responsibility for cleaning the construction zone lies with the contractors.

8.0 Traffic

8.1 Pedestrian: Pedestrian traffic from the construction zone should be directed away from patient areas, with workmen having a separate entrance to the construction site as outlined in the construction permit. When possible, patients and visitors should avoid entering the hospital adjacent to major construction/ demolition sites, where debris or dust is being removed from the works area.

8.2 Supplies: Alternative routes, which avoid the construction site, through which inanimate items are transported throughout the hospital, may need to be identified during construction. Clean or sterile

supplies or equipment should be transported to storage areas by a route that minimises contamination risks from the construction site.

- 8.3** In some critical areas and in some instances where it may not be possible to alter traffic patterns, consideration will have to be given to scheduling construction to off-hour periods and weekends. Some areas may need to be relocated or closed temporarily.

9.0 Protective Measures for At-Risk Patients

- 9.1** Patients deemed to be at risk of systemic mould infection should be stratified on the basis of their underlying disease, its treatment and the area in the hospital in which they are being treated in relation to the proposed building programme. An information leaflet on Aspergillosis is available for patients (Appendix III) and frequently asked questions (FAQs) are also provided (Appendix IV).

9.2 Environmental measures

9.2.1 Very high-risk patients (Group 4)

Patients at very high risk (Group 4) should receive maximum protection irrespective of the type/size of the building programme. All very high-risk patients should be nursed in HEPA filtered positive pressure rooms during the neutropenic period. If they are subsequently transferred to a ward, the windows should be sealed and suitable air quality provided (see section 5.2.2).

9.2.2 High-risk patients (Group 3)

Patients at high risk (Group 3) should receive protection (ideally in an environment that is fully HEPA filtered and at positive pressure) if the area of treatment is juxtaposed or near the hospital construction zone or if it is otherwise likely that *Aspergillus*-contaminated air may enter the area. High-risk patients should be nursed in a ward with sealed windows and suitable air quality (see section 5.2.2).

9.2.3 Increased-risk patients (Group 2)

Patients at increased risk (Group 2) are usually dispersed throughout the hospital and therefore physical protection may be impractical. Consideration should be given to moving patients away from the construction zone if the air quality cannot be guaranteed during construction.

9.3 Chemoprophylaxis

Antifungal chemoprophylaxis should be considered in at-risk patients in line with current guidelines and hospital policy and in consultation with the Consultant Microbiologist. Antifungal prophylaxis is not recommended for patients outside of those identified belonging to a high-risk group. However, in the event of a possible outbreak of aspergillosis in a patient group not belonging to a high-risk group, e.g. cardiothoracic patients, antifungal prophylaxis should be considered and expert advice sought.

10.0 Cessation of Works

- 10.1** Non-conformance to infection prevention and control aspergillosis risk reduction guidance will result in cessation of works until all measures are implemented. The Hospital Chief Executive Officer/Manager should convene a multi-disciplinary team meeting with the Project team, IPCT, Risk Manager/s and other relevant stakeholders.
- 10.2** Risk assessment of patient population risk group will be carried out in consultation with patients' primary team.
- 10.3** An adverse incident form should be completed.

Appendix I. Nosocomial invasive aspergillosis preventive measures compliance checklist

Name of project: _____ Date project commenced: _____

Name of ward/unit being monitored: _____ Monitored by*: _____

Standard	Date of inspection					
	dd/mm/yyyy	dd/mm/yyyy	dd/mm/yyyy	dd/mm/yyyy	dd/mm/yyyy	dd/mm/yyyy
Patient risk reduction						
Windows/vents sealed						
Restricted access to site						
No "at-risk" patients exposed						
FFP2 masks used, if required						
Other						
Traffic control						
Dust control						
Ventilation						
Debris removal						
Cleaning						
Comments						
Signature						

*Name of team or person assigned the responsibility to monitor compliance in a particular ward/unit e.g. Infection Prevention and Control Nurse

Appendix II. Sample Construction Permit

Construction Permit		
Permit No:	Permit Expiration Date:	Project Start Date:
Location of Construction:		Estimated Duration:
Contractor:	Contact Person:	Tel:
CEO Approval:		
Name:	Signed:	Tel:
Hospital Technical Services Manager Approval:		
Name:	Signed:	Tel:
Infection Prevention and Control Personnel Approval:		
Name:	Signed:	Tel:

Construction/Renovation Activity

Type A2 - Minor Internal Containable Activities

This includes, but is not limited to, minor works on a small scale where dust containment is achieved by using dust barriers and a HEPA-filtered vacuum. Activities that require access to conduit spaces, cutting of walls, woodwork or ceilings where dust migration can be controlled, for example installation or repair of minor electrical work, ventilation components, telephone wires or computer cables. It also includes minor plumbing as well as minor drilling to allow for the erection of brackets and shelving.

