The following proposed recommended practices for Environment of Care were developed by the AORN Recommended Practices Committee. It is being presented for public comment at this time.

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 and/or clinical situations that determine the degree to which the recommended practices can be implemented.

AORN recognizes the various settings in which perioperative nurses practice. These recommended practices are intended as guidelines adaptable to various practice settings. These practice settings include traditional operating rooms, ambulatory surgery centers, physician’s offices, cardiac catheterization laboratories, endoscopy suites, radiology departments, and all other areas where surgery may be performed.

Purpose

These recommended practices provide guidance for the provision of a safe environment of care and assist perioperative registered nurses in the identification of potential hazards in the practice setting. They include information on:

- security;
- privacy rules;
- workplace ergonomics;
- electrical safety,
- heating, ventilation, air conditioning (HVAC);
- medical equipment;
- clinical alarms;
- blanket and solution warming cabinets;
- fire safety;
- medical gases,
- anesthesia gas systems;
- surgical smoke plume;
- chemicals;
- methyl methacrylate bone cement;
- chemotherapeutic agents;
- tubing connections; and
- hazardous upon disposal waste.

They are not intended to cover aspects of perioperative patient care addressed in other recommended practices.

Recommendation I

Potential security risks associated with the perioperative
environment should be identified and safe practices should be established.

A security program helps to promote the
- safety of patients,
- safety of staff members,
- safety of visitors,
- prevention of drug diversion,
- theft, and
- protection of patient information.

I.a. A risk assessment should be conducted by an interdisciplinary committee at least annually, to identify potential security issues.

The interdisciplinary committee members provide various areas of expertise and the resources necessary to evaluate the entire scope of security issues.

Occurrence reports regarding security-related incidents should be reviewed along with electronic surveillance records and logs to determine the numbers, seriousness, and types of issues.

Potential resolutions should be determined, based upon this risk assessment.¹²

I.b An identification process should be in place to identify all persons entering the perioperative suite or the ambulatory center.

Access to the perioperative environment should be limited to those who have authorized access verified by proper identification.¹³

Photo identification badges should be
- worn by all authorized personnel,
- worn on the upper body, and
- be visible.⁴

Anyone without an authorized badge should be stopped and questioned to assure the appropriateness of their presence in the suite.⁴

Individuals with limited or temporary access to the perioperative environment (e.g., students, health care industry representatives, parents of pediatric patients) should be identified as visitors.

Visitors should wear temporary identification badges.
I.c. Tracking systems should be in place to identify who is present in the perioperative suite, (eg, electronic ID access tracking systems, visitor logs).

In case of fire, disaster, evacuation, or other emergency the identity of those present in the perioperative suite is necessary to assure that everyone has been evacuated and accounted for.

I.d. Door security systems should be used to restrict traffic.

I.e. Video surveillance should be used to monitor access.

Video surveillance provides monitoring of entry areas during off-shift hours.

I.f. A written management plan should be created describing security management activities to include:
- employee and visitor badges;
- security cameras;
- alarm systems;
- panic buttons;
- security illumination;
- restricted access to the facility during off hours; and
- restricted access to departments (eg, OR, postanesthesia care unit [PACU], endoscopy suites) or areas (eg, medication storage areas, medical records, sterile supply/equipment storage areas).\(^1\),\(^2\),\(^3\)

**Recommendation II**

The perioperative environment must provide for the privacy of patients and patient information, including their identity and reason for hospitalization.\(^5\),\(^6\)

*The Health Insurance Portability and Accountability Act of 1996 establishes guidelines for the safe communication of paper, electronic, and oral patient information, and must be followed.*\(^5\),\(^6\)

II.a. (I151;I115; I116). Perioperative registered nurses must share only the information necessary to provide safe care (eg, surgery schedules, hand-off report tools), and only if appropriate to their job role.\(^5\),\(^6\),\(^7\)

Information is necessary to enable care to be delivered and continued...
safely.

II.b. Protected health information should be shared only with individuals (eg, family members, significant others) the patient has identified as being able to receive this information.

Visitors may be assigned a number or pager to ensure that information is shared with the correct person.

II.c. Patient names may be listed on a display board in the restricted area.\textsuperscript{6,7}

II.d. Copies of personal health information including, but not limited to:

- surgery schedules,
- identification labels,
- identification/stamp plates,
- forms with patient identification, and
- photographs,

should be shredded.

Paper shredders or secured disposal containers (eg, shredding bins) should be readily available for proper disposal of hard copy or paper copies of personal health information.

Recommendation III

Potential ergonomic hazards associated with the perioperative environment should be identified, and safe practices should be established.

Ergonomic hazards are found throughout the perioperative environment and are created by patient handling or the physical environment and, if not corrected, can cause injury to staff members.\textsuperscript{8,9}

III.a. Perioperative staff members should follow the algorithms outlined in the AORN guidance statement \textit{Safe Patient Handling and Movement in the Perioperative Setting},\textsuperscript{9} and their organization’s policies and procedures while completing activities including:

- lateral transfer from stretcher to OR bed;
- positioning or repositioning the patient on the OR bed;
- lifting and holding extremities and heads for prepping;
- prolonged standing while holding retractors;
• retraction of tissue;
• lifting and carrying supplies or equipment; and
• pushing, pulling, and moving equipment on wheels.\(^9\)

These activities can create ergonomic stressors, which, if not recognized, can cause injury to the staff member. Ergonomic stressors can be defined as tasks which include, but are not limited to:
• forceful tasks (eg, pushing a stretcher and patient up a ramp);
• repetitive motion (eg, passing instruments, opening suture packets, tying suture);
• static posture (eg, standing for long periods of time in one position);
• moving or lifting patients or equipment;
• carrying heavy instruments or equipment; and
• overexertion (eg, protecting a combative patient emerging from anesthesia).\(^9\)

III.b. The physical environment should be designed to minimize the risk of ergonomic injury (eg, adequate room lighting, adequate storage to eliminate clutter).\(^8,9\)

During the design phase of construction, provisions should be made to minimize hazards (eg, head injuries) to staff members in operating rooms which will contain ceiling-suspended equipment (eg, booms).\(^9\)

Ceiling-, floor-, or wall-mounted booms should be hydraulic or electric and provide for ease of movement.\(^9\)

III.c. Adequate staff members and equipment should be available and used to decrease risks due to ergonomic hazards.\(^10\)

Appropriate mechanical devices should be used to reduce the risk of strain when moving a large or unconscious patient, or large extremities.\(^10,11\)

**Recommendation IV**

*Potential hazards associated with the use of electrical equipment in the practice setting should be identified, and safe practices should be established.*

Electrical hazards in the operating room may lead to fires, burns, and electric shocks. These injuries result from electric current flowing through inappropriate pathways.
IV.a. (I72). The electrical supply should be reliable and consistent with the needs of the operating room.\textsuperscript{12,13}

IV. b. Electrical access panels or circuit breaker panels should be:
- located on the same floor they serve,
- easily accessible, and
- not obstructed by equipment or carts.\textsuperscript{14}

IV.c. Isolated power systems should be considered for operating rooms which may be considered wet locations.\textsuperscript{15}

Adequate grounding provides protection from electric shock and fire hazards.\textsuperscript{16}

IV.d. Line-isolation monitors should be provided for each isolated power system to indicate possible leakage or faulty currents.\textsuperscript{15,16}

Line-isolation monitoring systems or ground-fault interrupting systems provide for continuous monitoring of current leakage. Systems that monitor current leakage and ground integrity reduce the hazards of shock, cardiac fibrillation, or burns produced by electrical current flowing through the patient’s body to ground.\textsuperscript{15,16}

IV.e. General lighting and specialty lighting, such as operating room overhead lights, should be on separate circuits.\textsuperscript{14,17}

IV.f. Lighting should be in working order and adequate for illuminating the surgical field, monitoring the patient, and performing perioperative duties.

