

Options for Operating Room Configuration and Use When a Patient with Suspected or Confirmed COVID-19 Requires Emergent Surgery

November 16, 2020

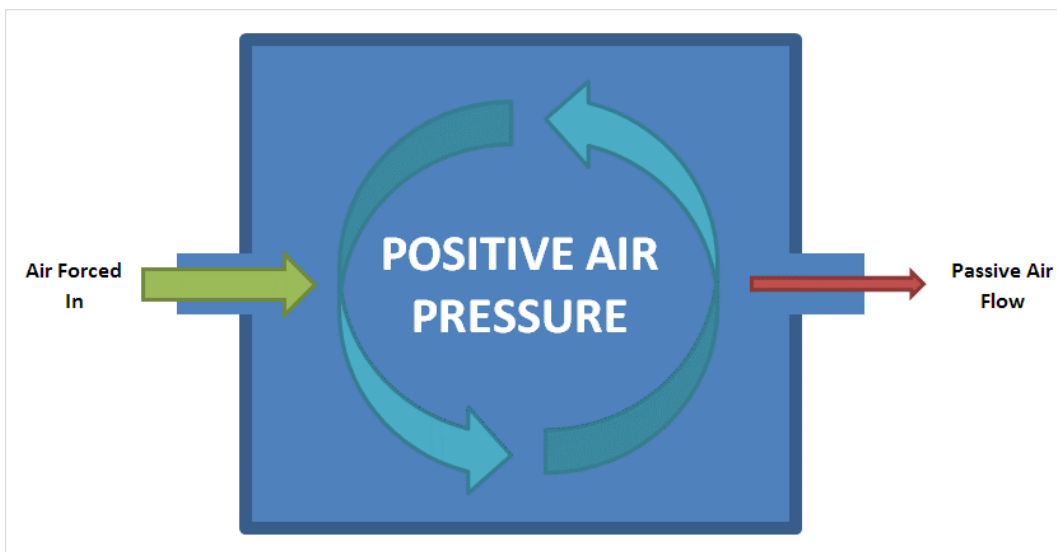
This document presents information and reasoning for consideration when determining the best option for facilities performing surgery on patients who are suspected or confirmed cases of COVID-19.

Key Terms

Operating Room (OR): The room where a surgery takes place.

Operating Room Suite (OR Suite): The combination of the OR, the anteroom (if there is one), the scrub room/area and the clean corridor.

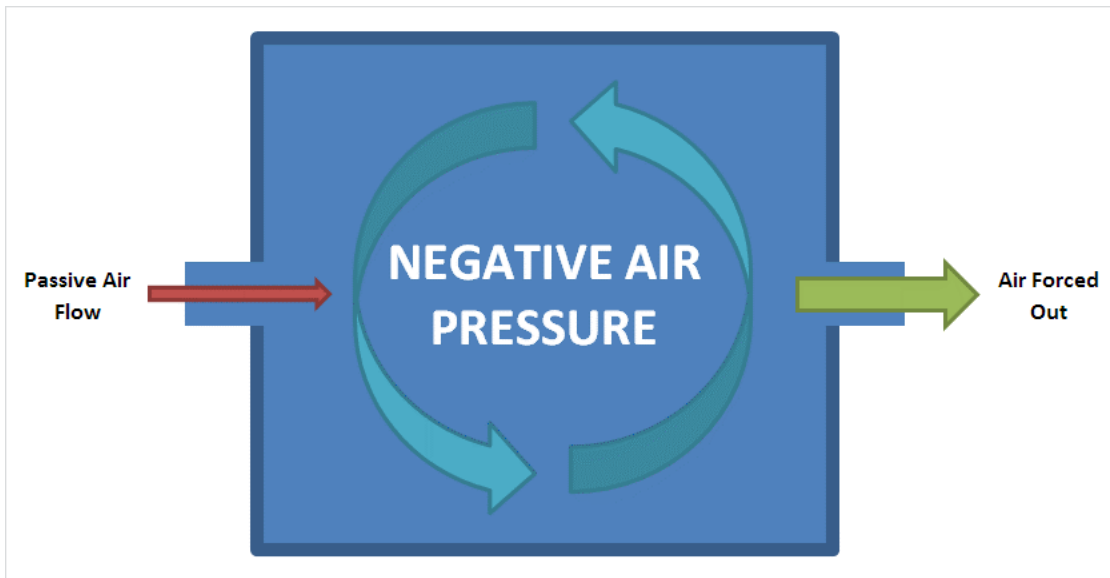
Positive Pressure: Air flows away from areas or rooms with *positive pressure* (pressurized), as more air is supplied to the room than is exhausted. Air flows by mechanical means (i.e., fans pushing air through the room).¹



¹ Image source: https://en.wikipedia.org/wiki/Positive_pressure



Negative Pressure: Air flows towards areas with negative pressure (depressurized), as more air is exhausted from the room than is supplied. Air flows by mechanical means (i.e., fans pulling air through the room).²



Caution: Changing settings in the heating, ventilation and air conditioning (HVAC) system of the OR may affect ventilation dynamics in other areas of the facility and result in reduced air exchanges.