Type B - Major Internal Containable Activities

Any work that generates a moderate level of dust or requires demolition or removal of any fixed building components or assemblies (e.g. counter tops, cupboards, sinks). These include, but are not limited to, activities that require sanding of walls for painting or wall covering, removal of floor-covering, ceiling tiles and stud work, new wall construction, minor duct work or electrical work above ceilings, major cabling activities, and any activity that cannot be completed within a single work shift. This type of activity includes extensive plumbing work. It also includes demolition or removal of a complete cabling system or plumbing and new construction that requires consecutive work shifts to complete.

Type C - Minor External Non-Containable Activities

External construction activities that generates moderate levels of dust or minor excavations. Such activities include, but are not limited to, digging trial pits and minor foundations, trenching, landscaping and minor construction and demolition work.

Type D - Major External Non-Containable Activities

External construction activities that generate large levels of dust. Such activities would include, but are not limited to, major soil excavation, demolition of buildings and any other construction activity not covered under Type C.

Population Risk Groups

Group 1 - No Evidence of Risk

- Staff members/service providers/contractors
- All patients not listed in Groups 2-4 below

Group 2 - Increased Risk

- Patients on prolonged courses of high dose steroids or tumour necrosis factor α antagonists
- Severely immunosuppressed AIDS patients
- Patients undergoing mechanical ventilation
- Non-neutropenic patients on chemotherapy
- Dialysis patients

Group 3 - High Risk

- Neutropenia for less than 14 days following chemotherapy
- Adult acute lymphoblastic leukaemia on high dose steroid therapy
- Solid organ transplantation
- Chronic Granulomatous Disorder
- Neonates in intensive care units
- COPD patients meeting GOLD stage III and IV criteria and in intensive care or high dependency units
- Patients with extensive burns

Group 4 - Very High Risk

- Allogeneic haematopoietic stem cell transplantation:
 - during the neutropenic period
 - with graft-versus-host disease requiring steroid \pm other immunosuppressive therapy
- Autologous haematopoietic stem cell transplantation, i.e. during the neutropenic period
- Non-myeloablative transplantation
- Children with severe combined immunodeficiency syndrome (SCID)
- Prolonged neutropenia for greater than 14 days following chemotherapy or immunosuppressive therapy (including acute myeloid leukaemia)
- Aplastic anaemia patients

Recommendations for Infection Control Preventive Measures

Class I

Class I Preventive Measures are recommended for Minor Internal Containable Construction Activities (Type A2)

Dust Control

- Immediately replace ceiling tiles displaced for visual inspection
- Execute work by methods to minimise dust generation from construction or renovation activities
- Provide active means to minimise dust generation and migration into the atmosphere

Cleaning

- Wet mop and vacuum area as needed and when work is completed
- Wipe horizontal and vertical work surfaces with hot soapy water

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity and the permit to be issued
- In collaboration with cleaners and technical services, ensure that the construction zone remains sealed and that the cleaning is adequate at all times

Patient Risk Reduction

- Move at-risk patients (Groups 2-4) away from construction zone. If it is not possible to move, e.g. ICU patients, an impermeable dust barrier should be erected around the construction zone
- Minimise patients' exposure to the construction/renovation area
- Minimise dust and increase cleaning in patient area

Class II

Class II Preventive Measures are recommended for Major Internal Containable Construction Activities (Type B)

In addition to the Class I measures outlined above, the following measures should be also implemented for Type B activities

Dust Control

- Execute work by methods to minimise dust generation from construction or renovation activities
- Erect an impermeable dust barrier from floor to slab/floor
- Ensure windows and doors are sealed
- A separate entrance away from patient traffic should be created for use by construction workers
- Protective clothing should be worn by construction workers and removed when leaving the construction site
- Dust barrier should not be removed until the project is complete

Ventilation of Construction Zone

- Seal windows
- Maintain negative pressure within construction zone by using a portable extract fan
- Ensure air is exhausted directly to the outside where feasible and away from intake vents or filtered through a minimum of an F9 filter
- Ensure the ventilation system is functioning properly and is cleaned if contaminated by soil or dust after construction or renovation project is complete

