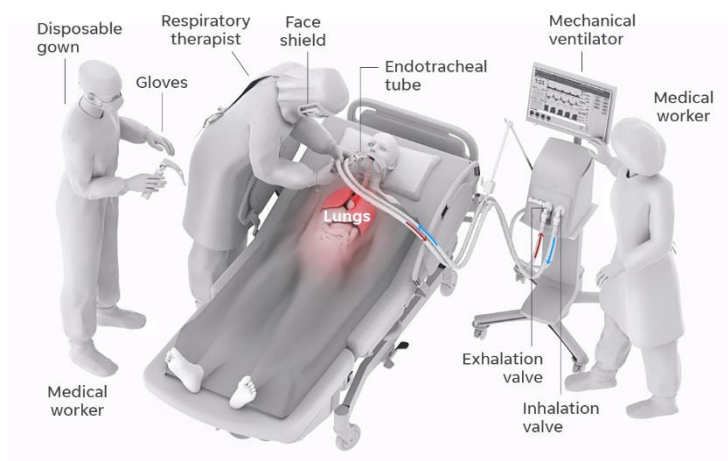




SOP FOR THE CLEANING AND DISINFECTION OF VENTILATORS



Ministry of Health and Wellness
MAURITIUS

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Approval Form

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STANDARD OPERATING PROCEDURE FOR THE CLEANING AND DISINFECTION OF VENTILATORS			
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Dr. D. Nuckchady. This document was vetted by the IPC Writing Committee.

PEER REVIEW

Version 1 was reviewed by Mr. M. Carbuhn (Service Manager for Heyer Medical AG - Germany) and Mrs. L. Tomlinson (Technical Support Lead for Vyaire Medical - USA).

Date of next review: December 2025

Updates

December 2022

- Minor clarifications were made to a few sentences
- Some information about the use of bacterial / viral filters were added
- Additional details regarding the frequency of cleaning and contact time were included

Version history

Version	Date
Version 1.0: Created	25 September 2021
Version 1.0: Approved	11 October 2021
Version 2.0: Revised	25 December 2022
Version 2.0: Approved	6 March 2023

Standard Operating Procedure for the Cleaning and Disinfection of Ventilators

Background

Following the introduction of version 1 of this document, it has been noted that external surfaces of ventilators are often cleaner, disposable ventilator tubing are more commonly in use (as opposed to reusable ones) and bacterial filters are more frequently available.

Purpose

This document is meant to act as a guidance to healthcare workers working in the public sector when cleaning and disinfecting ventilators. The expectation is that this standard operating procedure (SOP) will help to reduce the rate of ventilator-associated pneumonias in the intensive care units.

Key points

- Always consult the equipment's Operator's Manual for specific cleaning instructions.
- Ventilator circuits have a high concentration of pathogens, which may induce ventilator-associated pneumonia. Therefore, condensate should be removed regularly.
- Clean before disinfecting and sterilizing. Do not sterilize without cleaning. Turn off the ventilator before cleaning or disinfecting. Disassemble the circuit before cleaning.
- Place filters in both inspiratory and expiratory ends of the ventilator. Use an inspiratory antibacterial filter whenever available. Ensure that the filters and the tubing are first installed before re-calibrating the ventilator.
- Do not clean, disinfect or reuse any single-use components. Prefer single-use consumables over reusable components.
- It is inadmissible that remnants of organic material be left stuck onto any segment of the circuit before use. Do not use rough brushes, sharp tools and abrasive materials for manual cleaning.
- Mist-tent nebulizers and reservoirs that are used on the same patient should be subjected to daily low-level disinfection or pasteurization followed by air-drying.
- Between uses on different patients, portable respirometers and ventilator thermometers should be sterilized or subjected to high-level disinfection.
- Between uses on different patients, reusable hand-powered resuscitation bags should be sterilized or subjected to high-level disinfection.
- Decontaminate hands before and after contact with a patient who has an endotracheal or tracheostomy tube in place, and before and after contact with any respiratory device that is used on the patient.
- Wear gloves for handling respiratory secretions or objects contaminated with respiratory secretions of any patient.
- Reusable water traps should be autoclaved or undergo high-level disinfection using chemical agents.
- If contamination with prions is suspected, additional decontamination steps other than what is listed here may be required.