Adequate lighting is necessary to perform the planned invasive procedure and to evaluate the patient.

The light over the surgical field should be equipped with an automatic switch to the emergency power source for use if the usual power supply fails.\textsuperscript{18}

Surgical lights should produce a minimum of radiant heat to reduce damage to exposed tissues and discomfort to the surgical team.\textsuperscript{17}

Minimally-invasive surgical suites (MIS), gastrointestinal endoscopy suites, and other procedure rooms should provide the low lighting required for optimum surgical visibility, while providing adequate lighting for the anesthesia provider and the circulating nurse to complete their responsibilities without tripping, slipping, or falling.
Ambient blue or green light enhances the MIS screens, and allows adequate visibility for other personnel in the room to work safely.\textsuperscript{19}

Video vendors and the personnel responsible for the organization’s lighting should be consulted regarding lighting options and placement.

IV.g. Alternate sources of lighting and electrical power should be available when normal power is interrupted.\textsuperscript{14,20}

Battery-powered emergency lights provide immediate lighting in a power failure, which decreases the potential effect of a total power interruption.\textsuperscript{18}

Batteries should be labeled with their expiration date and replaced as needed.\textsuperscript{18}

IV.h. The emergency/alternate power source should begin operating within 10 seconds, and have the capacity to operate equipment for monitoring, anesthesia delivery, and surgical equipment for a minimum of two hours.\textsuperscript{13,21}

Emergency power should be tested per local, state, and federal regulations.\textsuperscript{18}

All emergency electrical outlets should be tested, including those on booms.

If the testing fails, the organization should implement interim measures, make necessary repairs, and perform a retest.\textsuperscript{22}

Electrical receptacle cover plates should be distinctly colored or marked, if supplied by the emergency backup system.\textsuperscript{12,14}

IV.i. Life-sustaining medical equipment should have battery backup, and backup supplies should be immediately available.\textsuperscript{12}

IV.j. Clinical contingency plans should be developed for periods of loss of emergency power.\textsuperscript{20}

**Recommendation V**

Potential hazards associated with HVAC systems in the practice setting should be identified, and safe practices should be established.

The air in a perioperative environment contains microbial-laden dust, lint, skin squames, and respiratory droplets.\textsuperscript{23} The number of
microorganisms in the air in an operating room is directly proportional to the number of personnel moving in and around the room. Outbreaks of surgical-site infections have been traced to airborne contamination from colonized health care workers.\textsuperscript{23} Heating, ventilation, and air conditioning systems dilute and remove contaminants from the air and control airflow patterns. Key components of an effective HVAC system are proper air quality, air volume changes, and airflow direction. In an operating room or procedural area, proper functioning of these components minimizes the contamination of the sterile field and risk of infection to the patient. A properly functioning HVAC system carries microbial-laden skin squames, dust, and lint away from the sterile field, and removes these contaminants through the exhaust ducts at the periphery.

V.a. The quality of air entering the operating rooms should be carefully controlled.

The air should be sequentially filtered through two filters. The first filter should be rated as 30% efficient and the second should be 90% efficient.\textsuperscript{14,23}

A minimum of 20% of the incoming air (ie, three air changes per hour) should be from the outdoors.\textsuperscript{14,23}

Filtered, outdoor air minimizes the recirculation of indoor contaminants within the perioperative area.

V.b. Relative humidity should be maintained between 30% and 60% within the perioperative suite, including operating rooms, recovery area, cardiac catheterization rooms, endoscopy rooms, instrument processing areas, and sterilizing areas, and should be maintained below 70% in sterile storage areas.\textsuperscript{14}

Low humidity increases the risk of electrostatic charges, which pose a fire hazard in an oxygen-enriched environment or when flammable agents are in use. High humidity increases the risk of microbial growth in areas where sterile supplies are stored or procedures are performed.

Free-standing humidifiers should not be used because they can harbor microorganisms in fluid reservoirs and aerosolize these microorganisms into the clean environment.

Humidity should be monitored and recorded daily using a log format or documentation provided by the HVAC system.\textsuperscript{24}

V.c. Temperature should be monitored and recorded daily using a log format or documentation provided by the HVAC system.\textsuperscript{24}

Temperature should be maintained between 68º F to 73º F (20º C to
23º C) within the operating room suite and general work areas in sterile processing.14

Self-regulating, area-specific, chiller units may be required because operating rooms are filled with personnel and heat-emitting equipment; therefore, achieving the low end of this range can be difficult.

The decontamination area temperature should be maintained between 60º F to 65º F (16º C to 18º C).14

A temperature of 70º F to 75º F (21º C to 24º C) should be maintained in recovery areas and cardiac catheterization rooms.14

V.d. The air-exchange rate in the perioperative area should be carefully controlled.

The number of air changes per hour is based upon the need to remove microbiological or chemical contaminants from the environment.

The minimum rate of total air exchanges per hour should be maintained at a constant level as follows.

- Operating room: minimum of 15 air exchanges per hour with a recommended range of 20 to 25 air exchanges.
- Cardiac catheterization rooms: 15 air exchanges per hour.
- Postanesthesia care unit: six air exchanges per hour.
- Compressed-gas storage area: eight air exchanges per hour.
- Sterile storage area: four air exchanges per hour.14

Air exchanges per hour should be monitored per the organization's policy.

V.e. Airflow patterns within the perioperative setting should be controlled and uninterrupted.

Air-flow patterns are architecturally designed and engineered to minimize contamination of the sterile field. Disruptions in the air-flow patterns within the operating room can redirect contaminants onto the sterile field, increasing the risk of surgical site infection.

The pressure gradient in the operating room should be positive to outer corridors at all times.14,23

Doors to the perioperative area should remain closed except when patients, personnel, and supplies are being actively moved in and out of the room.25
Equipment and supplies should be located away from exhaust ducts, to allow directed airflow out of the room.

Free-standing fans, humidifiers, or dehumidifiers should not be used in the operating room or sterile processing areas. Free-standing fans can disrupt the airflow patterns, resulting in contamination of the sterile field.

V.f. In the event of a failure of the HVAC system:
- surgeries presently in progress should be completed,
- elective procedures should not be started until the HVAC system is functioning correctly,
- procedures should be redirected to areas of the surgical suite where the HVAC system is functioning or postponed until the problem has been corrected, and
- the event should be reported through the organization event-reporting system.

