Government of **Western Australia**
Department of **Health**
Public and Aboriginal Health Division

Communicable Disease Control Directorate
Guideline

Microbiological Air Sampling of the Perioperative Environment in Western Australian Healthcare Facilities

Guideline 0004 / May 2025

These guidelines have been released by the Communicable Disease Control Directorate, Public and Aboriginal Health Division, Western Australian Department of Health, to provide consistent and evidence informed advice to agencies involved in the prevention of infections and management of communicable diseases in Western Australia.

ACKNOWLEDGEMENT OF COUNTRY AND PEOPLE

The Communicable Disease Control Directorate at the Department of Health acknowledge the Aboriginal people of the many traditional lands and language groups of Western Australia. We acknowledge the wisdom of Aboriginal Elders both past and present and pay respect to Aboriginal communities of today.

Contents

1. Definitions / Acronyms

Term	Definition
Active Air Sampling	Is conducted using an air sampler device that draws air through the device, directly onto the surface of the testing medium[16].
Air Sampler	A device that draws air through and directly over testing medium to determine air quality. Air Samplers must be clean, maintained, calibrated and used by those trained in doing so[17].
CSSD	Central Sterile Services Department – where the reprocessing of critical and semi critical reusable medical devices is undertaken.
Dust	The suspension of particles of solid materials in air. Can include microorganisms, spores and fungi.
Healthcare Facility	Any facility that delivers healthcare services. Can include inpatient, outpatient and community settings. For example: hospitals, haemodialysis centres, dentistry practices[15].
Healthcare Worker	Any person delivering healthcare services. Can include permanent, contract, students and volunteers[15].
HEPA Filter	A high efficiency particulate air (HEPA) filter is a disposable, extended media, dry type filter in a rigid frame, having a minimum filtration efficiency of 99.97% and designed to remove particles greater than 0.3 microns.[1]
HVAC	Heating, ventilation and air conditioning systems[17].
Laminar airflow	Laminar airflow refers to the delivery of air in a manner that provides uniform, directional, non-turbulent airflow at consistent velocity across the operating zone that does not readily mix or become entrained with other room air until lower velocities are achieved after passing through the operating zone.[2-5]
Minor refurbishment	Type A and B construction activity types as defined by the Australasian Health Care Facility Guidelines (refer Appendix 2).[6]
Major refurbishment	Type C and D construction activity types as defined by the Australasian Health Care Facility Guidelines (refer Appendix 2).[6]

Operating room (OR)	The room in which a surgical procedure is performed, with or without administration of an anaesthetic and there is use of microbiologically controlled air supply.
Operating room - conventional ventilation	Refers to an OR with general turbulent airflow (non-laminar). Air supply is to be delivered via a terminal HEPA filter. Supply airflow is not necessarily restricted to the operating zone but is distributed throughout the operating room. [2-5]
Operating room - ultra clean ventilation	Refers to an OR where a terminal HEPA filter delivers air via organised (laminar) flow, and it is delivered uniformly over the operating zone with minimal entrainment of room air. Proprietary ultra clean ventilation canopies can be provided to deliver this function. [2-5]
Perioperative Environment	Refers to all areas where patient safety during a surgical procedure may be at risk of acquiring a surgical site infection. Including but not limited to the operating rooms, CSSD, sterile setup rooms, sterile stock storage rooms, and interventional procedure rooms that are HEPA filtered. The perioperative environment may be collectively located or located across multiple areas. For example, where a CSSD is located in a separate location to the ORs.
Surgical Site Infection (SSI)	An infection that develops as a result of an operative procedure[15].

2. Purpose

The purpose of this Guideline is to describe the procedural requirements for microbiological air sampling in the perioperative environment. This Guideline has relevancy to all healthcare facilities (HCFs) in Western Australian (WA) that provide perioperative services. This guideline should also be applied to hybrid operating theatres and interventional procedure rooms that are HEPA filtered e.g. interventional radiology and cardiac catheterisation/angiography procedure rooms.

3. Introduction / Background

Surgical site infection (SSI) is a major complication following surgery and is associated with increased morbidity and mortality, as well as increased costs[7]. The function of OR ventilation is to prevent airborne microbial contaminants from entering surgical wounds. Potential sources of airborne microorganisms include particles shed from patients and staff and air supplies that are not properly filtered.[8] Contaminated dust particles dispersed during construction works and renovations within the perioperative environment can pose an infection risk to patients and staff. Careful planning of construction and renovation works is required to reduce this risk.

