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Recommended Practices for Cleaning, Handling, and Processing Anesthesia Equipment

The following recommended practices were developed by the AORN Recommended Practices Committee and have been approved by the AORN Board of Directors. They were presented as proposed recommended practices for comment to members and others. These recommended practices are effective Jan 1, 2005.

These recommended practices are intended as achievable recommendations representing what is believed to be an optimal level of practice. Policies and procedures will reflect variations in practice settings or clinical situations that determine the degree to which the recommended practices can be implemented.

AORN recognizes the numerous types of settings in which perioperative nurses practice. These recommended practices are intended to provide guidance for various practice settings, including traditional ORs, ambulatory surgery units, physicians' offices, cardiac catheterization suites, endoscopy suites, radiology departments, and all other areas where operative and other invasive procedures may be performed.

Purpose. Anesthesia equipment is a potential vector in the transmission of microorganisms. Proper handling and processing of medications, supplies, and equipment can reduce the risk of infection to the patient. These recommended practices provide guidelines for the handling, cleaning, disposal, and reprocessing of anesthesia equipment and instrumentation.

Recommended Practice I

Anesthesia equipment that comes in contact with the vascular system or sterile body tissue should be sterile at the time of use.

1. Items such as IV catheters, tubing, and stopcocks; syringes and needles; and medication vials and ampules are considered critical items. The Centers for Disease Control and Prevention (CDC) uses Spaulding's criteria to determine the potential for transmission of infectious agents. In this classification, items contacting the vascular system or sterile tissues pose the greatest risk of infection and are classified as critical.[1] Using sterile items when contacting the vascular system or sterile tissues minimizes the risk of infection.

2. Aseptic technique should be used when preparing medications. Breaks in aseptic technique have contaminated IV anesthetic agents and medications, resulting in clusters of infections.[2-9] Good practices include
   - performing hand hygiene before preparing medications,
   - cleaning vial stoppers before puncturing them,
   - using multiple needles to withdraw medication into multiple syringes,
   - not transferring syringes of unused medication between patients, and
   - not storing syringes of propofol at room temperature for the day.

   Medications should be stored in a clean area. Personnel should perform basic hand hygiene according to the CDC's "Guideline for hand hygiene in health-care settings,"[10] before preparing medication. Vial stoppers should be cleaned with alcohol before they are punctured. Single-dose vials should be used for only one patient. Syringes of unused medication should be discarded at the end of the procedure. Propofol should be withdrawn immediately before administration.

3. Aseptic technique should be used when administering medications. Bacteria from hands can contaminate syringes and their contents.[11-16] Multidose vials have been found to be contaminated.[17] Syringe contents have been found to contain blood or bloodborne pathogens after one injection or entry into IV tubing.[13,18-23] Using a common syringe in the IV tubing ports of more than one patient has transmitted infectious

diseases.[9,24] Syringes and needles should be used for only one application (eg, one syringe and one needle per entry into a multidose vial). Intravenous tubing ports should be cleaned with alcohol before they are punctured with a needle.

Recommended Practice II

Anesthesia equipment that comes in contact with mucous membranes should be sterilized or undergo high-level disinfection before use.

1. Reusable items (eg, airways, breathing circuits, connectors, fiberoptic endoscopes, forceps, laryngoscope blades, masks, self-inflating bags, some laryngeal mask airways [LMAs], transducer tubing, transesophageal probes) are considered semicritical. The CDC has determined that their potential for transmitting infectious agents is significant and has classified these items as semicritical.[1]

2. Reusable semicritical items should be cleaned as the first step in reprocessing. Removal of organic material provides optimal conditions for proper exposure of equipment to disinfectants and sterilants.[1,25,26] Rigid laryngoscopes should be disassembled and all components cleaned, including handles. Some automated pasteurization equipment has a cleaning step within the pasteurizing cycle.

