

[High Priority] - S0397 : [COVID-19] Anesthesia Units Can Be Repurposed to Provide Ventilatory Support for Critically Ill Patients, as Long as Precautions Are Taken [ECRI Exclusive Special Report] Medical Device Special Report

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Geographic Regions: Worldwide

Suggested Distribution: Anesthesia, Clinical/Biomedical Engineering, Emergency/Outpatient Services, Pulmonology/Respiratory Therapy, Risk Management/Continuous Quality Improvement

Problem:

1. Many COVID 19 patients will require mechanical ventilation; however, a shortage of ventilators has led to an increased risk of patient death.

ECRI Recommendations:

1. Anesthesia units that are not in use should be considered as safe supplements to a hospital's fleet of intensive care ventilators, as long as appropriate steps are taken.
2. Consider anesthesia units in your operating rooms, elsewhere in your immediate facility (e.g., cath lab), in affiliated facilities such as hospital-owned ambulatory surgery centers, and in unaffiliated facilities. Keep in mind that moving anesthesia units between facilities can take several days and clinical/technical expertise will be needed assure that all required components and accessories are moved and reconnected properly.
3. Ideally, trained anesthesia providers (i.e., anesthesiologists, certified registered nurse anesthetists) should be responsible for the care of patients receiving long-term ventilator support from anesthesia ventilators. If this is not possible, anesthesia providers should be available onsite at all times to provide support to other clinicians and should be regularly checking in (i.e., rounding) on these patients and the anesthesia units.
4. Unless you are using anesthetic agents to sedate ventilated patients, which is not recommended, empty or remove the vaporizers to prevent inadvertent delivery of agent.
5. For a detailed list of key safety considerations, see the [guidance](#) from the American Society of Anesthesiologists (ASA) and the Anesthesia Patient Safety Foundation (APSF), the Discussion section of this alert, and the guidance provided by the manufacturer of the anesthesia unit(s) in your facility.

Background:

1. Although modern anesthesia ventilators are very similar to intensive-care ventilators and able to provide the necessary ventilator support to patients, there are important differences between the two devices:
 1. Settings may be different.
 1. Modern anesthesia ventilators can provide volume and pressure control breaths as well as many advanced ventilation modes. However, the mode names may be different, even in ICU ventilators from the same vendor.
 2. Unlike ICU ventilators, anesthesia units do not have a control for FiO₂. Instead, oxygen concentration is controlled indirectly by setting fresh gas flow rates.
 3. Anesthesia units have a "bag" or manual mode in which mechanical ventilation is disabled and the clinician controls the gas to the patient via fresh gas flows and the manual breathing bag. ICU ventilators do not have a comparable mode.
 4. Anesthesia units have a setting that limits the amount of pressure in the breathing system when the ventilator is in volume control mode, typically called P_{max} or P_{limit}. This is similar to an inspiratory pressure alarm limit on an ICU ventilator, but it can behave differently. Some anesthesia units terminate the breath when this limit is reached, while others maintain the breath at the maximum pressure level.
 2. Anesthesia units are designed to undergo a daily pre-use check.
 1. ICU ventilators are designed to be checked before each patient use and then operate for several days without rechecking. Anesthesia units are designed to be checked daily.
 2. In the pre-use check, the device will measure system leak and compliance. If these measurements are off, which can happen if the pre-use check is not performed daily, delivered tidal volumes and other settings can be off significantly.
 3. The unit does not ventilate the patient during the pre-use check, so manual or other backup ventilation will be required. This will also entail disconnecting the patient from the breathing circuit in a way that minimizes the spread of aerosols and reduces the risk of lung de-recruitment.
 3. Rebreathing is possible with anesthesia units.
 1. Unlike an ICU ventilator, which vents exhaled gas into the room, an anesthesia unit recirculates exhaled gas.
 2. Even with high fresh gas flows, some rebreathing will occur, so CO₂ absorbent will be necessary.
 3. To maximize the life of CO₂ absorbent, ASA recommends monitoring inspiratory CO₂ levels rather than relying on the absorbent material changing color.
 4. Moisture must be managed.
 1. ICU ventilators are routinely used with a humidifier.
 2. Humidifiers will not be needed for anesthesia units, because the patient's exhaled gas will contain moisture and the reaction of the absorbent with CO₂ also creates moisture.