V.g. Preventive maintenance, including regular inspection, should be performed on HVAC systems, (ie, changing filters on a routinely scheduled basis).

A properly functioning HVAC system minimizes the risk of contamination of the sterile field and is an essential component to infection prevention. Failure of the system poses an unnecessary risk for the elective surgical patient.

**Recommended HVAC settings**

<table>
<thead>
<tr>
<th>Operating room</th>
<th>Temperature</th>
<th>Airflow</th>
<th>Humidity</th>
<th>Exchange per hour</th>
<th>Outdoor air exchange per hour</th>
<th>Recirculated by room unit (eg, fans)</th>
<th>Exhaust directed outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Institute of Architects (AIA)</td>
<td>N/D</td>
<td>Positive</td>
<td>30% to 60%</td>
<td>Minimum 15</td>
<td>N/D</td>
<td>No</td>
<td>N/D</td>
</tr>
<tr>
<td>American Association for the Advancement of Medical Instrumentation (AAMI)</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
</tbody>
</table>

| Anesthesia gas storage | | | | | |
|------------------------|-------------|---------|----------|-------------------|-------------------------------|--------------------------------------|-------------------------|
| AIA | N/D | Negative | 30% to 60% | 8 | N/D | No | Yes |
| AAMI | N/D | N/D | N/D | N/D | N/D | N/D | N/D |

| Postanesthesia care Unit (PACU) | | | | | |
|-------------------------------|-------------|---------|----------|-------------------|-------------------------------|--------------------------------------|-------------------------|
| AIA | 70º F to 75º F (21º C to 24º C) | N/D | 30% to 60% | 6 | 2 | No | N/D |
| AAMI | N/D | N/D | N/D | N/D | N/D | N/D | N/D |

<p>| Soiled -decontamination | | | | | |
|-------------------------|-------------|---------|----------|-------------------|-------------------------------|--------------------------------------|-------------------------|
| AIA | 68º F to 73º F (20º C to 23º C) | Negative | N/D | 10 | N/D | No | Yes |
| AAMI | 60º F to 65º F (16º C to 18º C) | Negative | 30% to 60% | 10 | N/D | N/D | Yes |</p>
<table>
<thead>
<tr>
<th>Location</th>
<th>AIA</th>
<th>AAMI</th>
<th>Temperature/Range</th>
<th>Humidity</th>
<th>RVR</th>
<th>AIA</th>
<th>AAMI</th>
<th>Temperature/Range</th>
<th>Humidity</th>
<th>RVR</th>
<th>AIA</th>
<th>AAMI</th>
<th>RVR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sterilizer loading/unloading</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td></td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>Restroom -housekeeping</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td></td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>Preparation and packaging</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td></td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>Textile packaging room</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td></td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>Clean/sterile storage</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td></td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>N/D = Not designated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Centers for Disease Control and Prevention recommends following the recommendations of the AIA.³


Recommendation VI
Potential hazards associated with the use of medical equipment in the practice setting should be identified, and safe practices should be established.

Hazards associated with medical equipment may be caused by frayed cords, damaged outlets, or extension cords and, if not corrected, may result in injury of patients, staff members, or visitors.
VI.a. (172). Equipment should be inspected periodically by a qualified biomedical technician or engineer. All electrical equipment should be inspected before use. Inspection should include, but not be limited to:

- new equipment before it is introduced into the practice setting,
- checking power cords and plugs for fraying or other damage, and
- checking outlets and switch plates for damage.

Damaged power cords or outlets can result in excessive current being delivered to the patient and/or staff members.

VI.b. Hospital-grade plugs are recommended when available, but plugs with adequate strain relief may also be used.

VI.c. Device cord length should be appropriate for the intended use of the equipment.

Cords that do not lie flat create a risk for tripping or accidental unplugging of the equipment.

Cords should be secured in a safe manner. An electrically safe, cleanable, or disposable device should be used to decrease the potential of tripping by the staff members.

Extension cords should be avoided unless used to decrease the potential for tripping.

Use of extension cords can result in excessive current leakage and/or electrical-system overload.

Biomedical personnel should change cords of inadequate length to longer lengths to eliminate the need for extension cords and decrease the risk of tripping.

VI.d. Equipment found to be in disrepair should be immediately removed from service.

Organizational policy and procedure should be followed regarding routing of equipment in need of repair.

VI.e. A written plan should be developed describing the processes to be implemented to effectively manage medical equipment, including selection, purchase, inspection, and maintenance.
Recommendation VII
Clinical alarms should be audible and should not be disabled.

A clinical alarm is an alarm that is patient specific and used for the purpose of alerting staff members to a patient emergency.\(^{28}\)

VII.a. An environmental assessment of every piece of equipment in the clinical setting should be conducted.

The assessment should:

- be developed as a collaborative effort between clinical engineering and nursing; and
- include a list of those devices with alarms, including but not limited to:
  - electrosurgery units (ESUs),
  - pneumatic tourniquets,
  - cardiac monitors,
  - carbon dioxide (CO\(_2\)) insufflators,
  - anesthesia equipment, and
  - infusion pumps.

VII.b. Alarms should be sufficiently audible to allow them to be heard at reasonable distances and above competing noise.

VII.c. Alarms should be checked

- upon initial setup,
- when connecting or reconnecting a device,
- before transporting a patient, and
- after transporting a patient.\(^{29}\)

VII.d. Alert alarms (e.g., medical gas alarms, code blue alarms) should be tested according to organizational policy and procedure.

Recommendation VIII
Blanket and solution warming cabinet temperatures should be controlled.

The danger of thermal burns from heated blankets or solutions is increased in the perioperative setting because patients are unconscious or sedated and cannot feel the increase in temperature or
communicate their discomfort. Attention to the temperature of warming cabinets is important. Even when solutions and blankets do not feel warm to staff members, heat continues to build up in these items and can be transferred to the patient.\textsuperscript{30}

VIII.a. (176;I77) The warming cabinet temperature should be checked at regular intervals per the organization’s policy and documented on a temperature log or recorded on a record provided by an electronic recording system.\textsuperscript{30,31,32}

The responsibility for setting, maintaining, and monitoring warmers should be assigned to specific personnel (eg, delegated assistive staff members).

If solution is stored in the warming cabinet, the cabinet should be labeled with safe temperature range settings as determined by the solution manufacturer.

Cabinet temperature above the safe range should be reported to clinical engineering for maintenance.\textsuperscript{30,31,32}

Dual cabinets should have dual controls for accurate regulation of both cabinets.

Blanket-warming cabinet temperatures should not exceed 110º F (43º C).\textsuperscript{33}

Blankets should be rotated on a first-in, first-out basis.

VIII.b. The fluid manufacturer’s recommendations should be obtained and followed for the maximum temperature and length of time fluids should remain in the warming cabinet.

Solution stability may vary according to the type of solution and storage container.

Solution-warming cabinet temperatures should be limited to the solution manufacturer’s specifications for solutions.\textsuperscript{31}

Fluids kept in fluid warmers should be labeled with the date they must be removed or the date when they were placed in the warmer.