3. Clean, semicritical reusable items should be processed by high-level disinfection, pasteurization, or sterilization with a US Food and Drug Administration (FDA)-approved agent, according to AORN's "Recommended practices for high-level disinfection" or "Recommended practices for sterilization in the practice setting."[27,28] Written instructions from the manufacturers of reprocessing equipment, chemicals, and instruments should be followed. High-level disinfection kills vegetative bacteria, tubercle bacilli, some spores, fungi, and viruses.[1] The CDC recommends that reusable semicritical items be high-level disinfected, pasteurized, or sterilized to minimize the risk of transmission of infectious agents.[1] This recommendation is supported by professional organizations, including the Association for Professionals in Infection Control and Epidemiology, Inc (APIC), the American Society of Anesthesiologists (ASA), and the American Association of Nurse Anesthetists (AANA).[1,29,30] Inadequately disinfected laryngoscope blades have been implicated in clusters of infections.[31-33] Laryngoscopes should be disassembled and all parts thoroughly cleaned and the blades high-level disinfected before they are reassembled. Some LMAs are designed for limited reuse. Manufacturers' instructions should be followed.

4. Flexible endoscopes should be processed according to AORN's "Recommended practices for cleaning and processing endoscopes and endoscope accessories,"[34] and the manufacturer's written instructions. Infections have been transmitted when flexible endoscopes have been reprocessed in an automated endoscope reprocessor with the biopsy port caps off or adapters that were incompatible with the equipment.[35,36] Users of this equipment should verify compatibility of the reprocessor with the endoscope and that adapters are approved by the manufacturer of the reprocessing equipment for use with the particular endoscope being processed. Manufacturers' written instructions should be followed.

5. Residual chemicals should be removed and the reprocessed item thoroughly dried before storage or use on a patient. Residual chemicals on items have led to allergic reactions and tissue burns.[37] Chemical stains have occurred when ortho-phthalaldehyde was not rinsed off adequately before use.[38] Users of chemical disinfectants should verify the appropriateness of the chemical's use on items being disinfected and thoroughly rinse the items according to the manufacturer's written instructions. These recommendations may include a triple rinse. Disinfected items

should be dried thoroughly and stored in manner that prevents recontamination or damage. Use of contaminated tap water to rinse semicritical items has resulted in transmission of *Pseudomonas Aeruginosa*.[39-43] This agent proliferates in the channels of endoscopes.[39,40,43] Items should be rinsed with sterile water after the chemical disinfection process. If sterile water is not used, the item should be rinsed first with water and then with 70% alcohol, and it should be thoroughly dried, along with its lumens and channels.[43]

6. Disinfected semicritical items should be stored in a clean location in a manner that prevents recontamination or damage. Storing semicritical items in a clean location minimizes the risk of contamination with pathogens before use. Endoscopes should be stored vertically with control valves, caps, and hoods removed.[43]

7. Personnel should be trained in the reprocessing procedures and equipment. Training personnel regarding the complexities of the equipment, chemicals, and processes used minimizes the risk of human error.

8. Quality control of reprocessing procedures should be performed and documentation maintained in accordance with
   - AORN's "Recommended practices for high-level disinfection,"[27]
   - AORN's "Recommended practices for sterilization in the practice setting,"[28] and
   - manufacturers' written instructions.

   Quality control measures provide assurance that mechanical and chemical conditions are optimal for high-level disinfection. Documentation provides a mechanism for process improvement and investigation of adverse events.

Recommended Practice III

Anesthesia equipment contacting intact skin should be clean at the time of use.

1. Items such as blood pressure cuffs, electrocardiogram (ECG) leads, and oximeter probes that contact only intact skin are considered noncritical. The CDC
   - has determined that the potential for transmission of infectious agents is lower when items contact only intact skin,
   - has classified these items as noncritical, and
   - recommends low-level disinfection.[1]

2. Reusable items and surfaces contacting intact skin (eg, blood pressure cuffs, ECG leads, skin temperature probes) should be cleaned between use on patients. Cleaning removes organic and inorganic material, which allows the disinfectant to contact all surfaces.[1,25,26]

3. Reusable laryngoscope handles should be cleaned and low-level disinfected between patients. Laryngoscope handles become contaminated during airway management. In studies, 40% to 50% of handles tested positive for blood.[44,45] Cleaning and disinfecting these handles minimizes the risk of transmission of bloodborne pathogens. The disinfectant selected should be registered with the Environmental Protection Agency (EPA) for use as a hospital disinfectant and used according to the manufacturer's written instructions.[46]

4. Reusable noncritical items should be low-level disinfected between patients. Low-level disinfection with an EPA-registered hospital disinfectant kills most bacteria and some viruses and fungi but may not kill tubercle bacilli or bacterial spores.[1] After subjection to low-level disinfection, the device is considered safe to come in contact with intact skin.

