

COVID-19

Recommendations for Heating, Ventilation, and Air Conditioning in Healthcare Facilities

October 2020

- Heating, Ventilation, and Air Conditioning (HVAC) systems are an important component of service in health care facilities. Providing adequate thermal conditions and ventilation systems that prevent the dispersion of pathogens, is fundamental to protect the health of patients, caregivers and staff, and to the overall operation of sensitive equipment.
- Possible modes of transmission for SARS-CoV-2 include contact, droplet, fomites, and airborne transmission.
- Airborne transmission of SARS-CoV-2 can occur during medical aerosol generating procedures (AGPs)¹. The AGPs included in the WHO list are: tracheal intubation, non-invasive ventilation (e.g. BiPAP, CPAP), tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation, bronchoscopy, sputum induction induced by using nebulized hypertonic saline, and autopsy procedures².
- Environmental and engineering controls play a key role in aiming to reduce the concentration of infectious respiratory aerosols (i.e. droplet nuclei) in the air and the contamination of surfaces and inanimate objects.

GENERAL RECOMMENDATIONS FOR HVAC AND NATURAL VENTILATION SYSTEMS TO PREVENT VIRUS TRANSMISSION WHILE MAINTAINING ADEQUATE THERMAL AND VENTILATION CONDITIONS

Item	Key Actions
Special considerations for clinical areas³, clinical management and medical procedures with HVAC systems.	<u>Operational aspects where Aerosol Generating Procedures are performed</u> <ul style="list-style-type: none">• The ventilation rate should be 6-12 air changes per hour (ACH)⁴, ideally 12 ACH for new constructions.• Utilize airborne infection isolation rooms with a recommended negative pressure differential of ≥ 2.5 Pa (0.01-inch water gauge).• Facilities should monitor and record daily the proper negative-pressure function of these rooms.• Consider source control options (Local Exhaust Source Control at Patient Head, ventilated headboards, intubation guards, etc.).• Maintain doors closed.• Do not recirculate the air.
	<u>Operational aspects where no AGPs performed</u> <ul style="list-style-type: none">• When AGPs are not performed, adequate ventilation is considered to be a minimum of 6 ACH for mechanically ventilated areas.

¹ <https://www.who.int/publications/i/item/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>

² <https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-2020.4>

³ Clinical areas refer to areas of a health care facility, including related corridors, equipment rooms, ancillary service and patient waiting areas, that house medical equipment, patient rooms, patient beds, diagnostic, operating, therapy, or treatment rooms or other accommodations related to the diagnosis, treatment, or rehabilitation of individuals receiving services from the health facility.

⁴ Air changes per hour (ACH) is the hourly air volume added to or removed from a space (e.g., room, building) divided by the volume of the space.

COVID-19

	<ul style="list-style-type: none"> • Maintain negative pressure in all rooms to prevent contaminated air from entering hallways and corridors. • Avoid moving suspected, probable or confirmed COVID-19 patients out of their rooms. If transport is required, use predetermined transport routes to minimize exposure and give patient a medical mask to wear if tolerated. • Recommendations when single rooms are not available: <ul style="list-style-type: none"> ○ Isolation curtains. ○ No recirculation of air. ○ Beds should be placed at least one (1)⁵ meter apart. <p><u>Air Filtration</u></p> <ul style="list-style-type: none"> • Work with your HVAC provider to implement filtration systems that match the layout and clinical goals of your facilities. • High Efficiency Particulate Air (HEPA) filtration is recommended for use in special-care areas. HEPA filters are usually fixed into the HVAC system serving those areas. • Air from airborne infection isolation rooms should be exhausted directly to the outside or be filtered through a HEPA filter directly. • Utilize portable HEPA filtration units in special-care areas that are not served by a HVAC system. • Notify healthcare workers that HEPA units cannot be turned off once in place, as this may result in the room becoming positively pressurized to the corridor. • Prefer Minimum Efficiency Reporting Value (MERV)⁶ ratings higher than 13 for systems serving patient treatment areas of health care facilities.
<p>Special considerations for clinical areas, clinical management and medical procedures in settings using natural ventilation, with no HVAC systems</p>	<ul style="list-style-type: none"> • When AGPs are not performed, adequate ventilation is considered to be 60 liters /second per patient for naturally-ventilated areas. • Alternative ventilation systems, such as a hybrid (mixed-mode) model, should be considered for areas where AGPs are performed, in order to meet the recommended average natural ventilation rate of 160 L/s per patient⁷. • Define risk areas within the facility. Risk areas might include rooms where aerosol generating procedures are performed, and rooms where COVID-19 confirmed patients are located. • Separate areas with aerosol generating procedures from other areas where patients are seen, keeping patients separated according to symptomology, in order to reduce transmission. • Maintain doors closed in risk areas. • Establish barriers to prevent airflow from areas with confirmed patients to other areas (consider both vertical and horizontal airflows).