Solutions should be rotated on a first-in, first-out basis.

IV solutions should only be warmed using technology designed for this purpose.\textsuperscript{33}
VIII.c. Fluids used for intracorporeal irrigation should not exceed 98.6º F (37º C) or approximate normal body temperature.\textsuperscript{33,34,35}

VIII.d. (I96). Intravenous (IV) fluid or irrigation fluid bags should not be used for positioning devices.

Warmed IV bags used as positioning devices have led to patient burns.\textsuperscript{36} In a closed claims study of intraoperative patient burns, the most common device causing the burn was either heated IV bags or bottles of irrigation fluids.\textsuperscript{32}

VIII.e. The temperature of fluid on the sterile field should be measured using a sterile thermometer or a commercially available intraoperative irrigation warming bath to ensure it does not exceed 98.6º F (37º C).\textsuperscript{33,35}

Solutions warmed to higher temperatures should be cooled to normal body temperature before use inside body cavities.

VIII.f. Surgical skin prep solutions should not be warmed in warming cabinets unless stated as allowable in the manufacturer’s directions.

**Recommendation IX**

**Potential hazards associated with fire safety in the practice setting should be identified, and safe practices should be established.**

Fire is always a risk to both patients and healthcare workers in the operating room.

IX.a. A written fire prevention and management plan should be developed by a multidisciplinary group and include all categories of perioperative personnel.

The plan should describe processes to be implemented to safely manage different fire scenarios.\textsuperscript{37}

IX.b (I73; I77). Ignition sources should be controlled.

The active electrode tip of the ESU should be kept clean and in a holster when not in use.

Electrosurgical units provide an ignition source when not used according to manufacturers’ recommendations, and when active electrodes are used in the presence of oxidizers, flammable solutions,
and volatile or combustible chemicals or liquids

Lasers should be used with wet towels placed around the surgical site, and after flammable prep solutions have dried.\textsuperscript{38}

An active, fiberoptic light cable should never be placed on surgical drapes.

Fiberoptic light cables provide an ignition source if they are not disconnected from the working element and if placed on drapes or sponges.

All light cables should be connected before activating the light source.

The light source should be placed into a stand-by mode, when not in use, to prevent ignition.

Backing into the light source or turning the fiberoptic light cable toward the body may cause surgical attire to ignite.\textsuperscript{39}

IX.c. Personnel should remove any equipment that emits smoke at any time, whether in use or not.\textsuperscript{40}

IX.d. Fuel sources should be controlled.

Waterless, brushless, surgical-scrub solutions should be allowed to dry completely to decrease the potential to produce ignition by static electricity or sparks.

Local and state fire regulations regarding storage of alcohol-based, surgical-scrub solutions should be followed.\textsuperscript{13}

Provide adequate time for the flammable surgical prep solution to dry completely and any fumes to dissipate before applying surgical drapes, using an active electrode or laser, or activating a fiberoptic light cable.\textsuperscript{41,42,43}

Prevent prep solutions from pooling, or soaking into the table linens or the patient’s hair by

- using reusable or disposable sterile towels to absorb drips and excess solutions during the skin prep application,
- removing materials saturated with prep solution before draping the patient,\textsuperscript{13}
- wicking excess solution with a sterile towel to facilitate the surgical prep area drying completely.\textsuperscript{13,44,45}

Drapes should not be applied until prep solutions are dry, to prevent the accumulation of volatile fumes beneath them.
Surgical skin preparations with clear instructions for use, preferably with unit dosed applicators should be used.\textsuperscript{13,44}

Gowns and drapes should not be exposed to ignition sources.

IX.e. Oxidizers should be controlled.

Oxygen and nitrous oxide should be used with caution in the presence of any ignition or fuel sources.

Oxygen-enriched environments are created when the oxygen concentration is greater than 21%. This lowers the temperature and energy at which fuels will ignite.\textsuperscript{46,47}

Anesthesia circuits should be free of leaks.

Electrosurgical units and lasers should be used with caution where oxygen is flowing.

Suction should be used to evacuate anesthetic gas accumulation.

When using a laser, only laser-resistant endotracheal tubes should be used for upper airway procedures or procedures near the trachea.\textsuperscript{38,46}

For surgeries involving the head and neck, water-soluble substances should be used to cover facial hair.\textsuperscript{48}

Oxygen concentration under drapes should be minimized by:

- tenting of drapes, and
- using the lowest possible oxygen concentration that provides adequate patient oxygen saturation.\textsuperscript{13,38,46,49,50}

Mixing oxygen with nonflammable gases such as medical air reduces the risk of fire.\textsuperscript{16,38,48}

Precautions should be taken when operating in the gastrointestinal tract because hydrogen and methane, which are flammable gases, may be present.\textsuperscript{48}

Nitrous oxide should be considered an oxidizer, and the same precautions, which are used with oxygen, should be observed.\textsuperscript{40}

IX.f. Risk of airway fires should be minimized by

- using radiopaque, wet sponges in the back of the throat to prevent or decrease oxygen leaks;
- inflating endotracheal tube cuffs with tinted solutions to improve visibility in the event of a cuff rupture;
• using suction to evacuate oxygen buildup;
• tenting drapes to prevent the accumulation of gases; and
• using pulse oximetry to evaluate the patient’s optimal oxygen saturation level.\textsuperscript{16,36,48}

IX.g. Processes should be in place to regularly inspect, test, and maintain fire extinguishing equipment and supplies.

IX.h. Fire extinguishers should be selected according to standards established by the National Fire Protection Association (NFPA) and the local authority having jurisdiction, and be immediately available for every operating and procedural room.\textsuperscript{13,51,52}

A water mist or CO\textsubscript{2} extinguisher should be stored in each operating room.\textsuperscript{53}

Water mist extinguishers are rated Class 2A: C.\textsuperscript{53}

The ECRI Institute recommends CO\textsubscript{2} extinguishers because the spray has a cooling effect, does not leave residue, and is not likely to injure patients or staff members.\textsuperscript{52,53}

Carbon dioxide extinguishers are rated Class B and C, but may also be used for Class A fires.\textsuperscript{53}

IX.i. Fire blankets should not be used in an operating room.\textsuperscript{51}

Fire blankets may trap fire next to or under the patient and cause more harm. Fire blankets can burn in an oxygen-enriched environment. Fire blankets are less effective in controlling a fire on a patient than other methods. Usage can lead to wound contamination or spread the fire.

IX.j. Specific evacuation routes should be established for the perioperative environment and developed in collaboration with local authorities and guided by NFPA regulations.\textsuperscript{13}

Personnel and emergency responders should be educated about how to implement the evacuation plan.

Evacuation routes should be clearly displayed in multiple locations throughout the practice setting.

IX.k. All personnel should recognize medical, gas-control valves and have the ability to shut down medical gases in the event of a fire.\textsuperscript{52}

IX.l. All personnel should receive instructions on how to contact the local fire department.\textsuperscript{40}
Recommendation X
Potential hazards associated with medical gases in the practice setting should be identified, and safe practices should be established.

The US Food and Drug Administration (FDA) considers compressed medical gases to be prescription drugs that must be dispensed by prescription only. Therefore, these gases should be stored in a secure area with controlled access.  