- After autoclaving items, fill out a logbook to ensure that items have not been reprocessed beyond their maximum number of cycles.
- Allow all surfaces to air-dry thoroughly after disinfecting to maximize the contact time.
- Never spray liquids in or on the ventilator, immerse the device in liquids or use abrasive cleaners.
- The following items should be cleaned and disinfected regularly if reusable or discarded if disposable:
 - a. Ventilator monitor
 - b. Ventilator plug and power cord
 - c. Dust filters (for fan / main air outlet / air intake)
 - d. Ventilator tubing - inspiratory and expiratory (or use disposable ones)
 - e. Inspiratory and expiratory valves
 - f. Humidifier (autoclavable or non-autoclavable)
 - g. Ambu bag
 - h. Reusable mask for non-invasive ventilation
 - i. Other tubing surfaces
 - j. Laryngoscope
 - k. Suction device (discard disposable parts)
 - l. Bain circuit (prefer disposable ones)
 - m. T-piece (prefer disposable ones)
 - n. Nebulizer bottle.
- Some disinfectants such as glutaraldehyde can be toxic. Rooms should be well-ventilated; alternatively, use local exhaust hoods; moreover, the wearing of gloves, masks and gowns (in cases where splashing is likely) is recommended when manipulating toxic substances.
- For additional details on the cleaning techniques and the solutions that may be used for high-level disinfection, please refer to the “SOP for the cleaning of healthcare facilities in the public health sector”.

Recommended maintenance frequency interval

- Clean and disinfect the external ventilator surface including faceplates, Y-pieces, and water traps at least every 8 hours to 24 hours, and in between patients.
- Clean and disinfect the expiratory and inspiratory valves after each patient and at least once a week.
- Change the heat-moisture exchanger after each patient or once a week. Similarly, the ventilator circuits do not need to be changed more frequently than once a week unless clogged.
- Bacterial / viral filters should be changed weekly or when resistance increases; there is limited evidence regarding their utility; inspiratory filters may protect the patient while expiratory filters may protect staff from infections.

- Dust filters should be cleaned every 4 weeks or when necessary.
- Ventilator tubing, laryngoscopes and ambu bags should be cleaned after each patient.
- Humidifiers, nebulizer bottles and reusable masks should be cleaned every 24 to 48 hours and in between patients.
- Jars for suction devices should be cleaned when two-thirds full.
- All suction equipment should be serviced every 12 months to ensure it is working correctly and details of this service must be documented in a register.
- Preventive maintenance is done after every 5,000 hours of use and at least once per year. This should also be documented.
- The internal battery should be checked every 3 months.

External surface of the ventilator

1. CLEANING:

- a. Wipe with a damp cloth immersed in alkalescent detergent (e.g., soapy water) and then wipe off the remaining detergent with a dry lint-free cloth.

2. DISINFECTING (LOW-LEVEL):

- a. Wipe with a damp cloth immersed in high-efficiency detergent (e.g., 0.5% sodium hypochlorite, 2% glutaraldehyde, 6%-7% hydrogen peroxide, 70-75% ethanol or isopropanol, 0.15%-0.35% peracetic acid or 1% potassium peroxymonosulfate), and then wipe off the remaining detergent with a dry lint-free cloth.
- b. The touch screen may be sensitive to strong detergents – use mild or neutral detergents (e.g., 0.05% sodium hypochlorite) under these circumstances. Some ventilators may be damaged by alcohol.
- c. Always allow the disinfectant to dry before use. Surfaces should typically remain damp for at least 10 minutes.
- d. Store sodium hypochlorite away from sunlight. Use newly diluted sodium hypochlorite every 7 days.
- e. Flammable vapors (e.g., alcohol) may cause fires when mixed with oxygen – if such substances are used, ensure proper precautions are taken; avoid contact with electrical wires.

Expiratory and inspiratory valves

1. CLEANING:

- a. Wipe with a damp cloth immersed in alkalescent detergent (e.g., soapy water) and then wipe off the remaining detergent with a dry lint-free cloth.
- b. Do not damage the membrane. Remove all mineral deposits if any. The set may tolerate up to 200 washing cycles.

2. DISINFECTING (HIGH-LEVEL):

- a. Immerse in high-efficiency detergent (e.g., 70% ethanol or isopropanol, 3% enhanced hydrogen peroxide or 0.55% ortho-phthalaldehyde) for 30 minutes and then wipe dry with a cloth.
 - b. Up to 100 disinfection cycles may be tolerated. Pre-disinfection with enzymes can be considered (protease, lipase and amylase).
3. **STERILIZING:**
- a. If high-level disinfection is not possible, then autoclave the valves – ascertain from the manufacturer's instructions that the product will not get damaged.
 - b. The sets support up to 50 autoclaving cycles (more cycles may be tolerated if a lower temperature and a shorter duration are used). The following parameters are usually selected: 20 minutes at 121 °C for a total cycle length of 2 hours; or 15 minutes at 134 °C (132 to 138 °C) for a total cycle length of 1.5 hours.