Debris Removal and Cleaning

- Contain debris in covered containers or cover with either an impermeable or moistened sheet before transporting for disposal
- Remove debris at end of the work day
- An external chute will need to be erected if the construction is not taking place at ground level
- Vacuum work area with HEPA-filtered vacuums daily or more frequently if required

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity and the permit to be issued
- In collaboration with cleaners and technical services, ensure that the construction zone remains sealed and that the cleaning is adequate at all times

Class II cont'd

Patient Risk Reduction

- Move all patients from within the construction zone
- If possible move at-risk patients (Groups 2-4) who are adjacent or near to the construction zone
- Ensure that patients do not go near construction zone
- All windows, doors, air intake and exhaust vents should be sealed in areas of the hospital containing patients who are classified as at increased risk (Groups 2-4), if the construction or demolition work is considered likely to result in *Aspergillus*-contaminated air entering these areas
- High and very high-risk patients (Groups 3-4) should preferably be treated in HEPA-filtered, positive pressure isolation rooms or facilities or if not available, do a risk assessment to identify alternative options (see Section 3.4 of the guideline document on Class II preventive measures)

Traffic Control

- In collaboration with the Technical Services Manager, designate a traffic pattern for construction workers that avoids patient care areas and a traffic pattern for clean or sterile supplies, equipment, patients, staff and visitors that avoids the construction zone
- A traffic path should be designated for the removal of rubble from the construction site which preferably is separate to and away from all hospital-related traffic.

Class III

Class III Preventive Measures are recommended for all External Non-Containable Construction Activities (Type C & D)

Dust Control

- Execute work by methods to minimise dust generation from construction or renovation activities
- Provide active means to minimise dust generation and migration into the atmosphere. During dry weather soil must be regularly dampened for the period involving any ground works

Debris Removal and Cleaning

- Contain debris in covered containers or cover with an impermeable or moistened sheet before transporting for disposal
- Ensure no increased dust within hospital, increased cleaning may be necessary

Infection Prevention and Control Personnel

- Approval must be sought from IPCT for the construction activity and the permit to be issued
- In collaboration with technical services ensure that dust is minimised from the construction site and that the construction site measures are being adhered to
- Ensure that cleaning is adequate to minimise dust within the hospital

Patient Risk Reduction

- No specific requirement for Risk Group 1
- If possible move at-risk patients (Groups 2-4) who are adjacent or near to the construction zone
- Ensure that patients do not go near construction zone
- All windows, doors, air intake and exhaust vents should be sealed in areas of the hospital containing at-risk patients (Groups 2-4), if the construction or demolition work is considered likely to result in *Aspergillus*-contaminated air entering these areas
- High and very high-risk patients (Groups 3-4) should preferably be treated in HEPA-filtered, positive pressure isolation rooms or facilities or if not available, do a risk assessment to identify alternative options (see Section 3.4 of the guideline document on Class III preventive measures)

Traffic Control

- In collaboration with the Technical Services Manager, designate a traffic pattern for construction workers, that avoids patient care areas and a traffic pattern for clean or sterile supplies, equipment, patients, staff and visitors that avoids the construction zone.
- A traffic path should be designated for the removal of rubble from the construction site which preferably is separate to and away from all hospital-related traffic.

Appendix III. Information Leaflet on Aspergillosis during Construction Activities

General Information

The purpose of this leaflet is to inform patients, relatives, healthcare workers and those involved in the activities of construction of the risk of aspergillosis during construction work. This leaflet should be considered as introductory information only.

Aspergilli are tiny fungi that cannot be seen by the eye but commonly occur in soil, water and decaying vegetation. They can also live in old buildings or in areas such as ventilation shafts. Many types of *Aspergillus* are found in nature but only a few species cause human diseases.

Aspergillus may be released into the air during construction/renovation/demolition activities. *Aspergillus* can be transported great distances by normal conditions such as air currents and wind. Small pieces of dirt or dust in the air are the main ways that *Aspergillus* travels and causes infection in hospitals. Hospital activities that generate dust such as maintaining the ventilation system, cleaning, vacuuming and dry dusting can also allow *Aspergillus* to travel through the air.

Patients who are undergoing high dose chemotherapy for leukaemia and related illnesses or who are having bone marrow, stem cell or other transplants, or who are having other forms of therapy which may suppress their immune system may be at risk of developing infection with this fungus in the lungs or other parts of the body. Healthy adults and children are not at increased risk of infection during construction work.