⁵ Infection prevention and control during health care when coronavirus disease (COVID-19) is suspected or confirmed: Interim guidance Section 3.1

⁶ Minimum Efficiency Reporting Values, or MERVs, report a filter's ability to capture larger particles between 0.3 and 10 microns (µm) ASHRAE https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_52.2_2017

⁷ Ventilation rate (l/s) = 0.65 × wind speed (m/s) × smallest opening area (m²) × 1000 l/m³ ¹¹

COVID-19

	<ul style="list-style-type: none"> Avoid moving suspected, probable or confirmed COVID-19 patients out of their rooms. If transport is required, use predetermined transport routes to minimize exposure and give patient a medical mask to wear if tolerated.
Recommendations for non-clinical areas⁸ (Applicable to common areas, offices and general spaces)	<p><u>HVAC system design</u></p> <ul style="list-style-type: none"> Ensure outdoor air intakes are open and do not use recirculated air systems. Implement a “clean to less clean” directional design for airflows. Establish a minimum separation distance of 10m (30ft) between exhaust outlets and outdoor air intakes. Avoid Variable Air Volume (VAV) systems, which present a risk to maintaining “clean to less clean” airflow. For health-care facilities without adequate natural or mechanical ventilation, the following approaches can be considered, in consultation with the hospital team of engineers: <ul style="list-style-type: none"> Installation of exhaust fans Installation of turbine roof vents (e.g. whirlybirds) <p><u>Operational aspects</u></p> <ul style="list-style-type: none"> Make sure your HVAC provider has the certifications and licenses required to provide services in your jurisdiction. Maintain relative humidity between 40-60%. Keep the temperature between 70°F–75°F (21°C–24°C). Do not regularly turn HVAC systems or air filtration equipment off. Doing so affects airflows and can cause contamination with agents such as molds and fungi. Ensure HVAC systems are connected to emergency power supplies. Prefer MERV ratings of 13 or higher for systems serving general environment.
Maintenance	<ul style="list-style-type: none"> Use Personal Protective Equipment (PPE) for maintenance activities. Start with areas of least potential contamination and move to Intensive care units of COVID-19 positive cases last. After maintenance activities, wash hands with soap and water or use an alcohol-based hand sanitizer. Change clothes between facilities. Filters should be disinfected with a sodium hypochlorite solution at 10% or another appropriate disinfectant approved for use against SARS-CoV-2, allowing it to act for at least 5 minutes before removal. Filters can then be bagged and disposed of in regular waste⁹.
Planning Activities	<ul style="list-style-type: none"> Develop a workplan with the maintenance team and HVAC provider to ensure timely maintenance and service of HVAC systems. Ensure good environmental ventilation in any closed setting.

⁸ Non-clinical areas refer to areas where no patients are accommodated, managed, treated or diagnosed and exclude patient waiting areas and corridors between clinical areas

⁹ <https://www.ashrae.org/technical-resources/filtration-disinfection#replacement>

COVID-19

	<ul style="list-style-type: none">• Assess the current status of the ventilation system (HVAC or natural) within the facility and modify to ensure minimum standards are reached.• Ensure physical distancing measures are implemented and barriers installed.
Other important considerations	<ul style="list-style-type: none">• Implement mold control measures.• Avoid additional emission sources:<ul style="list-style-type: none">○ Cool-mist humidifiers should be avoided, since they can disseminate aerosols containing allergens and microorganisms.○ Do not use air fresheners, perfumed candles or essential oil diffusers.○ Do not use solid fuels for cooking activities or burn incense.

For detailed HVAC design considerations for healthcare facilities please consult WHO^{10, 11, 12, 13}, EPA¹⁴ and CDC¹⁵ guidelines and the recommendations from ASHRAE Epidemic Task Force¹⁶.

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¹⁰ <https://apps.who.int/iris/handle/10665/112656>

¹¹ https://www.who.int/water_sanitation_health/publications/natural_ventilation/en/

¹² <https://www.who.int/publications/i/item/10665-331603>

¹³ Atkinson J, Chartier Y, Pessoa-Silva CK, Jensen P, LiY, Seto WH, editores. Natural ventilation for infection control in health care settings. Ginebra, Organización Mundial de la Salud; 2009 (disponible en <https://apps.who.int/iris/handle/10665/44167>), consultado el 16 de junio de 2020.

¹⁴ <https://www.epa.gov/coronavirus/ventilation-and-coronavirus-covid-19#:~:text=EPA%20recommends%20precautions%20to%20reduce%20the%20potential%20airborne,close%20contact%2C%20surface%20deaning%2C%20handwashing%2C%20and%20other%20precautions>

¹⁵ <https://www.cdc.gov/infectioncontrol/guidelines/environmental/background/air.html#c3>

¹⁶ <https://www.ashrae.org/technical-resources/resources>