There is no national or international consensus on the methods, frequency, types of sampling or acceptable levels of microbial contamination in the perioperative environment. However, there is evidence to support microbiological air sampling as part of the commissioning process of a new facility or following major refurbishment, as an adjunct to other heating, ventilation and air conditioning (HVAC) quality assurance controls. The purpose of microbiological air sampling is to gauge the efficacy of the HVAC systems, including HEPA filters following installation or after major structural refurbishment.[8-14]

4. Requirements

Each HCF should have a nominated health professional, who is responsible for the coordination and delivery of microbiological air sampling. Air sampling must be performed in collaboration with the infection prevention and control service, the surgical service, and the pathology service. Air sampling should be used in conjunction with other testing processes such as HVAC checking by a qualified engineer, air pressure and air changes per hour checked and verified, and air flow checked and verified.

Microbiological air sampling, in accordance with the procedural requirements described in Appendix 1 Procedure for Microbiological Air Sampling will be undertaken in the perioperative environment in the following situations:

- In conjunction with other testing processes and prior to commissioning or reopening.
- As part of the commissioning process of new builds includes sterile stock storage rooms, designated sterile set-up rooms and central sterile stock rooms.
- Following any major structural refurbishment i.e. Type C and D construction activity of existing facilities. Microbiological air sampling is not required for HEPA filter changes. A risk assessment should be undertaken by an infection control specialist for minor refurbishment i.e. Type A and B construction activity projects to assess if dust mitigation can be controlled, as microbiological air sampling may still be required [6].
- As part of an investigation into increased SSIs, if during investigation the evidence supports a link to the environment.

Following microbiological air sampling the facilities should not be utilised until acceptable results have been confirmed. HCFs need to ensure they have adequate turnaround time and plan accordingly as microbiological air sampling results can take between 3-7 days to be finalised.

There is no evidence to support additional microbiological sampling e.g. passive sampling such as the use of settle plates or collection of environmental surface samples, and therefore this is not recommended.

5. Relevant Legislation

- Nil applicable

6. Guideline Contact

Enquiries relating to this Guideline may be directed to:

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7. Document Control

Guideline number	Version	Published	Review Date	Amendments
0003	V.1.	26/11/2021	26/11/2023	Original version
0003	V.2.	13/12/2024	13/12/2027	Updated definitions Updated minor wording Updated Results and Interpretations definitions Updated bibliography
0003	V.3.	10/04/2025	10/04/2028	Clarified definition of perioperative environment Inclusion of testing outside of an operating room
0004	V.4.	05/05/2025	05/05/2028	Updated definitions and acronyms Updated minor wording Updated references / bibliography Clarification on sampling points

8. Approval

Approved by	Dr Paul Armstrong, Director Communicable Disease Control Directorate, Department of Health
Approval date	13/12/2024

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10. Appendices

Appendix 1 Procedure for Microbiological Air Sampling

The parameters used in this Guideline are based on current available evidence. It should be noted that there are no internationally agreed standards for microbiological air quality monitoring.

1. **Planning**

- HCFs need to identify a National Association of Testing Authority (NATA) accredited laboratory for environmental testing and establish timelines for sample collection, processing and provision of results with that laboratory.

- HCFs must ensure adequate time is allowed for processing of results and the possible need for re-cleaning and re-testing prior to utilisation of the facility if results are outside acceptable parameters.

- Staff performing microbiological air sampling are to be trained in the use of the specific air sampler being used and the procedure for air sampling and transport of samples to the laboratory.

- The air sampler shall be checked to ensure it has been calibrated and serviced according to manufacturer's instructions. The outside of the air sampler must be cleaned prior to entering the area to be tested.

- The area to be tested shall be empty of all non-fixed items, including supplies, sterile stock and any mobile equipment.

- Dust mitigation/control strategies must be used during construction and renovation works to reduce dust contamination and migration. For example, use of drop sheets, hoarding/barriers, sticky/wet mats, frequently cleaning or vacuuming (with a vacuum fitted with a HEPA filter), wet moping as necessary, covering building materials and wastes (rubbish/debris) when removing them from the area.

- Air sampling can be affected by movement in the area and adjacent rooms. No entry to the area or adjacent rooms is permitted during the sampling.

No microbiological air sampling of the perioperative environment is to be conducted until:

- All building and construction works have been completed and all building materials, equipment and waste has removed from the site and adjacent areas.

- All HVAC commissioning procedures have been completed for new builds and following a renovation, the HVAC has been checked and verified as working correctly by a HVAC qualified engineer.

- All of the ducting and air diffuser plates have been cleaned.