5. Surfaces of anesthesia equipment that are touched by personnel while they are providing patient care or handling contaminated items should be cleaned and low-level disinfected between use on patients, according to manufacturers' written instructions. Surfaces of anesthesia equipment become contaminated with oral secretions and blood during surgical procedures.[47-50] Researchers have found occult or visible blood on 29.5% to 35.5% of anesthesia machines, carts, and

monitors.[47,48] Blood also has been found on ventilator controls, flow meter knobs, vapor controls, ECG leads, oximeter probes, and blood pressure cuffs (ie, 25% to 64.3%).[48] Surfaces of anesthesia carts, drawer handles, touch screens, flow meter knobs, ventilator controls, ECG leads, oximeter probes, and blood pressure cuffs should be cleaned and disinfected between use on patients. Other surfaces known to have been touched during patient care also should be cleaned and disinfected between patients.

6. Exterior surfaces of anesthesia equipment (eg, anesthesia cart, machine, monitors) that are not knowingly contaminated during patient care should be terminally low-level disinfected at the end of the day according to manufacturers' written instructions. Contact with blood and body fluids is routinely associated with tasks performed by anesthesia care providers.[50] These surfaces may become contaminated during use, without the knowledge of the provider.[51] Low-level disinfection with an EPA-registered hospital disinfectant renders the surfaces safe to contact intact skin.[1] Manufacturers recommend specific agents to clean complex electronic equipment. These instructions should be followed.

Recommended Practice IV

Single-use items (eg, breathing circuits, endotracheal tubes, filters, needles, some LMAs, stylets, suction catheters, syringes) should be used once and discarded in accordance with local, state, and federal regulations.

1. Single-use items should be used for a single patient and not reused on subsequent patients. Patient care equipment and supplies are potential vectors of microorganisms and can transmit infectious agents. Safe cleaning and reuse of single-use items has not been established. These items should be discarded after use on a single patient.

2. Single-use items should not be reprocessed unless requirements for validation testing can be met. Reuse of items designed for single use creates the potential for injury related to mechanical failure, residual bioburden, and chemical residue from the reprocessing agent. For these reasons, reprocessing of items designed for single use is regulated by the FDA. Under the Federal Food, Drug, and Cosmetic Act, facilities reprocessing single-use devices must meet all regulatory requirements of a device manufacturer, including
   - facility registration and device listing,
   - premarket clearance or approval,
   - labeling,
   - corrections and removals,
   - medical device tracking,
   - medical device reporting, and
   - quality system regulation.[52]

   These requirements exceed the capabilities of most perioperative settings.

Recommended Practice V

Anesthesia equipment should meet performance and safety criteria established by the practice setting and that is consistent with the manufacturer's written instructions.

1. Written information regarding safety and testing methods, warranties, and a manual for maintenance and inspections should be obtained from the manufacturer for all anesthesia equipment. These manuals help in developing operational, safety, and maintenance guidelines. Recommendations vary by manufacturer and equipment model. Manuals should be maintained for each.

2. Anesthesia equipment should be assigned an identification number. Identification numbers allow for documentation of inspections, safety checks, preventive maintenance, repairs, and tracking in the event of a patient or equipment problem.

3. Before placing anesthesia equipment into service, the safety features of the equipment should be tested by qualified, trained personnel, according to manufacturers' written instructions. These tests should be specific to the type and model of equipment involved

and include, but not be limited to, calibrations and alarms. Testing the equipment before initial use minimizes the risk of patient injury resulting from faulty equipment.

