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Guidelines for the control and prevention of coronavirus disease (COVID-19) transmission in surgical and anesthetic settings

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Precautions must be taken in surgery and anesthesia-related clinical settings to prevent the transmission of coronavirus disease (COVID-19) via droplets or contact with contaminated surfaces and materials, especially in areas where patients with COVID-19 had been present.

Transmission control can be ensured by using disposable or dedicated instruments whenever possible. However, material and equipment that may inevitably have to be shared among multiple patients must be thoroughly cleaned and disinfected before use on the next patient. In addition to medical instruments, caution must be taken to prevent contamination of high-touch surfaces, including doorknobs and light switches, in the surrounding environment.

This guideline is based on the “COVID-19 infection prevention and control guidance for healthcare facilities” issued by the Korea Centers for Disease Control and Prevention [1]. It was drafted specifically for surgery- and anesthesia-related settings. Specific details of the guideline may be modified and applied in accordance with the circumstances in each institution.

1. Basic rules

- (1) Proper ventilation must be maintained, and cleaning and disinfection must be performed in all areas inside the medical facility, including the surgical and anesthetic environments.
- (2) When a patient with COVID-19 is admitted in an isolation unit, intensive care unit, or operating room, appropriate means of communication, such as a telephone or interphone, must be in place to allow communication with people outside the clinical setting.
- (3) Materials and furnitures inside the area where a patient with COVID-19 is admitted should be minimized to reduce the number of objects that can become a medium for contact transmission.
- (4) Among the instruments used to treat patients, single-use equipment should be used whenever possible.
- (5) With regard to non-disposable materials such as stethoscopes, dedicated materials

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should be used for each patient.

- (6) Facilities where a patient with COVID-19 is admitted must be equipped with a dedicated waste bin and materials for hand hygiene.

2. Hand hygiene (handwashing or disinfection)

- (1) Must be performed before and after coming in contact with patients with COVID-19.
- (2) Must be performed when exposed to a patient's surrounding environment, blood, bodily fluid, secretions, or excrement, or other contaminants.
- (3) Anyone who comes in contact with a contaminant must use soap and water for disinfection. Alternatively, an alcohol-based hand sanitizer can be used.
- (4) Perform hand hygiene for 40–60 seconds when using soap and water and for 20–30 seconds when using an alcohol-based hand sanitizer.

3. Personal protective equipment

- (1) Personal protective equipment (PPE) must be replaced whenever entering an isolation unit, intensive care unit, or operating room where a patient with COVID-19 is present.
- (2) PPE must also be worn by all workers who handle laundry, clean or disinfect areas where a patient with COVID-19 had stayed, or wash instruments used by any patient with COVID-19.
- (3) PPE must also be worn when performing laboratory tests that require handling of sample(s) obtained from a patient with COVID-19.
- (4) After completion of patient treatment or examination, and upon completion of any work that may involve contact with contaminants, including disinfection, cleaning, washing of instruments, and environmental disinfection, PPE must be removed, and hand hygiene must be performed (handwashing or disinfection) before leaving the area.
- (5) When removing PPE, caution must be taken to ensure that possible sources of infection do not contaminate other parts of the body or the surrounding area. PPE must be removed properly and immediately discarded into the medical waste bin.
- (6) Damaged or contaminated PPE cannot be reused or stored, and must be disposed immediately.

4. Operating and cleaning instructions for the anesthesia machine and breathing circuit, and procedure for suctioning airway secretion [2]

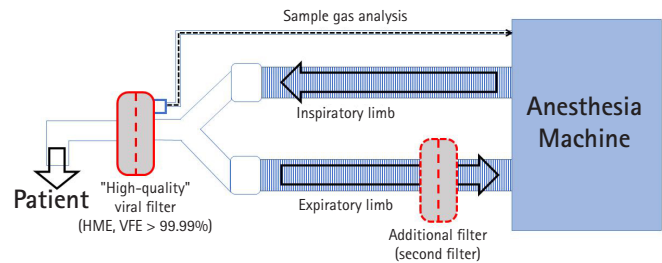


Fig. 1. Example of an anesthesia machine/breathing circuit/filter setup
HME: heat moisture exchanger, VFE: viral filter efficiency.

- (1) As long as a “high-quality” viral filter (viral filter efficiency > 99.99%) is properly used for each patient, the risk of infection through the anesthesia machine can be prevented. A heat moisture exchanger with a high-quality viral filter function is recommended. If no humidification function is available, low-flow anesthesia (< 1–2 L/min) can be performed (Fig. 1)
- (2) To prevent contamination of the anesthesia machine by a patient with suspected or confirmed COVID-19, a high-quality viral filter should be installed between the patient's respiratory tract and the breathing circuit (as shown in the figure). An additional filter (second filter) is installed between the anesthesia machine and the end of the expiratory limb. Moreover, an additional filter may optionally be installed between the anesthesia machine and the end of the inspiratory limb; however, this is not absolutely necessary (Fig. 1).
- (3) Sample gas collected after passing through the filter can be permitted to reenter the breathing circuit because it is not contaminated. However, sample gas that has not passed through a reliable filter must not reenter the breathing circuit. In such cases, mounting a 0.2 μm epidural injection filter at the opening of the water trap can be helpful (This can slightly affect the waveform of capnography).
- (4) If the anesthesia machine is properly equipped with a high-quality filter, which is used separately for each patient, disinfection is not required because the risk of infection through the anesthesia machine is eliminated. If contamination of the anesthesia machine could not be prevented because of improper filter use or excessive secretion from the patient, disinfection of the inner components of the machine must be mandatorily performed.