X.a. Medical gases should be stored in a secure area, separate from industrial gases.  

Full cylinders should be segregated from empty cylinders.  

Segregating full cylinders from empty cylinders minimizes the risk of connection to an empty cylinder and a delay in administration of vital gases.  

X.b. Medical gas cylinders stored indoors should be in a room with a minimum one-hour fire resistance rating.  

X.c. Gas cylinders should be stored in a well-ventilated room in a holder or storage rack, away from heat sources.  

Securing cylinders with a chain-like device or in wooden racks prevents the cylinders from falling out of the holder or rack.  

X.d. Cylinders should not be stored in an egress hallway.  

Cylinders and carts directly associated with a currently present patient are considered “in use.” Cylinders and carts not directly associated with a specific patient for 30 minutes or more are considered not in use or in storage. These cylinders and carts should be removed from corridors and properly stored.  

X.e. Gas-cylinder valves should be closed properly to avoid leakage during storage.  

X.f. Gas cylinders should be transported in a carrier designed to prevent tipping, dropping, or damage to the cylinder, and not carried by hand.  

Carrying a cylinder by hand poses a risk of dropping the cylinder and causing sudden release of the compressed gas, which can cause propulsion of the cylinder and subsequent injury.  

X.g. Gas cylinders used during patient transport should be secured to the transport cart or bed in holders designed for this purpose, and not
placed on top of the bed or cart next to the patient.

Holders minimize the risk of the cylinder falling. Transport carts are available with built-in holders.

The maximum amount of oxygen stored inside a health care institution is 566,335 L or 20,000 cubic feet. Reserve cylinders provide an emergency backup for use in a medical gas failure.

X.i. Gas cylinders and gas lines must clearly identify the medical gas contained or delivered, by the color of the cylinder/line, written labels, and a unique pin-index safety system connector.

The FDA has approved standardized colors for identification of different medical gases (eg, green indicates oxygen). The pin-index safety system connector for different medical gases prevents connecting the wrong gas to the delivery system.

Serious injuries and deaths have resulted when an incorrectly identified medical gas has been used. Reliance on the color of the cylinder alone does not differentiate between single gases and combinations of gases that may be contained in a cylinder. In one instance, insufflation of a combination of oxygen and carbon dioxide from a blue cylinder into a patient's abdomen resulted in that patient's death.

Before use, gas cylinders should be checked for
• appropriate label,
• appropriate pin-index safety system connector, and
• appropriate color coding.

When opening a cylinder valve, a small amount of gas should be released before attaching the regulator.

Compressed medical-gas tank valves should be opened fully during use to prevent excessive heat buildup through the regulator.

Temperatures can increase more quickly if the valve is only partially opened. A flash fire may occur, if combustible materials such as dirt or oil are present at the gas outlet.

X.j. Fittings on medical gas cylinders and hoses should not be altered under any circumstance.

Serious injuries and deaths have resulted when personnel have altered the pin-index safety system, permitting delivery of an incorrect gas into the system.
If the connection does not easily fit, review the label on the gas cylinder or hose to verify that it is correct.

If the label is correct, return the cylinder to the distributor for examination.59

If the label is incorrect, replace with a correctly-labeled gas cylinder.

X.k. Shut-off valves must be identified with the name of the gas, the location served, and a caution to avoid closing the valve except in emergency situations.13

Responsibility and authority for valve shut-off should be defined in the health care organization policy and procedure, but all staff members should be knowledgeable about the procedure.

X. l. Vacuums systems should exhaust outdoors away from windows, doors, and air intakes.13

Exhausting vacuum systems outdoors away from windows, doors, and air intakes will help to prevent contamination of the facility or environment.13

X.m. Liquid oxygen tanks must be handled, filled, stored, and transported according to state and federal regulations.60

Gloves and personal protective equipment (PPE) must be worn and the tanks held an elbow-length away from the body at filling stations.60

Liquid oxygen containers should be stored in a cool, dry place outside of the building or in a separate building.13

Liquid oxygen containers should have product identification visible from all sides with a 360-degree label and two-inch high letters.13

Liquid oxygen container contents should be verified before use.13

X. n. Manufacturer recommendations for attaching regulators to oxygen tanks should be followed.

The sealing gasket specified by the regulator company should be used.

The regulator, gasket, and washers should be inspected before use.

Washers present on oxygen cylinder yokes should be removed before installing the oxygen regulator.
The regulator should be tightened with a T-handle until it is firmly in place.

The valve should be opened slowly to determine if there is a leak, and the valve should be closed quickly, if a leak is found.\textsuperscript{58,60}

Reusable gaskets on oxygen regulators should be checked regularly and at least with each cylinder change for failure to seal properly.\textsuperscript{61}

Reusable gaskets should be discarded if deformed or leaking.\textsuperscript{61}

Fluorocarbon, elastomer, and brass gaskets should be used because of their low ignition potential.\textsuperscript{61}

An adequate emergency supply of oxygen should be stored at the facility to provide an uninterrupted supply for one day.

Recommendaion XI
Potential hazards associated with the use of anesthetic gases in the practice setting should be identified, and safe practices should be established.\textsuperscript{12,13}

The level of occupational risk associated with exposure to trace anesthetic gases is unclear. Uncontrolled, retrospective studies conducted in the 1970s found an increase in the incidence of spontaneous abortion and development of congenital abnormalities in offspring among OR personnel.\textsuperscript{62,63,64} Researchers found a relationship between anesthetic gases and chromosome deformities after prolonged exposure.\textsuperscript{65} In a prospective study, researchers found no relationship between trace anesthetic gas exposure and adverse health effects.\textsuperscript{66} Subjects exposed to sevoflurane concentrations below the National Institute for Occupational Safety and Health (NIOSH) recommended limits showed no kidney damage, in another study.\textsuperscript{67,68} Delivering nitrous oxide through an open system has been found to result in high concentrations of nitrous oxide in the air, and is associated with reduced fertility and spontaneous abortion in female dental assistants.\textsuperscript{69} The level of risk from occupational exposure to halogenated anesthetic agents has not been thoroughly studied.\textsuperscript{70} Therefore; it remains prudent to limit the amount of waste anesthetic gases in the perioperative environment.

XI.a. The health care organization should establish a waste anesthetic gas management program that minimizes the exposure of healthcare workers to waste anesthetic gases.

The NIOSH standard for nitrous oxide levels is no more than 25 parts per million (ppm) over an eight-hour period, and no more than 2 ppm of
any halogenated anesthetic agent over one hour.⁶⁷ When scavenging systems are not used, levels can exceed 1000 ppm.⁶⁹

Air sampling for the most frequently used anesthetic gases should be conducted every six months to evaluate occupational exposures and the effectiveness of control measures.⁷⁰

Gas monitoring should occur at the organization’s defined scheduled intervals for nitrous oxide and other inhalation anesthetics using dosimeters or analyzers.⁷⁰

XI.b. A scavenging system should be used to remove waste anesthetic gases.