Conversion of an OR from its usual positive pressure to negative pressure must be thoroughly planned and properly designed prior to implementation. This also includes testing, verification, and proper continuous monitoring of the room pressure. This work takes a considerable amount of time and operational resources. This may require work to be undertaken by outside contractors in some cases. Creating a negative pressure OR within a suite of ORs could have unintended adverse effects on adjacent ORs and may have unforeseen and unintended consequences for patients, staff and other areas of the facility.

When performing a surgical procedure in a *negative* pressure environment, air flow may transfer airborne microorganisms from the corridors into the OR. This may have unintended, adverse consequences for patients, such as increased risk of surgical site infection. Risk management, infection prevention and control and workplace health and safety personnel should be consulted for a risk and benefit evaluation.

Once the work is completed to create the negative pressure room, switching back to positive pressure is time consuming and requires manually restoring the HVAC system (i.e., removing negative pressure measures and reinstating the system to normal function).

² Image source: https://en.wikipedia.org/wiki/Negative_room_pressure



Key Assumptions & Requirements Used to Develop Options:

- Surgery cannot be performed using spinal or local anesthesia; general anesthesia (intubation) is required.
- Intubation is an aerosol generating medical procedure (AGMP).
- Transfer of patient to a facility with the preferred OR specifications is not possible and surgery cannot be postponed.
- Facilities management engineers and infection prevention and control with specialized knowledge in HVAC are consulted. Facilities management engineers are to lead any changes to the HVAC system or any modifications made to air flow in the OR - including anteroom construction.
- Relative humidity of the OR suite is maintained at 40-60%.
- All of the health-care team in the OR suite follow appropriate use of personal protective equipment (PPE).
- Droplet/contact and airborne precaution signs are posted on every door into the OR.
- Traffic into and out of the OR is strictly controlled (doors to the OR should be kept closed except when moving patients and supplies in or out) so adequate pressure is maintained and turbulence of air is prevented.
- A disposable anesthesia circuit is used to minimize the risk of contaminating anesthesia equipment. If a disposable circuit is not available, the entire circuit is changed after the surgery is complete and reprocessed according to the manufacturer's instructions.

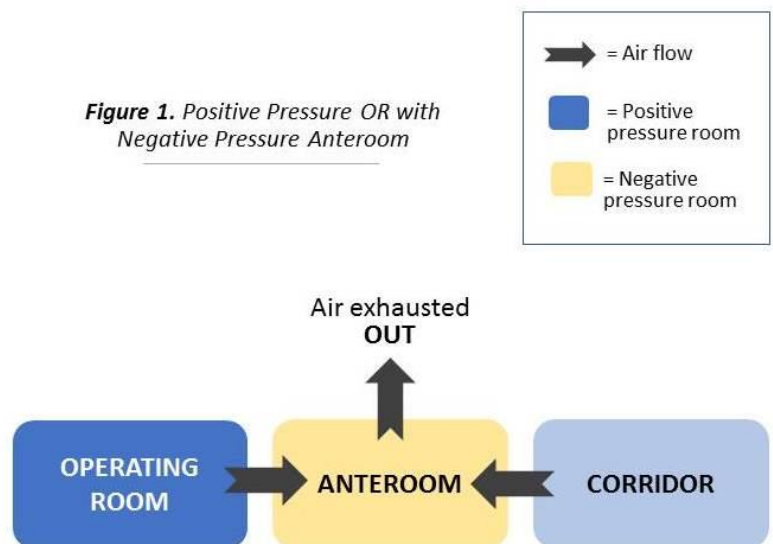
Options for OR Configuration and Use When a Patient with Suspected or Confirmed COVID-19 Requires Emergency Surgery

Please note: These options should be determined in advance. Implementing any of the options below should never occur in circumstances where delays may occur and result in patient harm (e.g., obstetrical patients including those with a planned general anesthesia or emergency anesthesia where delays result in maternal and fetal harm).

Option: Use a Positive Pressure OR with negative pressure anteroom (Preferred Option).