4. Before use, anesthesia equipment should be tested according to manufacturers' written instructions and the safety standards of the facility. This check provides assurance that basic safety features of the equipment are operational. The FDA's "Anesthesia apparatus checkout recommendations" can be adapted for this purpose.[53]

5. Routine maintenance of anesthesia machines should be conducted on a regular schedule by qualified, trained personnel, according to manufacturers' written instructions. Regular preventive maintenance minimizes the risk of mechanical failure of anesthesia equipment.

6. Any equipment not meeting safety standards should be removed from service. Equipment failing safety checks poses a risk to patients and/or personnel. Removal of the equipment minimizes these risks. The ASA has published guidelines for determining when anesthesia machines should be considered obsolete.[54] Obsolete machines and equipment should be replaced.

7. Before use on a patient susceptible to malignant hyperthermia (MH), the anesthesia machine should be prepared in a manner that minimizes trace anesthetic agents. Halogenated anesthetic agents may trigger MH in susceptible patients.[55] Removing traces of these agents minimizes this risk. The Malignant Hyperthermia Association of the United States recommends changing the soda lime and breathing circuit, draining and inactivating vaporizers, and flushing the machine with 10 L of air or oxygen for 10 minutes before using the machine for an MH-susceptible patient.[56]

8. Equipment containing mercury should be replaced with alternatives that are mercury-free. Mercury poses a risk to patients and personnel as well as the environment. Removing mercury from the health care environment minimizes these risks.[57]

Recommended Practice VI

Internal components of the anesthesia machine breathing circuit should be cleaned regularly.

1. Reusable absorbers and valves should be cleaned on a regular basis according to manufacturers' written instructions. Particular attention should be given to the valves. An appropriate and cost-effective schedule for reprocessing has not been established.[58] Single-use absorbers are available and should be used for only one patient. Routine sterilization or high-level disinfection of the internal components of anesthesia machines is unnecessary.[29,30,58]

2. Anesthesia ventilator bellows should be cleaned regularly according to manufacturers' written instructions.

3. Soda lime should be changed according to the manufacturer's written instructions. Soda lime canisters do not filter bacteria adequately.[59-61] In one study, 40% of bacteria passed through the soda lime.[61] The bactericidal activity of soda lime also is unreliable.[61,62] *Mycobacterium tuberculosis* has been found to survive three hours in soda lime.[61] Soda lime, therefore, should not be used as the only method of filtration. Canisters and contents should be replaced according to the manufacturer's written instructions.

4. Routine use of single-use breathing circuits with bacterial filters should be considered. Bacteria circulate through the anesthesia circuit and proliferate inside the absorber and accessories.[63-65] Filters prevent microorganisms from contaminating the ventilator and escaping into the OR through the positive pressure relief valve of the waste gas scavenging system.[62,66-73] Research findings indicate that the absence of bacterial filters does not lead to an increased rate of nosocomial pneumonias.[58,74] In one investigation, however, contamination

of the anesthetic circuit was identified as the likely cause of transmission of hepatitis C virus.[75] Currently, there is no consensus about the routine use of bacterial filters.[29,30,58,76,77] For patients with known or suspected tuberculosis, the CDC, ASA, and AANA recommend using a bacterial filter between the patient and breathing circuit.[29,30,58] The Canadian Society of Anesthesiologists also recommends use of bacterial filters for patients with severe acute respiratory syndrome (SARS).[78] With the increased prevalence of tuberculosis, increased numbers of immunocompromised patients, and the advent of SARS, it is prudent to consider the routine use of bacterial filters on the inspiratory and expiratory limbs of the anesthesia circuit. Some single-use circuits have a heat and moisture exchanger equipped with these filters. Reusable circuits should be cleaned and undergo high-level disinfection, pasteurization, or sterilization between use on patients.

