AORN Guidance Statement:
Fire Prevention in the Operating Room

Introduction

AORN recognizes that fire is an inherent risk in ORs. Fire is an ever-present danger and poses a real hazard to patient and health care worker safety. In 2003, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) issued a sentinel event alert related to fires that occur during operative and invasive procedures. The bulletin raised the level of awareness about the dangers of surgical fires. The Joint Commission recommends that health care organizations prevent surgical fires by providing education and training for perioperative practitioners.1 In July 2004, surgical fire prevention was added to the 2005 National Patient Safety Goals for ambulatory and office-based surgical facilities.2

The approach to developing policies and procedures to reduce fire risk should be multidisciplinary and involve all professionals who provide patient care. Facilities are encouraged to report surgical fires to JCAHO, ECRI, or the US Food and Drug Administration (FDA). Systematic reporting of fires can help educate care providers about how and why fires occur and can help prevent fires in the future.1

Background

Fires involving surgical patients have been reported by hospitals and ambulatory surgical centers; some medical device manufacturers, and other experts, such as ECRI, for many years. There is no centralized database being collected by any agency at present on the total number of surgical fires;3 however, data from ECRI and the FDA estimate that approximately 100 surgical fires occur each year, resulting in approximately 20 patient injuries that are serious, with one to two deaths per year.1,4 The overriding consideration with surgical fires is that they are 100% preventable.1,4

Fires occur when the elements that support combustion—an ignition source, a fuel source, and an oxidizer—come together. These three elements are referred to as the “fire triangle.” All three elements are present in abundance during operative and invasive procedures4 (Tables 1-3). Operating rooms in hospitals and ambulatory surgery suites, physicians’ offices, and endoscopy suites are some of the critical areas where fires occur, and they contain all the elements that support combustion.

Ignition sources are anything that produces heat; the two most common sources are the electrosurgical unit (ESU) and the laser. Other equipment that produces heat includes, but may not be limited to, fiber-optic light cables and light source boxes; drills, saws, and burrs; hand-held electrosurgical devices; argon beam coagulators; and defibrillators.4

Almost everything in the perioperative arena can be a fuel source, especially when an accelerant, such as oxygen, is present. The items used to set up the sterile field and protect the patient (eg, linens, drapes, gowns, supplies, preps, gauzes, clothes) should all be considered fuel sources. The patient’s body hair and body gases also can be fuel sources.5

The primary oxidizers in the surgical environment are oxygen and nitrous oxide. Fires can occur when the oxygen level in the atmosphere rises above the level of ambient air (ie, 21%). Oxygen can escape into the air when patients are given mask or nasal oxygen. A level above 21% should be treated as an oxygen-enriched environment.6

Guideline

Education

Education and training in fire risk reduction strategies for perioperative RNs, surgical technologists, anesthesia care providers, surgeons, and other personnel is essential to promote and maintain a fire-safe perioperative environment. Health care industry representatives and students should be included in fire drill education. Each perioperative team member is responsible for promoting a culture of fire safety. Preparation is the key to ensuring readiness for preventing fires in the OR. Recommendations from ECRI include that
perioperative team members participate in fire drills;
• team members receive training on the use of fire fighting equipment, rescue methods, and evacuation;
• staff members know where medical gas panels and ventilation and electrical systems are located, which personnel are permitted to shut them off, and when;
• staff members in the perioperative care setting be shown how to initiate a “Code Red” or fire alarm at their facility;
• staff members know specific protocols to contact the local fire department;4
• students rotating through the perioperative area are included in fire education and training; and
• health care industry representatives are educated on fire safety hazards in the perioperative area during their credentialing process.

A health care facility’s fire plan should be reviewed and actively discussed. This assists the facility in refining the fire plan. The use of fire extinguishers should be demonstrated to provide staff with instruction on the why, when, and how to use extinguishers. Perioperative clinical leaders must take additional action to keep patients and staff members safe. Fire drills should be conducted regularly based on local, state, and JCAHO guidelines.4 Fire drills should include the following.

• Use of National Fire Protection Association (NFPA) standards for classification of the different types of fire extinguishers, including
  – Class A: for use on wood, paper, cloth, and most plastics (eg, combustible materials);
  – Class B: for use on flammable liquids or grease; and
  – Class C: for use on energized electrical equipment.4

• The acronym **PASS** should be reviewed to operate the fire extinguisher.
  – **P**—Pull the pin.
  – **A**—Aim nozzle at the base of the fire.
  – **S**—Squeeze the handle.
  – **S**—Sweep the stream over the base of the fire.7

To enhance user skill and confidence, allow every staff member time to practice handling the fire extinguisher. Teach staff members to use the fire extinguisher with their back toward an escape exit for easier access. Labels on the fire extinguisher should be checked for color, size, and shape of the extinguisher to prevent personnel assisting in extinguishing fires from using the wrong extinguisher (eg, water on an electrical fire). The following information will help staff members become more competent.