3. Excessive amounts of moisture are possible when an anesthesia unit is used for long-term ventilator support.
4. Higher fresh gas flows can reduce the amount of moisture buildup in the patient circuit. However, fresh gas flows that are too high can lower the patient's temperature.
5. Anesthesia units do not compensate for leaks.
 1. ICU ventilators have leak compensation features that are not normally included in anesthesia units.
 2. The daily pre-use check includes a measurement of any leaks in the patient circuit. If the leak is too high, the pre-use check will fail.
 3. If the leak occurs between the patient and the expiratory filter, it is a potential source of contamination.
 4. If the leak is higher than the fresh gas flow, the reservoir will eventually empty, leading to the unit being unable to provide the set tidal volume or inspiratory pressure.
2. Alarm management will be a key consideration when using anesthesia units for long-term ventilator support.
 1. Unlike alarms on ICU ventilators, anesthesia unit alarms do not latch. Users will have to check the alarm log to see any alarms that occurred while no one was present.
 2. Anesthesia unit alarms are typically not as loud as ICU ventilator alarms, so the volume must be turned as high as possible to ensure that alarms can be heard at a distance.
 3. Remote alarm annunciation is not necessary in the OR, so this may be difficult to implement on an anesthesia unit.
3. Some physical configuration adjustments to the anesthesia unit may be necessary.
 1. Other devices that are mounted to the anesthesia unit, such as a physiologic monitor and computer workstation, may not be required outside of the OR and may need to be removed.
 2. Unless inhaled anesthetic agent is being used to sedate ventilated patients, vaporizers should either be emptied or removed from the unit.
 3. Scavenging is not necessary unless anesthetic agent is being delivered. As such, most scavengers do not need to be connected to suction.
 1. The exception is a closed active scavenging system. Unless these systems are either modified or connected to suction, pressure will build up, which can lead to inadvertent positive end-expiratory pressure (PEEP) being delivered to the patient.
 2. These systems can be easily identified by the reservoir bag that hangs on the underside of the scavenger.
 3. Removing the reservoir bag will eliminate the build-up of pressure. Alternatively, the waste gas exhaust can be connected to wall suction (an adapter or modified hose may be required).
4. Appropriate filtration will be necessary to limit the spread of virus and to prevent contamination of the anesthesia unit.
 1. A filter at the end of the endotracheal tube (typically a HMEF) will prevent the virus from entering the gas sample line.
 2. A second filter at the end of the expiratory limb (where it connects to the anesthesia unit) will protect the anesthesia breathing system from contamination.
 3. Filters must be changed at least as frequently as they are for patients on ICU ventilators. HMEFs may become clogged and require more frequent changes.
 4. Filter resistance should be checked regularly via the spirometry tools and other features on the unit.
5. Several things will need to be checked on a regular schedule. Refer to the ASA guideline for a comprehensive chart. Some key items include:
 1. Check absorbent and monitored parameters every hour.
 2. Look for accumulated moisture in the gas analyzer water trap and breathing circuits every hour.
 3. Perform the pre-use check daily.

Manufacturer's Corrective Action/Recommendations:

1. Using anesthesia units for long-term ventilator support constitutes off-label use.
2. Mindray: [Alert A34796](#)
3. Draeger: [Alert A34763](#)
4. GE: [Alert A34787](#)
5. Getinge: [Alert A34800](#)

References & Source Documents

- <https://www.asahq.org/in-the-spotlight/coronavirus-covid-19-information/purposing-anesthesia-machines-for-ventilators>

- This alert is a living document and may be updated when ECRI receives additional information.

Source(s):

- 2020 Apr 16. ECRI researched report