5. Humidifiers should be used and cleaned according to manufacturers' written instructions. The water in humidifiers is heated to temperatures that reduce or eliminate microbial growth.[79] Tap water may contain stationary-phase forms of *Legionella pneumophila*, which are heat resistant.[66] Sterile water should be used in humidifiers.[58,79-81] Reusable humidifying chambers should undergo sterilization or high-level disinfection between patient uses.[58,79] Single-use chambers should be discarded after use on one patient.

Recommended Practice VII

Waste must be disposed of in a manner consistent with local, state, and federal regulations.

1. Biohazardous waste should be placed in a biohazardous waste bag. Some anesthetic waste poses a risk of transmission of bloodborne pathogens. Placing it in designated biohazardous containers alerts handlers to this risk. Management of biohazardous waste within the health care facility is regulated by the Occupational Safety and Health Administration (OSHA).[82] State and local laws also apply. Perioperative professionals should be aware of and act in accordance with these laws.

2. Sharps should be handled in a manner that minimizes the risk of percutaneous injury. To minimize the risk of injury from contaminated sharps, OSHA requires that puncture-resistant sharps containers be located at the point of use.[82] Placing the container next to or on the anesthesia equipment meets this expectation. Sharps should be placed directly into the container.

3. Waste that is hazardous upon disposal must be managed in a way that minimizes environmental impact. Some waste poses a risk to the environment (eg, alcohol, bezoin, epinephrine, mercury). This waste is classified by the EPA as hazardous upon disposal and is regulated under the Resource Conservation and Recovery Act.[83] The EPA requires that this waste be placed in hazardous waste containers at the point of use to alert handlers to the need to take precautions upon its disposal.[84] State and local laws also may apply.

Recommended Practice VIII

Potential hazards to perioperative personnel that are associated with handling and processing clean and contaminated anesthesia equipment (eg, exposure to infectious organisms, chemicals) should be identified, and practices should be established to reduce the risk of injury.

1. Contaminated sharps must be discarded in a puncture-resistant container at the point of use. Immediate disposal of sharps prevents injuries to people unaware of the location of the sharp and is required by OSHA.[82]

2. All personnel involved with cleaning and processing anesthesia equipment should practice according to AORN's "Recommended practices for standard and *transmission*-based precautions."[85] These precautions define general measures for infection control.

3. Anesthesia equipment should be processed using methods that reduce the risk of exposure to pathogens and injury. Manual cleaning methods that minimize splashing, spraying, spattering, and generation of droplets protect personnel from exposure to blood, body fluids, and cleaning agents.

4. Personnel must be apprised of the hazards in the workplace, including chemicals used for reprocessing anesthesia equipment. Knowledge of the hazards in the workplace, preventive measures, and exposure management minimize the risk of injury to employees and are required by OSHA.[86]

5. Personal protective equipment (PPE) must be provided to minimize the risk of exposure to bloodborne pathogens and chemicals used in the workplace. Use of barrier protection minimizes the risk of exposure to bloodborne pathogens by personnel performing tasks likely to generate contact with blood. According to OSHA regulations, employers are required to provide PPE (eg, gloves, gown, mask, protective eyewear, face shield) for their employees.[82]

6. Personnel should actively participate in the evaluation of engineering devices and work practice controls to minimize the risk of exposure to bloodborne pathogens. Active participation in the selection of PPE and practices provides the best opportunity for designing a safer workplace. According to OSHA regulations, employers are required to solicit nonmanagerial employee input during evaluation of engineering devices and work practice controls to minimize exposures to bloodborne pathogens.[87]

Recommended Practice IX

Anesthesia equipment should be handled, cleaned, processed, or discarded in the same manner in all areas of the practice setting.

1. Guidelines should be developed and approved by appropriate mechanisms and governing bodies in the practice setting. Equipment may be located in satellite areas (eg, labor and delivery). Guidelines should be consistent throughout the practice setting because all patients are entitled to the same standard of care.[88]

Recommended Practice X

Policies and procedures on cleaning and processing anesthesia equipment should be developed, reviewed periodically, and readily available in the practice setting.

1. These recommended practices should be used as guidelines for developing policies and procedures in the practice setting. Policies and procedures establish authority, responsibility, and accountability for cleaning, handling, and processing anesthesia equipment and serve as operational guidelines. Policies and procedures also help in developing performance improvement activities.