• Staff members should be shown where fire extinguishers are located in the perioperative setting.
• Operating room doors should be able to open completely without equipment blocking them.
• Staff members should know the location of all fire exits and ensure that these exits are clear and accessible at all times.
• Surgical team members should know where the medical gas shutoff valves are and their facility’s policy on who should turn them off and when.
• Review roles of every staff member at the point of the fire’s origin and away from the immediate area.
• Take staff members through evacuation routes, both primary and secondary, to an evacuation location point beyond a firewall.
• Fire blankets should not be used in the OR; the fire could be trapped on or under the patient.4

Depending on the size of the perioperative setting, planning for an initial fire drill may take up to three months.5 Key points in planning a fire drill include

• choosing a date and time;
• developing a well-thought-out scenario(s);
• obtaining the facility fire drill evaluation form, and modifying it where necessary;
• completing a fire drill record, and noting all participants and pertinent details;
• identifying observers and their locations;
• designating surgical team members who will participate in the event and briefing them on the scenario;
• reviewing fire safety/drill policy and procedures and their roles with staff members;
• notifying facility administrators of the upcoming fire drill and posting signs;
Every fire drill should be considered a forum for learning. Perioperative staff member preparedness will ensure an effective and efficient response to a fire in a smooth and coordinated manner (Sample Forms 1 and 2).

Evacuation plan
All perioperative departments should develop and implement a well-rehearsed and well-thought-out fire evacuation plan. Evacuation plans help ensure that all staff members are familiar with the proper evacuation routes and equipment that may be used before or during an evacuation. In the event a fire occurs in the perioperative area, personnel should follow the standard fire emergency response procedure and activate RACE.

- Use of the acronym **RACE** as the response component of the fire safety plan:
  - R—Rescue the individual involved in the fire.
  - A—Alarm should be sounded as soon as possible.
  - C—Confine the fire.
  - E—Extinguish the fire and evacuate if required.

Surgical team duties in a fire evacuation. Each surgical suite should have designated fire responder teams with defined responsibilities to take if a fire occurs in the surgical suite. There should be a chain of command that includes an authority who has jurisdiction to manage the incident. If the OR must be evacuated, several steps should be taken by personnel responsible for the care of the patient in the OR. First, surgical team members should become oriented in relation to where they are located, the proximity of the nearest exit, and how to safely evacuate to that destination. The roles of the surgical team may be as follows.

- **The surgeon should**
  - remove from the patient materials that may be on fire and help put out the fire;
  - control bleeding and prepare the patient for evacuation if necessary;
  - conclude the procedure as soon as possible;
  - place sterile towels or covers over the surgical site; and
  - if the patient is not in immediate danger, help move the patient.

- **The anesthesia care provider should**
  - shut off the flow of oxygen/nitrous oxide to the patient or field and maintain breathing for the patient with a valve mask respirator (ie, ambu bag);
  - collaborate with the circulating nurse on the need to turn off the medical gas shutoff valves;
  - disconnect all electrically powered equipment on the anesthesia machine;
  - disconnect any leads, lines, or other equipment that may be anchoring the patient to the area;
  - maintain the patient's anesthetic state and collect the necessary medications to continue anesthesia during transport; and
  - place additional IV fluids on the bed for transport with the patient, if time permits.

- **The scrub person should**
  - remove from the patient materials that may be on fire and help put out the fire;
  - assist with conclusion of procedure if possible;
  - obtain sterile towels or covers for the surgical site and instruments;
  - gather a minimal number of instruments onto a tray or basin and place them with the patient for transport; and
  - assist with patient transfer from the OR table to a stretcher/bed for transport out of the OR.

- **The perioperative RN circulating should**
  - ensure the patient’s safety by remaining with him or her and comforting him or her;
  - activate the fire alarm system and call the fire code to alert all necessary personnel;
  - extinguish small fires or douse them with liquid if appropriate;
  - remove any burning material from the patient or sterile field, and extinguish it on the floor;
  - prevent fire from spreading to shoes or surgical clothing by not stepping on it;
– provide the scrub person and anesthesia care provider with needed supplies;
– collaborate with the anesthesia care provider on the need to turn off the medical gas shutoff valves;
– carefully unplug all equipment if the fire is electrical;
– be aware of the safest route for escape;
– obtain a transport stretcher if necessary;
– remove IV solutions from poles and place them with the patient for transporting out of the OR;
– help the anesthesia care provider disconnect any leads, lines, or other equipment that may be needed for transporting the patient; and
– not delay leaving the OR suite.

♦ The perioperative registered nurse in charge/designee should
– notify the telephone operator, safety officer, or designated person of a fire and its location;
– document the time the fire started;
– determine how many people are in the department and account for everyone;
– set up a communication point and identify a person to staff it;
– determine the state of ongoing surgery/procedures in each area;
– consult with the anesthesia care provider in charge on how to handle each patient;
– assign personnel to assist where needed;
– ask visitors to leave if necessary; and
– evacuate patients who may need to be moved immediately.

♦ Ancillary personnel should
– help clear corridors for evacuation;
– secure equipment for transporting the patient as directed by the circulating nurse;
– help prepare safe area to transfer patients to if this is needed;
– follow instructions for evacuating the patient if needed; and
– assist where directed.