- (5) When suctioning to remove sputum or secretion from the patient, a closed suction system must be used to prevent contamination.
- (6) All disposable products such as breathing circuits, masks, reservoir bags, sample gas tubes, and filters must be discarded after use, and all surfaces must be cleaned and disinfected.
- (7) The method used for cleaning the anesthesia machine need not vary significantly from that typically employed after regular patients if a high-quality viral filter has been properly used. Refer to the recommended manufacturer's protocol for detailed cleaning instructions for each individual equipment.

① GE Healthcare

- Refer to the link and attached file for protocols to disassemble, clean, disinfect, and reassemble the respiratory system of the anesthesia delivery system (Attachment 1. Cleaning and sterilization of GE breathing system manual; Avance/Aisys ABS:

<https://www.youtube.com/watch?v=3MU2BsRAvY8>).

- Refer to the attached file for a list of cleaning agents. The list of cleaning agents for Aisys may be used for Avance (Attachment 2. Cleaner compatibility). When using cleaning agents that are not included in this list, those with a pH range of 7.0–10.5 are recommended.

② Mindray

- Refer to the links and attached file for the protocols to disinfect the anesthesia machine and monitor (Attachment 3. Cleaning and disinfection manual of Mindray anesthesia machine; <https://www.youtube.com/playlist?list=PLhnlWcdDi3TeiVRvr8vJkp1JVcrucCrND>; <https://www.youtube.com/playlist?list=PLhnlWcdDi3TebTUrGMClr0uD-HKDMU14Zb>; https://www.youtube.com/playlist?list=PLhnlWcdDi3TdhdaJHvuoMhMUia_ltvH5o).

③ Draeger

- Refer to the link and attached file for the protocols to disassemble, clean, disinfect, and reassemble different types of anesthesia machine (Attachment 4. Cleaning and disinfection manual of Draeger anesthesia machine; https://www.youtube.com/watch?v=7pS_VVMZ6B0&feature=youtu.be).
- Refer to the link for details information about medical devices used for diagnosing, preventing and treating COVID-19; (https://www.draeger.com/ko_kr/Home/Coronavirus-COVID-19).

5. Disinfection of reusable instruments

- (1) Instruments contaminated by blood, bodily fluid, secretion, or excrement after use must be carefully transferred to a washing station to prevent contamination of the surrounding environment.
- (2) After sufficiently soaking the instrument in a designated washing station separated from the area used by other patients or where clean materials are stored, carefully wash the instrument while making sure that the cleaning agent does not splash.
- (3) Wash thoroughly to make sure no blood, bodily fluid, secretion, or excrement remains.
- (4) Depending on the instrument criticality, low-level disinfection is performed for non-critical items; high-level disinfection or sterilization is performed for semi-critical items; and sterilization must be performed for critical items.
- (5) Recommendations by the manufacturer of the disinfectant must be checked. It is necessary to strictly adhere to the recommended disinfection process, including the dilution of the disinfectant, duration of the application of the disinfectant, shelf life of the disinfectant, and measurement of the effective concentration.

6. Cleaning and environmental disinfection

- (1) If there are organic substances on the surface of the environment, it cannot be properly disinfected; thus, the surface must be wiped before disinfecting the environment.
- (2) To prevent airborne dispersion of pathogens while cleaning, use a rag wet with a cleaning solution or disinfectant for cleaning instead of a broom or vacuum cleaner.
- (3) Instead of using a spray-type disinfectant, use a clean towel wet with disinfectant or ready-to-use products, such as a disinfectant tissue (towel), to thoroughly wipe environmental surfaces.
- (4) Whenever possible, use disposable or dedicated cleaning tools. Except when reusing cleaning tools, the tools must be appropriately disinfected with the proper disinfectants and stored for reuse after drying.
- (5) Surfaces contaminated by blood, bodily fluid, secretion, or excrement must be disinfected immediately, and the surrounding environment of the isolation unit occupied by patients must be disinfected at least once a day, while any surfaces prone to frequent hand contact should be disinfected often. The room must be disinfected after the pa-

tient is discharged.

- (6) Disinfectants generally used in medical institutions include sodium hypochlorite (1000 ppm recommended) and 70% alcohol (localized surface), while a viral disinfectant with proven sterilizing power could also be used.
- (7) When using a disinfectant, the manufacturer's recommendations on the dilution factor, contact duration, and handling precautions should be followed.

7. Medical waste management

- (1) Waste must be disposed in accordance with the medical waste disposal guidelines of each institution.
- (2) For proper and safe handling, all wastes must be separated from the place where the waste occurred and then disposed of.
- (3) Sharps such as needles and blades must be collected in a puncture-resistant sharps container, which must be placed in areas where such materials are collected.
- (4) Infectious non-sharp waste (solid biohazardous waste) must be collected in a leak-proof waste bin with the lid closed.
- (5) Bodily fluid or excrement from patients must be disposed into the sewage system in accordance with wastewater discharge regulations. Caution should be taken not to contaminate the surrounding environment or people during the waste disposal process.

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Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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