The scavenger system connections should be intact and functioning.¹⁴ Scavenging systems should be tested when installed and at three-month intervals for leaks and compliance documentation maintained.⁶⁷ The scavenger system should be vented directly to the outside of the building.¹⁴

XI.c. Anesthesia delivery systems should be in proper working order and maintained on a regularly scheduled basis, consistent with the manufacturer’s written instructions and the organization’s policies.

XI.d. Anesthesia equipment located in areas other than the surgical suite should be included in the safety program.

**Recommendation XII**

**Potential hazards associated with surgical smoke generated in the practice setting should be identified, and safe practices should be established**

Surgical smoke (plume) is generated from use of heat producing instruments such as electrosurgical devices and lasers. This plume has been found to contain toxic gases and vapors (eg benzene, hydrogen cyanide, formaldehyde) that produce an offensive odor; bioaerosols, including blood fragments; and viruses.⁷¹ Experts have noted that there may be over 600 chemical compounds that exist in surgical smoke.⁷² In high concentrations, surgical smoke causes ocular and upper respiratory tract irritation in health care personnel.⁷³ The smoke generated from electrosurgery and laser contain chemical by-products.⁷³,⁷⁴

The National Institutes of Occupational Safety and Health recommends that smoke evacuation systems be used to reduce potential acute and chronic health risks to personnel and patients.⁷³ The Occupational
Safety and Health Administration (OSHA) has no separate standard related to surgical smoke. The OSHA addresses such safety hazards in the General Duty Clause and Bloodborne Pathogen Standard.\(^{74}\)

XII.a. Smoke plume should be removed by use of a smoke evacuation system in both open and laparoscopic procedures.

The suction wand of the smoke evacuation system should be placed as close to the source of the smoke generation as possible to maximize particulate matter and odor capture and enhance visibility at the surgical site.\(^{75}\)

In situations in which minimal plume is generated, a central suction system with an in-line filter may be used to evacuate the plume. The in-line filter is placed between the suction wall/ceiling connection and the suction canister. Central suction units are designed to capture liquids, making the use of in-line filters necessary to capture the smoke particulate in the air. Low suction rates associated with centralized suction units limit their efficacy in evacuating plume, making them suitable for minimal plume only.\(^{76}\)

Central wall suction units are designed to capture liquids, making the use of in-line filters necessary. Low suction rates associated with wall suction units limit their efficacy in evacuating plume, making them suitable for minimal plume evacuation only.\(^{76}\) A centralized system dedicated for smoke evacuation may be available.

Care should be taken to flush the smoke evacuator lines to ensure particulate matter build-up does not occur. This should be done according to the manufacturer’s instructions.

In circumstances in which large amounts of plume are generated, an individual smoke evacuation unit with an ultra low penetration air filter should be used to remove smoke plume. Smoke evacuation units and accessories should be used according to manufacturers’ written instructions. Filters should be changed as recommended by the manufacturer.

Smoke evacuation systems and accessories should be used according to manufacturers’ written instructions.

Detectable odor during the use of a smoke evacuation system is a signal that:

- smoke is not being captured at the site when the plume is
being generated,

- inefficient air movement through the suction or smoke evacuation wand is occurring, or
- the filter has exceeded its usefulness and should be replaced.\textsuperscript{76}

XII.b. Standard precautions should be used when changing smoke evacuation system filters.\textsuperscript{75}

Airborne contaminants produced during electrosurgery or laser procedures have been analyzed and are shown to contain gaseous toxic compounds, bioaerosols, and dead and living cell material. At some level, these contaminants have been shown to have an unpleasant odor, cause visual problems for physicians, cause ocular and upper respiratory tract irritation, and have demonstrated mutagenic and carcinogenic potential.\textsuperscript{75} The possibility for bacterial and/or viral contamination of smoke plume remains controversial but has been highlighted by different studies.\textsuperscript{77,78}

XII.c. Personnel should wear high-filtration surgical masks during procedures that generate surgical smoke.

High-filtration masks are specially designed to filter particulate matter that is 0.1 micron in size and larger, and help filter particulate matter found in surgical smoke plume.\textsuperscript{79} These masks should not be viewed as absolute protection from chemical or particulate contaminants and should not be used as the first line of defense for protection against surgical smoke inhalation.\textsuperscript{75}

Recommendation XIII
Potential hazards associated with the use of chemicals, including methyl methacrylate, in the practice setting should be identified, and safe practices should be established.
Improper handling of chemicals can result in injury to health care workers and patients. Injuries may result from exposure to any portion of the body including the integumentary or respiratory systems.

XIII.a. Material safety data sheet (MSDS) information for every potentially hazardous chemical must be readily accessible to employees within the practice setting. This information includes identification of hazards, precautions or special handling, signs and symptoms of toxic exposure, and first aid treatments for exposure.\textsuperscript{80}

XIII.b. (I75; I84). When using chemicals, personnel should read and
follow all instructions provided on the container label or found on the MSDS provided by the manufacturer of the chemical.

All chemicals should be handled according to their respective MSDS sheets including, but not limited to:

- disinfectants and sterilants (eg, glutaraldehyde, orthophthalaldehyde, ethylene oxide, hydrogen peroxide, peracetic acid);
- tissue preservatives (ie, formalin); and
- antiseptic agents such as hand hygiene products and surgical prep solutions.  

XIII.c. Chemicals should not be combined unless safe outcomes can be ensured.

Mixing chemicals can result in unsafe substances that are unstable and/or caustic.

XII.d. Chemicals should be stored according to

- MSDS sheets;
- Manufacturer’s directions;
- flammability;
- patient and staff safety requirements; and
- local, state, and federal regulations.

XIII.d. (I75). Safe practices should be established for the use of methyl methacrylate bone cement.

Methyl methacrylate is a respiratory, eye, and skin irritant. The fumes contain carbon monoxide, hydrogen, and methane, which can cause personnel to experience vertigo, difficulty breathing, and nausea. All of these symptoms are short-term and are relieved once the fumes dissipate. The OSHA permissible exposure limit for methyl methacrylate for general industry is 100 ppm or a time-weighted average of 410mg/m³.  

Methyl methacrylate fumes should be extracted from the environment and the fumes exhausted to the outside air or absorbed through activated charcoal.

Vacuum mixers with fume extraction should be used to reduce the fume
levels users are exposed to.\textsuperscript{84,85}

Eye protection should be worn to prevent contact with eyes.\textsuperscript{83}

Methyl methacrylate fumes may produce an adverse reaction with soft contact lenses leading to irritation and possible corneal ulceration. There is no documented evidence of problems with hard contact lenses.

Manufacturer’s recommendations should be followed.\textsuperscript{83}

A second pair of gloves should be worn when handling methyl methacrylate and should be discarded after use.\textsuperscript{83}

Methyl methacrylate may be absorbed through the skin and penetrate many plastic and latex compounds leading to dermatitis.\textsuperscript{84}

A cement gun or mixing system should be used to reduce handling of the product, instead of hand mixing.\textsuperscript{84,86}

For spills of methyl methacrylate:

- the spill area should be ventilated until odor has dissipated,
- all sources of ignition should be removed,
- appropriate PPE should be worn during clean up,
- the spill area should be isolated,
- the liquid should be covered with an activated charcoal absorbent,
- the waste product should be covered disposed of in a hazardous waste container.\textsuperscript{87}

Methyl methacrylate is hazardous waste and should be disposed of per state, local, and federal requirements.\textsuperscript{87}

**Recommendation XIV**

Hazards associated with chemotherapeutic (eg, cytotoxic) agents used in the practice setting should be identified, and safe practices should be established.