- OR is positively pressured to the anteroom (air flows from the OR into the anteroom).
- Ensure outlet air vent is not close to an intake air vent.
- Corridor is positively pressured in relation to the anteroom (air flows from the corridor into anteroom).
- The anteroom is negatively pressured in relation to the OR and corridor, with air being discharged to the outside (i.e., air flows into the anteroom and is exhausted outside).

Figure 1. Positive Pressure OR with Negative Pressure Anteroom



- Anteroom is not to be used for donning and doffing of PPE. Infectious organisms are drawn into the anteroom before being discharged outside therefore the anteroom area should be considered contaminated while the patient is in the operating room and for a time period after.
- Temporary modification equipment such as a construction air handling unit high-efficiency particulate air (HEPA) filter may be used for maintaining negative pressure in the anteroom only.

If the above option is not possible, other options include:

Option: Use a positive pressure OR for the entire process.

- Patient is intubated in the OR just prior to surgery.
- Doors to the OR remain closed. Staff is restricted from adjoining corridors.
- Limit personnel in the OR for intubation to registered nurse (RN), anesthesiologist, respiratory technologist.
- Complete surgical procedure. Surgical team leaves OR once complete.
- If additional equipment (e.g. surgical supplies, blood) is required, movement into the room can occur after the appropriate air exchanges (or 30 minutes if air exchange rate is unknown).
- Limit staff in OR (registered nurse, anesthesiologist, respiratory technologist) until ready to move the patient to designated unit:
 - Extubate and recover in OR.
 - When medically suitable, patient can be returned to their room on the patient care unit.
- Next patient can be taken to OR after the appropriate number of air exchanges have occurred.

Or,

Option: Use a negative pressure OR for the entire process.

- Patient is intubated in the OR just prior to surgery.
- Limit personnel in the OR for intubation to the RN, anesthesiologist, respiratory technologist.
- If required, movement of equipment or supplies can take place once patient is intubated.
- Complete surgical procedure. Surgical team leaves OR once complete.
- Limit staff in the OR (RN, anesthesiologist) until ready to move the patient, respiratory technologist to designated unit:
 - Extubate and recover in OR.
 - When medically suitable, patient can be returned to their room in the patient care unit.
- Next patient can be taken to the OR after the appropriate number of air exchanges have occurred.

* Time may differ based on rate of air exchanges in the OR suite. Determining appropriate times for air clearance post-AGMP should be made for each OR suite in consultation with infection prevention and control and facilities management. If this information has not yet been determined, wait 30 minutes.



Table 1³: Air changes/hour and time required for airborne-contaminant removal by efficiency*.

Air Changes/ Hour (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
15	18	28
20	14	21
50	6	8

* Table 1 (above) was originally adapted from a 1973 National Institute for Occupational Safety and Health (NIOSH) article for industrial particulates. It has been used since then as a guideline for room clearance and has never been updated. The table is a general guideline only, particularly as air handling systems have become more sophisticated since the formula used for this table was first developed.

Or

Option: Facilities management engineers with specialized HVAC training configure one OR to permanently be under negative pressure, IF the existing HVAC system allows for this.

- OR will need to be dedicated and kept available for this specific procedure.
- Intubate patient in this OR and then transfer to a separate OR that is positive pressure to perform the surgery.
- A disposable bacterial filter should be placed on the patient's anesthesia breathing circuit at the endotracheal tube or expiratory side of the circuit.
- When surgery is complete, transfer the patient from OR that is positive pressure to the OR that is negative pressure to recover and extubate the patient.
- When medically suitable, the patient can be returned to their room in the patient care unit.

Note: This option may not be medically suitable for some patients, as it extends anesthesia time and requires movement of an unconscious, intubated patient.

³ Source: <https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html>



Or

Option: Use a negative pressure room or a private room (if the facility does not have a negative pressure room) located as close to the OR suite as possible for intubation.

- Intubate the patient in a negative pressure room (as close to the OR as possible) or a private room (if the facility does not have a negative pressure room) and then transport the patient to the OR.
 - A disposable bacterial filter should be placed on the patient's anaesthesia breathing circuit at the endotracheal tube or expiratory side of the circuit.
 - An AGMP should not be performed on route.
- Transport the patient directly into the OR and bypass the holding area.
- Complete surgical procedure in an OR that is positive pressure.
- When surgery is complete, transfer patient to a negative pressure or private room in the post anaesthetic care unit (PACU) or as close to PACU as possible.
- Recover and extubate the patient in the negative pressure room.
- When medically suitable, the patient can be returned to their room on the patient care unit.

Note: This option may not be medically suitable for some patients, as it extends anesthesia time and requires movement of an unconscious, intubated patient

References

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