- The area being sampled has been thoroughly cleaned by staff trained and deemed competent to do so, including ceiling spaces, service cavities, ventilation grills, all horizontal and vertical surfaces including ceilings and walls, and any fixed equipment in the area.

- A second clean of all horizontal and vertical surfaces within the area is performed to ensure any contamination is removed (highly recommended).

- The HVAC system has been running continuously on normal flow rates, for 24 hours following completion of all building and construction and rubbish removal. Cleaning can be performed during this period.

2. Sampling Specifications

- Active air sampling is the required method for microbiological air sampling for commissioning or following construction and renovation works.

- The sampling sites will depend on the type of OR (conventional or ultra clean).

- For commissioning new ultra clean ventilated ORs (laminar airflow), sample points include;[9]
    - one at each corner of the unidirectional airflow zone perimeter
    - halfway along each side of the perimeter
    - one at each corner of the inner zone
    - one in the centre.

- For conventional ventilated ORs and for ultra clean ventilated ORs following major refurbishment, the air sampler is to be placed in the middle of the OR, or secured on a trolley where the OR table is usually located. Two samples are required.

- For other areas being tested within the perioperative environment, the air sampler is to placed directly under each HEPA filter.

- The size of the sample must be 1,000 litres (1m3) collected from each air sampler location.

- The type of sampler used should be capable of sampling the volume of air without causing excessive drying of the recipient agar surface.

- Agar plates should be at room temperature prior to sampling.

3. Procedure

- The air sampler shall be cleaned prior to use and run for 5-10 minutes prior to loading the agar strips/plates to blow any contamination out of the sampler.

- The area being sampled, and any area that is adjacent to or feeds air into the area, shall be left vacant with closed doors for a minimum of 15 minutes, but preferably one hour, before sampling proceeds, to avoid false-positive results due to any recent activity e.g. cleaning.

- Staff performing the air sampling shall wear theatre attire, a hair cover, surgical mask and don sterile gloves after performing hand hygiene. Note: clothing is to be supplied by the HCF when external contractors are used.

- Using aseptic technique, proceed with setting up and placing the agar strips or plate into the sampler as per manufacturer's instructions.

- When sampling the air sampler should be operated by remote control or a delayed start timer, at least 5 minutes after the room has been vacated and from outside the area to avoid compromising air quality.

- The doors to the area being sampled must be kept closed and the area empty of personnel until sampling is complete.

- Once air sampling is complete, aseptically remove the agar strip or plate, package to avoid contamination and label specific details including hospital name, room name or number, volume of air sampled, date and time and transport to laboratory in a timely manner.

4. Results and Interpretation

- Preliminary results are generally not available until at least 48 hours after air sampling is completed. Results obtained at 24 hours may be misleading as many organisms will not grow visible colonies within this time frame.

- The acceptable level of colony forming units (CFUs) for the purpose of this guideline is the same for all perioperative environments.

- Aerobic cultures on non-selective media should not exceed 10 bacterial and 1 fungal CFUs per cubic metre (m^3) of air sampled. (Acceptable results: ≤10 cfu/m^3 bacteria and ≤1 cfu/m^3 fungal spores, including *Aspergillus* spp.).

- If results received are outside of these limits, the area should not be used. The results need to be discussed with a clinical microbiologist, IPC and surgical services personnel to initiate an appropriate course of action. The cleaning of the environment (check for dust, fibres, fans, ventilation ducts/grills, ceiling voids and adjacent areas), sampling process, engineering systems such as filters and air change rates should be reviewed.

- Prior to retesting, repeat cleaning of all horizontal and vertical surfaces must be performed.

- If repeat testing produces results above acceptable levels the HVAC systems should be reviewed by the appropriate personnel.

Appendix 2 Definitions of the Construction Activity Types [6]

Type A Inspections and general upkeep activities	Type B Small scale, short duration activities, which create minimal dust	Type C Any work that generates a moderate to high level of dust	Type D Major demolition and construction projects
Includes but not limited to: removal of ceiling tiles for visual inspection (limited to 1 tile per 5m^2; painting (but not sanding); installation of wall covering; electrical trim work; minor plumbing; any activities that do not generate dust or require cutting into walls or access to ceiling other than for visual inspection.	Includes, but is not limited to, installation of telephone and computer cabling, access to chase spaces, cutting into walls or ceilings where the dust migration can be controlled.	Includes, but is not limited to, demolition or removal of built-in building components or assemblies, sanding of wall painting or wall covering, removal of floor covering/ wallpaper, ceiling tiles and casework, new wall construction, minor ductwork or electrical work above ceiling, major cabling activities.	Includes, but is not limited to, heavy demolition, removal of a complete ceiling system and new construction.

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