USING VENTILATION TO REDUCE THE COVID19 INFECTIONS WITHIN HOSPITALS: A REVIEW OF THE GUIDELINES

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COVID19 AND THE INCREASED BURDEN OF HEALTHCARE ACQUIRED INFECTIONS

Each year Australia records about 165,000 incidents of healthcare acquired infections (HAIs) which are acquired upon visiting a hospital [1]. The cost of these HAIs in Australia was predicted to be approximately $1 billion per year [2] in 2009. The recent pandemic of COVID19 has only aggravated the situation and added to the burden of HAI. It was reported that 11% of the COVID19 infections were acquired within the hospitals in Victoria, Australia [3]. It's not just Australia, the spread of COVID19 within hospital facilities have been reported internationally as well. Approximately, 18% of COVID19 infections in the UK and 12% in China were reported to be hospital acquired [3].

POOR VENTILATION LINKED TO COVID19 OUTBREAKS

It has now been established that COVID19 spreads through air, and good ventilation strategy becomes important [4]. Crowded places, confined spaces and poor ventilation and airflow are found to be favourable for airborne spread of COVID19 [5]. Many of the outbreaks in Australia have been linked to poor ventilation in the quarantine spaces [6]. A recent news article reported that about half of the isolation wards in Victorian hospitals could not meet the ventilation guidelines for COVID19 prevention [7]. However, a Department of Health spokesperson explained in the article that the department is working to improve the HVAC (Heating, Ventilation, and Air Conditioning) systems across Victoria and Australia.

MANAGING THE RISK OF COVID19 IN HOSPITAL BUILDINGS

Hospital buildings are complicated and have several types of sensitive areas, making it highly challenging to implement good air quality practices. QED provided a risk management strategy for hospital buildings based on the functional areas and their sensitivity status. For example, isolation wards are highly sensitive areas and should be provided with high level of care. Based on the variable sensitivity levels of hospital areas, QED reviewed the ventilation strategies for hospital buildings and isolation wards published by the respective health departments of Australian states.

Australia has adopted the Centres for Disease Control (CDC) and Prevention Guidelines for Environmental Infection Control in Health-Care Facilities [8] – which provides guidance on isolation, ventilation (air changes) and filtration. The Department of Health in Western Australia highlights the importance of ventilation and outdoor air exchanges in their COVID19 infection control guidelines [9] based on CDC guidelines and the Australasian Health Facility Guidelines, part D, Infection Prevention and Control. Similarly, the New South Wales Government [10] and Queensland Government [11] specifies the air conditioning requirements for management of COVID-19 based on CDC and Australasian Health Facility Guidelines, with a particular emphasis on outdoor air intake of at least 12 air changes per hour (ACH) in the isolation room. The Victorian Government [12] provides a comprehensive step-by-step policy specifically for HVAC optimisation based on CDC guidelines, which could help to prevent the spread of COVID 19 within a facility.

VENTILATION REQUIREMENTS IN HOSPITALS TO CONTROL COVID19 INFECTION

The ventilation and air cleaning strategies recently provided by the Department of Health [12] include:

1. **Barrier**: The first step is to create a barrier air flow from a COVID-19 patient isolation room as well as COVID RED ward (identified as highly sensitive area- Group 4 in the QED Risk infection matrix). These wards should be actively ducted to the outside atmosphere of hospitals and should be maintained at negative pressure (i.e. outside air passively flows into the ward/zone and the inside air flows out).

2. **Dilution**: The Department of Health recommends increasing the outside air, as reasonably possible. It is recommended to achieve 100% outside air if possible, with minimum recommended outdoor air be greater than 40%. The use of return air (air recirculation) including that from energy recovery systems should be limited.

3. **Filtration**: High grade filters such as F8 or F9 (ideal) high-efficiency particulate air (HEPA) filters are recommended to remove any suspended aerosol particles (that are known to carry the virus) which may return back to the air handling unit. In conjugation with the HVAC filters, standard air cleaning devices such as scrubbers with HEPA filtration may be placed in zones or rooms where air exchange rates may be lower, more prone to crowding or non-patient areas in close proximity to wards with COVID-19 patients (for example nurse stations).

4. **Comfort**: Temperature and relative humidity (RH) – It is recommended to maintain the indoor temperatures between 24°C and 27°C during the warmer months and RH between 50-60%. The guidelines state that HVAC systems should not be set to low 'cold' temperatures, below 21°C; and 'dry' low humidity settings, below 40%. This may not be achievable in all settings and should be considered a minimally effective infection prevention and control measure. Consideration should be given to patient comfort and the comfort of Health Care Workers when wearing full PPE for prolonged periods

5. **Variation rate**: the isolation rooms that are being maintained at negative pressure and have a separate supply air and exhaust, should have a minimum of 12 air changes per hour (ACH) once the viral load (contamination source/infected patient) has been removed from the room. This is different from the other standard hospital rooms where, a minimum of 6 ACH is recommended. The air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency is provided in Table 1 [12].

Table 1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency (Source: [12])

ACH	Time (mins.) required for removal: 99% efficiency	Time (mins.) required for removal: 99.9% efficiency
2	138	207
4	69	104
6+	46	69
8	35	52
10+	28	41
12+	23	35

Besides this, it is recommended that toilet and bathroom ventilation systems should be kept at negative pressure as well, and if possible and should run 24 hours, 7 days a week. Further, natural ventilation (for example, through opening of windows) should only be used if mechanical ventilation is not possible or available.

Finally, proper and regular maintenance of the HVAC system is required where the HVAC systems are set to pandemic mode and are labelled accordingly. Monitoring and recording HVAC system metrics with respect to temperature, RH, pressure and ventilation should be done daily. The minimum maintenance requirement of the HVAC should be achieved for the critical areas.

QED provided an action priority ranking based on the AHU hygiene and functional areas that can be used to stay on top of the minimum maintenance requirements. An example of the risk assessment is provided below.

MAINTENANCE PRIORITY RANKINGS

QED Action Priority Ranking				
	Functional Area Sensitivity Status			
Hygiene risk	Group 1 (E.g. Office and Public areas)	Group 2 (E.g. Outpatient clinics)	Group 3 (E.g. General medical wards)	Group 4 (E.g. ICU and Operation rooms)
Low	1	1	1	2
Moderate	2	2	3	4
High	2	3	4	5
Very High	4	4	5	6

1. Routine maintenance issue
2. Moderate Priority
3. High Priority
4. Very High Priority
5. Extremely High Priority
6. Requires Urgent and Immediate Attention

It is important to deliver and maintain appropriate ventilation standards in different areas of hospitals. QED recommends a regular measurement of the number of air changes in hospital wards to ensure compliance and reduce the risk of infection. QED is always keen to work with hospital managers to provide good air quality in their facilities. Reach out to us via our website to get more information on ventilation and HVAC maintenance in healthcare facilities.

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