Cytotoxic drugs have the potential to cause serious health risks to health care workers exposed to them. These risks may include:
carcinogenicity, teratogenicity, reproductive toxicity, organ or tissue damage, and chromosomal damage. The Occupational Safety and Health Administration has not determined safe levels of exposure to these drugs and no reliable system is available to monitor exposure levels.  

XIV.a. Health care organizations should develop a plan for medical surveillance of personnel handling cytotoxic agents.

XIV.b. A current MSDS sheet must be kept on all cytotoxic agents used in the workplace.

XIV.c. Cytotoxic agents should be transported in sealed containers with Luer caps and no needles attached.

The transport container should be:

- leak proof,
- resistant to breakage, and
- labeled with warning labels to alert personnel that contents are hazardous.

XIV.d. Personnel handling cytotoxic agents should wear PPE consistent with the type of exposure that can reasonably be anticipated.

Chemotherapy gloves should be worn when administering or handling open containers of chemotherapy drugs.

When scrubbed during surgery, personnel should double glove and change the outer glove after contact with a cytotoxic agent.

An impervious or chemotherapy-rated gown should be worn when arms and torso skin contact the may occur.

Face shields should be worn when the potential for splashing or splattering exists.

Face shields protect against mucous membrane and skin exposure. Some cytotoxic agents may cause corneal damage.

XIV.e. Chemotherapy spill kits should be available to contain accidental spills.

XIV.f. Unused chemotherapy agents must be disposed of in accordance with federal, state, and local laws.
Items contaminated with small amounts of chemotherapy agents should be disposed of according to written instructions from the health care organization’s waste management vendor.

XIV.h. Manufacturer’s recommendations for use of the chemotherapeutic agent should be followed regarding requirements for cleaning and handling of instrumentation exposed to the chemotherapeutic agent.

Some chemotherapeutic agents leave a residue on instruments and require specific PPE and cleaning techniques.

XIV.i. Staff members involved in handling cytotoxic agents should be educated regarding the hazards involved, exposure prevention, and management of spills.

XIV.j. Recommendations from the manufacturer of the chemotherapeutic agent should be followed regarding requirements for disposal of body fluids of patients receiving chemotherapeutic agents (eg, flushing the toilet/hopper twice for disposing of body fluids up to 48 hours after chemotherapeutic agent infusion).

**Recommendation XV**

Waste that is hazardous upon disposal must be identified, and disposed of in manner consistent with federal, state, and local laws.\(^91\)

Waste classified by the Environmental Protection Agency (EPA) as hazardous upon disposal, (eg, hazardous, acutely hazardous, flammable chemicals, acids and bases, heavy metals) is regulated under the Resource Conservation and Recovery Act and must be managed in a way that minimizes environmental effects.\(^91,92\)

XV. a. (I75). Chemicals considered hazardous upon disposal must be placed in hazardous waste containers at the point of use to alert handlers to take precautions upon its disposal.\(^91,93\) State and local laws also may apply and may be more stringent.

Unused and empty containers of epinephrine must be placed in a hazardous waste container for disposal.
The EPA has determined that epinephrine is acutely hazardous to the environment. Containers of epinephrine mixed with another active ingredient (eg, lidocaine) are not regulated by the EPA.\textsuperscript{93,94}

Flammable liquids (eg, alcohol, benzoin, collodion, formalin, methyl methacrylate, silver nitrate) must be contained and placed into a hazardous waste receptacle for disposal.\textsuperscript{94}

These chemicals pose a fire and environmental hazard if discarded in the regular waste stream.

XV.b. The use of mercury-containing devices should be eliminated in the practice setting.\textsuperscript{93,95}

Alternative non-mercury products (eg, thermometers, manometers) are available. Mercury poses a serious contamination risk to wildlife and to people, who may eat contaminated fish or game.\textsuperscript{96}

**Recommendation XVI**

**Potential hazards associated with misconnections of tubing and lines should be identified and safe practices established.**

Multiple cases of tubing which has been incorrectly connected (ie, blood pressure monitors to needleless IV ports; oxygen tubing to needleless IV ports) have led to patient injuries. This has occurred due to Luer connectors that allow different equipment to be connected if a female and male Luer connection are present.\textsuperscript{97}

XVI.a. Safe practices should be established when using Luer connectors.

When purchasing equipment with Luer connectors, the connector should not be compatible with IV Luer connectors.\textsuperscript{98}

When connecting two or more lengths of tubing, the tubing should be traced to the point of origin.\textsuperscript{99}

During the hand-off process, all tubing should be traced to the point of origin.\textsuperscript{97}
Instruct all indirect care givers, patients and families to obtain help before connecting or disconnecting tubings.  

Tubing used for high-risk catheters should be labeled and should not have injection ports.  

Tubing and catheters should be routed to avoid tangling and facilitate easy identification.  

Standard Luer syringes should not be used for oral medications or enteric feedings.  

**Recommendation XVII Competency**  
**Personnel should receive initial education and competency validation, and at least annual updates on new regulations, equipment, and procedures.**  

Ongoing education of perioperative personnel facilitates the development of knowledge, skills, and attitudes that affect patient and worker safety.  

XVII.a. An introduction and review of policies and procedures should be included in orientation to the perioperative setting for personnel and observers. Continuing education should be provided when new elements in the environment of care are introduced.  

Education should include, but not be limited to:  

- potential security hazards in their environment along with methods of protection;  
- how to implement the evacuation plan;  
- potential hazards in the environment and methods of protection;  
- patient privacy policy;  
- available ergonomic equipment and safe lifting/moving practices;  
- safe use of electrical equipment in the practice setting;  
- the location of ventilation and electrical systems and who is permitted to shut them off in the event of an emergency;  
- air exchange, temperature and humidity parameters;  
- the safe use of medical equipment in the perioperative
environment;

- the location of ventilation and electrical systems and who is permitted to shut these systems off in the event of an emergency;

- appropriate responses to clinical alarms;

- the safe use of blanket- and solution-warming cabinets;

- fire prevention education and fire drills, which should be conducted regularly as per the AORN guidance statement, federal, state, local regulations, and accrediting agency standards;

- the safe use and handling of medical and anesthetic gases;

- the location and operation of medical gas shut-off panels;

- the procedures involved in maintaining a safe environment of care;

- the correct procedures involved to avoid tubing misconnections,\textsuperscript{97} and

- employers must provide training and competency validation of staff members who work with chemicals and other agents in the workplace.\textsuperscript{89} Training should include, but is not limited to the safe handling of:
  - methyl methacrylate bone cement;
  - chemicals (eg, disinfectants, sterilants, formalin);
  - cytotoxic agents, the hazards involved, exposure prevention, and management of spills;
  - hazardous wastes and their disposal; and
  - handling of instruments exposed to chemotherapeutic agents.