Ventilator tubing / patient circuit

1. Some plastic tubes may be damaged by alcohol, concentrated sodium hypochlorite, ethylene dioxide or heat.
2. **CLEANING:**
 - a. Wash and soak in soapy water (or enzymatic detergents) at a temperature of 30-40°C. Flush and rinse the tubing.
 - b. Use a soft plastic brush to remove solid pollution from the components' surface.
 - c. Wash the components under a stream of clean water.
 - d. Dry in the air.
 - e. Inspect and dispose if defective.
3. **DISINFECTING (HIGH-LEVEL):**
 - a. Immerse in a high-efficiency detergent (1.5% glucoprotamin, 2% glutaraldehyde or 1% sodium hypochlorite) for at least 30 minutes.
 - b. Dry the components in the air. Do not wipe.
 - c. Throw away the detergent and use new detergent at least every 24 hours. Clean the container holding the detergent at least every 24 hours.
 - i. An exception is activated glutaraldehyde which can be used for 7 days to 4 weeks.
4. **STERILIZING:**
 - a. If high-level disinfection is not possible, then autoclave the valves – ascertain from the manufacturer's instructions that the product will not get damaged.
 - b. Sterilize the components in a hot steam sterilizer at 134°C and 0.21 MPa for 30 minutes.
 - c. Some parts of the ventilator tubing may not be autoclavable for more than 25 times. Generally, reusable tubing should be changed at least every 3 to 5 years.

Cleaning of other components

- Infant hot wire flow sensors should be disinfected with 2% glutaraldehyde.
- The reusable water trap should be autoclaved.
- Dust filters should be soaked in soapy water, dried and dipped in 1% chlorine for 30 minutes, followed by rinsing with water.
- The humidifier, ambu bag, laryngoscope, reusable jars (for suctioning), nebulizer bottles and reusable masks can be dipped in 2% glutaraldehyde for 20-30 minutes for high-level disinfection or 6 hours for sterilization.
 - Always clean and scrub with detergent and water prior to disinfection.
 - Clean the device using a soft bristle brush to adequately remove adhering substances from each component while soaking in a commercially available, anionic detergent and pay extra attention to crevices and cavities.
 - Allow to air-dry.
 - Alternative chemical agents that can be used include 0.55% ortho-phthalaldehyde and 0.15% peracetic acid.
 - Agents used for dipping should be changed at least every 24 hours. Clean the container holding the detergent every 24 hours.
 - An exception is activated glutaraldehyde which can be used for 7 days to 4 weeks.

Additional precautions to be taken when dealing with COVID-19 patients

- Whenever possible, use dedicated ventilators for COVID-19 patients.
- Wear appropriate personal protective equipment (PPE) before cleaning and disinfecting the ventilator surfaces and parts.
- Doff PPE after every cleaning and disinfection procedure in the doffing area and discard PPE in the appropriate bin.
- Discard disposable ventilator parts in the appropriate bin.
- The external surfaces of the ventilator should be cleaned frequently i.e., at least 3 times per day.
- The jars used for suctioning should be changed frequently. Avoid splashing injuries.
- Adopt single-patient use circuits (water-trap with one-way valve mechanism). Do not routinely change circuits unless damaged or soiled. Changing circuits leads to the dispersion of contaminated droplets and aerosols, as well as increased use of medical resources (workload and consumables).
- Place the ventilator on stand-by to suspend the ventilator from operating prior to disconnecting the circuits to prevent splashing.
- Use closed suctioning.
- For high-level disinfection, use the same concentration of disinfectants as described above.
- When using a single-limb non-invasive ventilator (NIV), the NIV should use a disposable exhalation valve as much as possible instead of using vented masks. A filter should be added

between the mask and the exhalation valve – this minimizes aerosolization of the virus into the environment.

- During NIV, use a well-fitted oro-nasal mask (or helmet, if available). A poor fit can increase aerosolization of the virus.
- Prefer single-patient-use masks during NIV. If reusable masks are used, the maximum number of times such masks can be reprocessed is 10.

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