AIRAH

COVID-19 common practices:

ADVANTAGES, DISADVANTAGES, RISKS, AND COMMENTS

AIRAH Infection Control and Operating Theatre Practices Special Technical Group

Contents

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Introduction

This document provides considerations related to various measures that may be employed in operating rooms (OR) to reduce the spread of COVID-19. This includes advantages, disadvantages, risks, and comments associated with each measure.

It contains general feedback from the AIRAH Infection Control and Operating Theatre Practices Special Technical Group (STG) on common practices in infection control and operating theatres. It is a window to the STG's committee meetings and is provided for consideration only. Hospitals, facility managers, and consultants analysing future changes to an operating room should develop a comprehensive study of the facility, infection control regimes, patient movements, and HVAC equipment (resources in general) to advocate and decide the best outcome for the project.

The STG welcomes feedback on this document. For contact details, visit airah.org.au/stgs

AIRAH's Infection Control and Operating Theatre Practices STG

The purpose of the AIRAH Infection Control and Operating Theatre Practices STG is to provide members with strategic leadership in the development, implementation and sustainability of programs, activities and strategies that seek to analyse the current standards and guidelines for operating theatre design, construction, commissioning, certification and service practices to improve the minimum set of parameters while always having infection control as a main consideration.

Please note that the STG is currently drafting a set of guidelines and design characteristics that enable the adoption of best practices for design, construction, commissioning, certification and service of operating theatre environments to be presented to the Australian HVAC industry, government and health departments.

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For more resources and information about COVID-19 related to HVAC&R and building services, please go to airah.org.au/coronavirus

For more information about the AIRAH Infection Control and Operating Theatre Practices Special Technical Group, please visit airah.org.au/stgs

Types of HVAC systems

Best practice indicates that in the event of a pandemic, any modifications planned for the OR HVAC system should be done on type 01 ORs.

Australia understands the design and construction of two types of HVAC systems for ORs:

- Type 01: Ultra clean ventilation (UCV), also known as ultra clean air (UCA) or unidirectional flow systems. This system is generally characterised by a bank of HEPA filters with a diffuser that covers the patient and staff. This creates a protected area (zone) with unidirectional flow designed to displace the airborne particles away from the patient wound.

- Type 02: Turbulent air design. The common design is based on HEPA filter arrangements that provide turbulent air and air dilution. A specific protected area (zone) is not defined.

There is literature (including numerous scientific and technical articles and expert opinions) regarding which system offers better protection for the patient and medical staff, but not a common and conclusive direction. The STG agrees that type 01 delivers better protection levels that may help to reduce and mitigate the risk of infection inside the ORs (for patient and staff).

OR CONSIDERATIONS IN THE CONTEXT OF COVID-19

1. Negative pressure conversion

Advantages:

- Reduction by a small amount of any contaminated aerosols leaving the theatre. Note, the aerosols discharged from a patient during most surgeries would be minimal. Most of the aerosols generated would be from staff, who would be releasing them throughout the hospital anyway (note that most of them will be wearing masks both inside and outside the theatre).
- Commonly known practice, positive psychological effect on the staff. Protecting staff in this case.
- Reducing the potential of spread from the OR to other areas.

Disadvantages:

- Drawing in of contaminated air from the surrounding areas. This may include the ceiling space.
- Potential to elevate the background contamination in the OR, which may increase the risk of a standard (non-COVID) patient infection.
- Limited use during non-pandemic times. A system able to be easily converted between positive and negative regimes should be considered when it is technically possible.

Risks:

- A negative-pressure OR will always represent a higher risk of infection to a patient with an open wound who already has a compromised immune system.
- Influx of contamination from other uncontrolled areas.
- In the case of retrofitting a positive-pressure OR into a negative-pressure OR, there are possible complications with the corridor/ORs air balancing (not only the negative OR), which need to be analysed. The interaction of a negative OR to a common corridor with positive ORs also needs to be considered. This risk may be mitigated using doors with a lower air leakage rate or by building an anteroom when possible. Both entrances to the OR and any exit to a dirty corridor must be considered.

Comments:

- An exhaust system in the ceiling space is best practice to guarantee that the ceiling space remains at a negative pressure to the OR.
- Filter installation on the return points is best practice.
- Good practice would be to convert the OR furthest away from the main hospital areas to negative. It may minimise the risk of polluted air entering the negative OR. Closer attention to the corridor ventilation system should be considered to minimise this risk. Specific considerations should be given to the logistics of moving a respiratory infected patient to the negative OR, closest OR to the lifts, transfer rooms and so on.
- Airlocks. The use of airlocks should be considered (if possible, installation) to create similar advantages of having a negative OR, however, keeping the OR in positive.
    - Positive-pressure theatre: The use of a negatively pressurised airlock (with suitable supply and exhaust filtration) can reduce the potential risk of airborne contamination from a COVID-positive patient migrating from a positively pressurised (standard) theatre into the surrounding support spaces.
    - Negative-pressure theatre: The use of a positively pressurised HEPA filter supplied airlock in conjunction with a negative-pressure operating theatre can reduce the flow of airborne contamination entering the theatre and the potential for patient exposure.

2. Filter installation on the exhaust air grilles and return air grilles

Advantages:

- Selection of a combination of return air filter and AHU filters, with the highest **practicable** combined ISOePM1 rating, will provide a risk mitigation from the AHU system to OR and to other areas/zones. At recertification, the selection of the highest **practicable** combined ISOePM1 performance classification will also mitigate the risk of infections.