Recommendation XVIII-Documentation

Records should be maintained for a time period specified by the health care organization and in compliance with local, state, and federal regulations.

Accurate records are necessary for identifying trends, and demonstrating compliance with regulatory and accrediting agency requirements.

XVIII.a. The following items should be documented per organization policy, including but not limited to:

- daily operating room HVAC system function (eg, air exchange rate, temperature, humidity);\textsuperscript{24}
- blanket/fluid warming cabinet temperature;
- testing of anesthesia waste gas scavenging
systems,\textsuperscript{64} and
\begin{itemize}
  \item employee health records.
\end{itemize}

**Recommendation XIX- Policy & Procedure**

Policies and procedures for the provision of a safe environment of care should be developed, reviewed periodically, revised as necessary, and be readily available in the practice setting.

Policies and procedures serve as operational guidelines and establish authority, responsibility, and accountability within the organization. Policies and procedures also assist in the development of patient safety, quality assessment, and improvement activities.

XIX.a. The policies and procedures should include, but not limited to:
\begin{itemize}
  \item safe patient handling and movement in the perioperative setting;
  \item description of security management activities including access control;
  \item action to be taken during periods of loss of usual and emergency power;\textsuperscript{20}
  \item monitoring of air exchanges per hour;
  \item describing the processes to be implemented to effectively manage medical equipment, including selection, purchase, inspection, and maintenance processes;
  \item monitoring and recording the temperature of warming cabinets;
  \item inspection, testing and maintenance of fire extinguishment equipment and supplies;
  \item defining responsibility and authority for gas valve shut-off;
  \item monitoring of nitrous oxide and other inhalation anesthetics;
  \item schedule and criteria for maintenance of anesthesia delivery systems;
  \item medical surveillance of personnel handling cytotoxic agents;
  \item storage of chemicals according to manufacturer’s directions, MSDS sheets, flammability, patient and staff safety requirements and local, state, and federal regulations; and
  \item other policies as dictated by applicable local, state, and federal regulations.
\end{itemize}

**Recommendation XX Quality**
The health care organization’s quality management program should evaluate the environment of care to improve patient safety.
XX.a. Personnel in the perioperative setting should:

- identify safety hazards,
- take appropriate corrective actions, and
- report hazards per organizational policy.

XX.b. A quality-management plan should be developed by a team involving representatives from all types of positions within the perioperative area.

The quality management plan should include:

- critiquing of fire drills by a team that includes members from all perioperative departments and categories of personnel to identify deficiencies and opportunities for improvement;
- collecting and analyzing information about adverse outcomes associated with the environment of care as a part of the institution-wide performance improvement program, which addresses adverse events and near misses;\textsuperscript{23}
- creation of a patient safety culture to include policies and procedures supporting that culture;
- the creation of a patient safety culture that will foster reporting of adverse events and near misses;\textsuperscript{100}
- monitoring of actual and potential risks in each of the environment of care areas to be completed on a regular basis (e.g., at least monthly environment of care rounds by a team that includes clinicians, administrators, support personnel);\textsuperscript{23}
- developing a process to monitor and report incidents of equipment malfunction leading to patient harm as outlined in the \textit{Safe Medical Devices Act of 1990};\textsuperscript{101}
- developing a plan to monitor compliance with safe handling of chemicals, cytotoxic agents, and hazardous waste in the workplace;
- conducting scheduled “walk-around” safety rounds to test clinical alarms and to observe staff members response to the alarms;
- developing an organization wide event reporting system for HVAC failures and power interruptions;\textsuperscript{28}
- developing processes to regularly inspect, test and
maintain fire extinguishment equipment and supplies; and

- a mechanism for reporting work-related health problems.

### Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical Alarms</strong></td>
<td>Alarm systems that are patient specific and are used for the purpose of alerting staff members to a patient emergency.</td>
</tr>
<tr>
<td><strong>Compressed medical gas (CMG)</strong></td>
<td>A liquefied or vaporized gas alone, or in combination with other gases, which is a drug as defined by the FDA (eg, oxygen, nitrogen, nitric oxide, nitrous oxide, carbon dioxide, helium, medical air).</td>
</tr>
<tr>
<td><strong>Container</strong></td>
<td>A metal container designed to contain either liquefied or vaporized CMG.</td>
</tr>
<tr>
<td><strong>Cylinder</strong></td>
<td>A metal container designed to contain CMG at a high pressure.</td>
</tr>
<tr>
<td><strong>Ground-fault circuit interrupter</strong></td>
<td>A device that senses a significant flow of leakage current and interrupts the flow of electricity to prevent electric shock.</td>
</tr>
<tr>
<td><strong>Line isolation monitor</strong></td>
<td>A device used to continuously monitor an ungrounded power system that is isolated from the commercial power supply received from the utility company. Isolated, ungrounded power systems may allow leakage currents, also known as hazard currents, to flow from the power system to ground. This leakage current may flow through a person's body and presents a shock hazard to that person. Standards for the maximum allowed leakage current have been established. The line isolation monitor displays the calculated level of leakage current and sounds an alarm if the current exceeds the predetermined level.</td>
</tr>
<tr>
<td><strong>Pin-Index safety system</strong></td>
<td>A safeguard to eliminate cylinder interchanging and the possibility of accidentally placing the incorrect gas on a yoke designed to accommodate another gas. Two pins on the yoke are arranged so that</td>
</tr>
</tbody>
</table>
they project into the cylinder valve. Each gas or combination of gases has a specific pin arrangement.

**Teratogenicity**

The ability of a substance to cause the development of abnormal structures in an embryo or fetus exposed to that substance during gestation.

**Warming device**

A device used in the perioperative setting to assist with the control of body temperature and prevent hypothermia.

**Wet locations**

Patient care areas where procedures are performed that are normally subject to wet conditions, including standing fluids on the floor or drenching of the work area, while patients are present.

References


8. Position statement on ergonomically healthy workplace practices. In: *Standards, Recommended Practices, and


35. Moore SS, Green CR, Wang FL, Pandit SK, Hurd WW. The role


61. Reusable gaskets on oxygen regulators will wear out. [Hazard


65. Bilban M, Jakopin CB, Ogrinc D. Cytogenetic tests performed on operating room personnel (the use of anaesthetic gases). *International Archives of Occupational & Environmental Health*. 2005;78:60-64.


74. US Department of Labor, Occupational Safety, and Health Administration. Safety and Health Topics: Laser/Electrosurgery


76. ECRI Institute. Smoke evacuation systems, surgical, Healthcare Product Comparison System; March 2002;1-3


88. Polovich M, White JM, Kelleher LO. Fundamentals of administration. In: Chemotherapy and Biotherapy Guidelines and


93. Wastes. Environmental Protection Agency, 

94. Sloan-Kettering fined for failure to properly manage hazardous waste. Environmental Protection Agency (January 27, 2004). 


96. Health Care Without Harm. Making medicine mercury-free: a resource guide for mercury-free medicine. Available at: 