For the Patient

Should you be undergoing treatment in hospital which suppresses your immunity to infection you may become susceptible to developing infection with a fungus found in the environment called *Aspergillus*. Everyone breathes it into their airways and it normally doesn't do any harm. However, this fungus can be a major cause of illness if you become exposed to high numbers of *Aspergillus* in the air while your immunity is suppressed. This immunosuppression can be caused by an underlying blood cancer like leukaemia, by chemotherapy, or other immunosuppressive drugs e.g. drugs like corticosteroids, by stem cell or solid organ transplantation, or because of an underlying chronic lung condition. During building work every effort will be made to prevent the spread of *Aspergillus*. The medical team who are treating you will be in close communication with builders and the Microbiology/Infection Prevention and Control Team to make sure that the risk of spreading *Aspergillus* is kept to a minimum and will tell you if you need to take any special precautions.

Appendix IV: Frequently Asked Questions (FAQs)

What is *Aspergillus* and why is it a hazard for certain hospitalised patients?

Aspergillus is an environmental mould fungus that survives in soil and dust. Disturbance of these during hospital building, renovation or demolition work can generate airborne spores of the fungus which if inhaled by susceptible patients can lead to an often fatal lung infection called invasive aspergillosis.

Which patients are at risk of developing invasive aspergillosis?

Severely immunocompromised patients such as those undergoing treatment for leukaemia, transplant recipients or those receiving long-term immunosuppressive therapies, e.g. steroids, are at risk of developing invasive aspergillosis. Patients in intensive care, particularly those with underlying chronic lung conditions e.g. Chronic Obstructive Pulmonary Disease (COPD) have more recently been identified as being at increased risk. On the basis of the known incidence of invasive aspergillosis in these patient populations an at-risk classification can be devised which guides the preventive measures needed for their protection during hospital building work.

What preventive measures are effective to prevent nosocomial aspergillosis?

A risk assessment will help to devise a combination of measures that may include environmental dust control and cleaning, prevention of ingress of airborne spores from outside clinical areas, protective environments for highest risk patients, and antifungal drug prophylaxis.

What type(s) of protective environment are used to prevent nosocomial aspergillosis?

HEPA-filtered positive pressure isolation rooms are the only type of protective environment for which there is a scientific evidence base. Recently, neutral pressure isolation rooms have been introduced which may provide some protection to at-risk patients but they have not been shown to reliably prevent ingress of fungal spores from outside the patient's isolation room.

Which antifungal drugs are effective for prophylaxis against *Aspergillus* infection, and which patients should be prescribed them?

Published international guidelines show that the evidence for effective prevention of *Aspergillus* infection is limited to patients with haematological malignancies and those undergoing haematopoietic stem cell transplantation. The triazole Posaconazole has the strongest grade of recommendation in these groups.

Is there concern about triazole antifungal drug resistance in *Aspergillus*?

Resistance to the triazoles in the main pathogenic species *Aspergillus fumigatus* has been reported in an increasing number of countries. To date, the prevalence of drug resistance is variable and unpredictable. Ideally all clinical isolates of *A. fumigatus* from at-risk patients should be tested in vitro for susceptibility to triazoles. Other *Aspergillus* species are less commonly identified as pathogens in this setting but have less predictable susceptibility to triazoles.

Should clinical areas with at-risk patients be monitored by environmental air sampling?

Routine air sampling is not recommended; however, where major works are to be undertaken it may be useful to establish baseline levels of *Aspergillus* in the air and continue to monitor during construction work in order to detect increased counts which will prompt additional preventive measures

Is aspergillosis difficult to diagnose?

Yes, because clinical symptoms and signs are not specific to invasive aspergillosis and a definitive diagnosis by e.g. lung tissue biopsy is often not feasible. A combination of clinical, radiological, and laboratory criteria help to identify patients with probable invasive aspergillosis. These measures should be employed as part of monitoring at-risk patients during any construction activities.

Do all patients who develop evidence of invasive aspergillosis acquire it from the hospital environment?

No, some patients may be admitted to hospital with *Aspergillus* infection that is not clinically manifested but only when they receive intensive immunosuppression do they develop clinical signs and symptoms.

What measures should be taken before a hospital project associated with potential release of airborne *Aspergillus* spores is started?

All interested parties must be informed in advance of the scope and activity of the planned project. The Hospital Infection Prevention and Control Team will advise on which clinical areas with at-risk patients may become affected and what appropriate preventive measures are required. Tender documents must comply with national and local guidelines on prevention of nosocomial aspergillosis. A permit to work will be required for each phase of the project.

References

HPSC (2017). National Guidelines for the Prevention of Nosocomial Aspergillosis. Available at <http://www.hpsc.ie/A-Z/Respiratory/Aspergillosis/Guidance/>

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