Disadvantages:

- Filters on exhaust air will provide no advantage to the patient and staff, as the air will be leaving the facility. Considerations should be given to provide filters to the air outlets to the atmosphere.
- Extra energy usage.
- May affect air balance if not properly checked after installation.
- Requirement of service access to sterile area by maintenance personnel, balanced against preventative maintenance routine.
- Potential for increased system pressure drop if product selection, specification and scrutiny of data credibility are not applied.

Risks:

- Disrupt air balance. Increase air leakage to other areas.
- Risk of fomite transmission to service personnel. SWMS/PPE required to mitigate this.

Comments:

- Filters capture airborne contamination and over time can concentrate the levels; however, the airflow through the filters generally tends to dry out (desiccate) the particles, reducing virus viability.
- It is not clear how long SARS-CoV-2 can survive in an air conditioning system. However, it would be collected by any HEPA filter on the supply, so wouldn't re-enter the room. There may be risk to maintenance staff.

- Adding filtration at the exhaust or return terminal reduces the chances of airborne contamination from leaving the operating theatre and either entering the plant, or being discharged at exhaust, with potential secondary exposure. Filters removed/changed within the theatre space are more likely to be considered and treated as medical waste.
- Consideration must be given to the additional pressure from terminal filters, and the effects of filter loading on airflow and pressure.
- Filters should be bagged and treated as medical waste.

3. 100 per cent fresh air

Advantages:

- Reduction in potential for contaminated air to go back to the OR as in recirculation systems, although the HEPA filters should prevent this.

Disadvantages:

- Extra energy usage. May affect air balance if not properly checked after installation.

Risks:

- Disrupt air balance. Risk of disrupting pressure regimes.

Comments:

- If it is an existing hospital, the current HVAC plant may not be able to manage the new thermal load (cooling, heating and humidity control). It may also cause humidity issues; this is more critical in tropical areas.

4. UVC installation for airflow treatment (ducts)

Advantages:

- Within the airstream, subject to **proper UVC design** (dosage and intensity), it may provide a level of deactivation of viruses and bacteria.
  Proper design consideration: Common literature, standards and certification do not exist to support the design, installation commissioning and service of the UVC system for ducts. This is an emerging technology and currently the industry relies heavily on manufacturers' R&D.

Disadvantages:

- UVC tubes degrade over time (become less effective).
- Extra energy usage.
- Disruption to ductwork.

Risks:

- Potential exposure.
- Risk of fomite transmission to service personnel – SWMS/PPE required to mitigate this.

Comments:

- UVC tubes do not remove particles from the system, duct, or the airstream. It is recommended that they are always used in conjunction with filtration.
- UVC is not a substitute for HEPA filtration in operating theatres.
- UVC may require a long exposure time, which would probably need to extend significant metres along the duct.

5. Increase the airflow velocity

Advantages:

- Will remove contaminated air from the area more quickly.
- Staff protection – it may help to reduce the risk of surgical smoke getting to the staff face level.

Disadvantages:

- Colder air on staff and patients.
- Higher energy usage.
- May affect air balance.
- Could produce some turbulence that may increase the risk of a standard (non-COVID) surgical infection.

Risks:

- Potential increase to non-COVID infection risk. More turbulence.
- Risk of drying the wound.

Comments:

- This would not do much at all.
- The turbulence and risk of drying the wound can be mitigated by increasing the HEPA diffuser dimensions (if the OR is Type 01), allowing increased airflow but maintaining suitable velocities.
- Special attention should be given to air temperature and RH and their effects in relation to the air velocity.

6. Minimum supply airflow requirement

Advantages:

- Reducing supply airflow could be an easy and economical way to achieve negative pressures.

Disadvantages:

- By reducing supply airflow from the design airflow, the infection control design may be disrupted, increasing the risk of infections.

Risks:

- Increased risk of infection for the patient.

Comments:

- This practice may mitigate the risk of having particles leaving the OR and entering other areas, but at what cost? High risk for a patient with an already compromised immune system.
- Reducing outside air rates, not recommended for COVID.

7. Cooling coils

Comments:

- The viability of SARS-CoV-2 is extended at low temperatures. As a cooling coil environment is moist and usually <12°C, it provides a location where viable virus particles can survive for the longest period of time. Note that these virus particles may not proliferate, but could remain infectious as fomites or as aerosols if this area is disturbed during maintenance. Note also that to reach the cooling coil, a virus particle that originates in the operating theatre will have to make it through at least one stage of filtration.
- The use of UVC for coils (static) may be recommended.

8. Aerosol release from patient during surgery

Comments:

- The use of clear plastic enclosures over the patient's upper body/head can be considered to reduce the risk of aerosol release from the patient's respiratory tract. Dedicated ventilation/filtration can also be beneficial.

9. Monitoring

Comments:

- Any change to a critical piece of infrastructure should be monitored on an ongoing basis to ensure that the change has been properly implemented and does not adversely affect any other parameters.
- If an operating room pressure is changed from positive to negative, the pressure should be closely monitored and trended after the change is made.
- Temperature and humidity should also be monitored.
- In addition, as there is the risk of unconditioned air being drawn into a negative-pressure room, the microbial load should be regularly monitored on an ongoing basis. Trends should be analysed to ensure there is no sudden increase in CFU/m³.
- Selection of pressure regime with display/logging should be applied along with selection of pressure controls for constant volume fans on supply air and return air to ensure pressure regimes are maintained against increasing filter loading.