REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

Ventilation in patient rooms

Ventilation systems for special patient rooms like airborne infectious isolation rooms (AIIR) have been well developed for infection risk control[1]. These rooms apply two principles: by preventing the spread of airborne microbes adjoining rooms and the surrounding area and by reducing the amount of airborne microbes in patient room with efficient ventilation. To prevent the spread by airborne transmission from a source patient to susceptible patients and other persons in a patient room, it is important to keep the patient room with negative pressure comparing with adjacent rooms in hospitals. Patient rooms with negative pressure are also known as 'Class N isolation room', 'airborne infection isolation' and 'infectious isolation units'. A few recommendations are presented here specifically for the operation of patient rooms during COVID-19 temporary hospital settings according to several national regulations/standards[2][3][4][5][6]. Generally, hospital ventilation systems designed according to these regulations/standards have provided adequate airborne infection risk control for COVID-19 disease so that no cross-infections have been reported from modern hospitals.

For normal areas/patient rooms:

- Normal patient rooms that are not intended for patients with infectious diseases, need at least 4 air changes per hour (ACH).
- If used for airborne precaution, it should be updated to meet the requirement for isolation rooms, where adequate ventilation is considered to be at least 6 ACH (equivalent to 40 L/s/patient for a 4x2x3 m^3 room).

For temporary areas/wards for patients with infectious diseases:

- Healthcare facilities without enough single isolation rooms in emergency departments should designate a separate, well-ventilated areas/wards where patients with suspected COVID-19 can wait.
- If feasible, ventilation system should be updated to meet the requirement for isolation rooms.

For isolation rooms with airborne infections:

- AIIR air shall be exhausted directly to the outdoors, using HEPA filter whenever it is possible to avoid possible cross contamination if the exhaust air outlet are nearby windows or outdoor air intakes.
- Ensure supply air ducts are independent of the common building supply air system.
- The supply airflow rate should be 6-12 ACH (e.g. equivalent to 40-80 L/s/patient for a 4x2x3 m^3

[1] Guidelines for the classification and design of isolation rooms in health care facilities, Victorian Advisory Committee on Infection Control 2007. http://docs2.health.vic.gov.au/docs/doc/4AAF777BF1B3C40BCA257D2400820414/$FILE/070303_DHS_ISO%20RoomGuide_web.pdf
[2] ASHRAE Standard 170-2013
[3] VDI 6022 https://www.vdi.de/richtlinien/unsere-richtlinien-highlights/vdi-6022
[4] https://www.fhi.no/publ/eldre/isoleringsveilederen/
[5] https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html#tableb2
[6] https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-2020.4

room) for existing isolation rooms, ideally at least 12 ACH for new constructions. See Figure 1 for illustration of the effect of high airflow rates.

- Recommended negative pressure differential is ≥5 Pa to ensure that air flows from the corridor into the patient room.
- Exhaust air shall be located directly above the patient bed on the ceiling or on the wall.
- Ensure the room is as airtight as possible
- Extract air from the patient room and toilet should not be recirculated and returned to the room.
- Fit a local audible alarm or local visual means in case of fan failure and negative differential pressure is not maintained.
- A separate exhaust system dedicated to each room that removes a quantity of air greater than that of the supply system.
- If possible, anteroom or air lock should be used to prevent the transmission of infectious agent from the door opening of the AIIR.

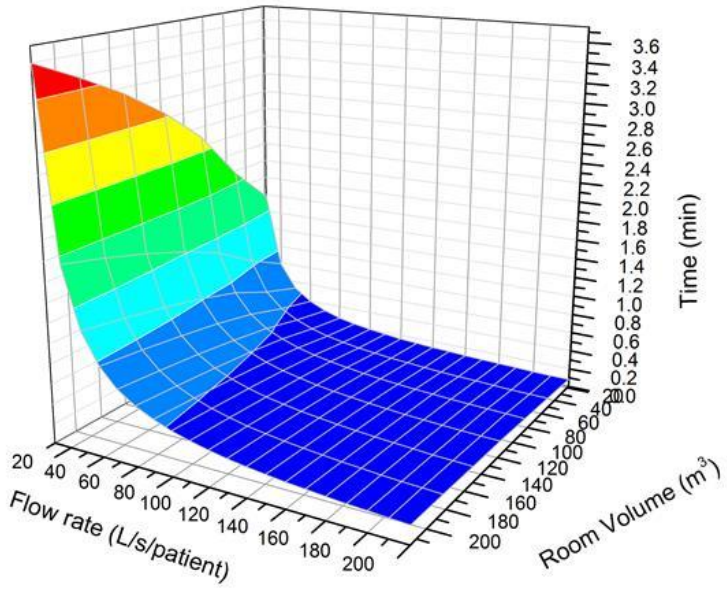

Figure 1. illustration of high airflow rates. Time to replace the air in the room as a function of airflow rate and room volume.

If natural ventilation is used, higher ventilation rates are recommended because of unstable operation of ventilation where sufficient ventilation cannot be guaranteed at all times. Natural ventilation is suitable for the use only in favourable climate conditions. Comprehensive natural ventilation guidance is provided by WHO[7].

[7] Natural Ventilation for Infection Control in Health-Care Settings. WHO 2009. https://www.who.int/water_sanitation_health/publications/natural_ventilation.pdf