2. Policies and procedures for cleaning and processing anesthesia equipment should include, but not be limited to,
   - disposal of single-use items,
   - equipment maintenance programs,
   - equipment quality checks,
   - personal protection,
   - personnel education,
   - processing reusable equipment, and
   - waste disposal.

Glossary

Anesthesia equipment: Equipment used to provide anesthesia and/or monitor the patient under sedation or anesthesia.

Cleaning: A process using friction, detergent, and water to remove organic debris.

Critical item: An item that contacts the vascular system or enters sterile tissue, posing the highest risk of transmission of infection.

High-level disinfection: A process that uses a government-registered agent that kills vegetative bacteria, tubercle bacilli, some spores, fungi, and lipid and nonlipid viruses, given appropriate concentration, submersion, and contact time.

Low-level disinfection: A process by which most bacteria, some viruses, and some fungi are killed. This process may not kill resistant

organisms, such as *Mycobacterium tubercle* or bacterial spores.

NONCRITICAL ITEM: An item that comes in contact with intact skin but not with mucous membranes, sterile tissue, or the vascular system.

PASTEURIZATION: A process that employs time and hot water (ie, 160° to 170° F [21.7° C to 25° C] for 30 minutes) for high-level disinfection. The intensity of heat and duration of exposure must be determined by the manufacturer of the pasteurization unit and the manufacturer of the product or device to be cleaned.

SEMICRITICAL ITEM: An item that comes in contact with mucous membranes or with skin that is not intact.

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New Biopsy Technique Reduces Need for Surgery

Researchers have found a new, nonsurgical technique that can help physicians determine when breast cancer has spread to the lymph nodes, according to a Nov 29, 2004, news release from the University of Michigan Health System, Ann Arbor, Mich. The technique may spare some women an extra trip to the OR.

The technique, which uses ultrasound along with a fine needle biopsy, determines reliably whether the lymph nodes are malignant. Traditional means of determining cancer's spread to the axilla (ie, underarm) are sentinel lymph node sampling, in which the first lymph node is identified and assessed for cancerous cells, or axillary lymph node dissection, in which all lymph nodes in the underarm are removed and examined for cancer. If the sentinel node biopsy shows cancer, then a patient must undergo surgery to have the lymph nodes removed.

For some women, chemotherapy may be necessary before surgery. In these cases, physicians must determine whether the lymph nodes are affected before the chemotherapy begins. Rather than performing a sentinel lymph node sampling surgery, physicians can use ultrasound-guided fine needle aspiration to confirm the cancer's spread without surgery.

The technique uses ultrasound to identify the axillary lymph nodes and determine if their appearance is normal or abnormal. If they look abnormal, a 22-gauge needle is inserted into the node to extract cells to be evaluated for cancer. The technique requires only local anesthesia and involves no surgical incisions, unlike sentinel lymph node sampling and axillary node dissection, which are full surgical procedures.

Researchers used ultrasound to examine 57 women who were recently diagnosed with breast cancer. If the lymph nodes appeared abnormal on ultrasound, the researchers performed a fine needle aspiration, using ultrasound to guide the biopsy. Patients then underwent breast surgery and either sentinel lymph node sampling or axillary node dissection.

Pathology reports from surgery were compared to results from the ultrasound-guided fine needle aspiration. Of the women whose ultrasounds showed abnormal lymph nodes, 92.8% had cancerous nodes at surgery. Additionally, all the women with an abnormal ultrasound and a positive biopsy were found to have cancer in their lymph nodes at surgery.

Researchers note that the technique is not reliable to rule out the cancer's spread—it only can confirm positive lymph nodes. If a test is negative, therefore, sentinel lymph node sampling still is necessary.

New Biopsy Technique Helps Assess Breast Cancer's Spread *(news release, Ann Arbor, Mich: University of Michigan Health Center, Nov 29, 2004)* http://www.med.umich.edu/opm/newspage/2004/biopsy.htm *(accessed 8 Dec 2004)*.