Patients should be evacuated horizontally to a safe area on the same floor. It is very important to maintain an accurate count of all patients and staff members during the evacuation. After evacuation of the room, the last person to leave the room should close the doors and place a wet towel at the base of them. After the fire, everything should be left in place so the safety officer and the fire department can conduct a thorough investigation of the cause of the fire.7

Risk reduction strategies
Risk reduction strategies involve educating surgical team members about the components of the fire triangle and developing policies and procedures that will prevent surgical fires. Fuel sources must be managed in a way that will prevent fires, ignition sources must be controlled so that they do not come in contact with fuels, and oxidizers must be contained or properly vented so that they do not come in contact with fuels or ignition sources. Keeping the sides of the fire triangle apart is critical.

Notes

<table>
<thead>
<tr>
<th>Ignition sources</th>
<th>Strategies to manage</th>
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<tbody>
<tr>
<td>Electrosurgical unit (ESU)</td>
<td>Use the lowest possible power setting.</td>
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<td>Place the patient return electrode on a large muscle mass close to the surgical site.</td>
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<td></td>
<td>Large reusable return electrodes should be used according to the manufacturer’s instructions.</td>
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<td></td>
<td>Always use a safety holster.</td>
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<td></td>
<td>Do not coil active electrode cords.</td>
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<td></td>
<td>Inspect the active electrode to ensure integrity.</td>
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<td></td>
<td>Do not use ESU in the presence of flammable solutions.</td>
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<td>Ensure that electrical cords and plugs are not frayed or broken.</td>
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<td>Do not place fluids on top of the ESU.</td>
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<td></td>
<td>Do not use the ESU near oxygen or nitrous oxide.</td>
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<td>Ensure that the ESU active electrode tip fits securely into the active electrode hand piece.</td>
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<td></td>
<td>Ensure that any connectors and adaptors used are intended to connect to the ESU and fit securely.</td>
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<td>Do not bypass ESU safety features.</td>
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<td>Ensure that the alarm tone is always audible.</td>
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<td></td>
<td>Remove any contaminated or unused active accessories from the sterile field.</td>
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<td></td>
<td>Keep the active electrode tip clean.</td>
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<td></td>
<td>Use wet sponges or towels to help retard fire potential.</td>
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<td></td>
<td>Never alter a medical device.</td>
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<td></td>
<td>Do not use rubber catheters or protective covers as insulators on the active electrode tip.</td>
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<td></td>
<td>Use cut or blend instead of coagulation when possible.</td>
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<td></td>
<td>Do not open the circuit to activate the ESU.</td>
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<td></td>
<td>Ensure that the active electrode is not activated in close proximity to another metal object that could conduct heat or cause arcing.</td>
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<td></td>
<td>After prepping, allow prep to dry and fumes to dissipate. Wet prep and fumes trapped beneath drapes can ignite.</td>
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<td></td>
<td>Provide multidisciplinary inservice programs on the safe use of ESUs based on the manufacturer’s instructions.</td>
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<tr>
<td>Argon beam coagulator</td>
<td>Argon beam coagulators combine the ESU spark with argon gas to concentrate and focus the ESU spark. Argon gas is inert and nonflammable, but because it is used with an ESU, the same precautions as with an ESU should be taken.</td>
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<tr>
<td></td>
<td>Always use a safety holster.</td>
</tr>
<tr>
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<td>Ensure that the active electrode is not activated in close proximity to another metal object that could conduct heat or cause arcing.</td>
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</table>
| **Lasers**                                                                 | Use a laser-specific endotracheal tube (ie, a tube that has laser-resistant coating or contains no material that will ignite) if head, neck, lung, or airway surgery is anticipated.  
Wet sponges around the tube cuffs may provide extra protection to help retard fire potential.  
Keep towels moist and away from the edge of the surgical site to retard fires.  
Do not use liquids or ointments that may be combustible.  
Inflate cuffed tube bladders with tinted saline (eg, methylene blue) so that inadvertent rupture may be detected during chest or upper airway surgery.  
Do not use uncuffed, standard endotracheal tubes in the presence of a laser or the ESU.  
If an endotracheal tube fire occurs, oxygen administration should be stopped, and all burning or melted tubes should be removed from the patient immediately.  
Prevent pooling of skin prep solutions.  
Have water and the correct fire extinguisher type available in case of a laser fire.  
Ensure that alarm tone is always audible.  |
| **Fiber optic light sources**                                              | Ensure that the light source is in good working order.  |
| **Fiber optic light cables**                                              | Place the light source in standby, or turn it off when the cable is not connected.  
Place the light source away from items that are flammable.  
Do not place a light cable that is connected to a light source on drapes, sponges, or anything else that is flammable.  
Do not allow cables that are connected to hang over the side of the sterile field if the light source is on.  
Ensure that light cables are in good working order and do not have broken light fibers.  |
| **Power tools/drills/burrs**                                              | Instruments/equipment that moves rapidly during use generate heat. Always ensure that they are in good working order.  
A slow drip of saline on a moving drill/burr helps to reduce heat buildup.  
Do not place drills, burrs, or saws on the patient when they are not in use.  
Remove instruments/equipment from the sterile field when not in use.  |
| **Defibrillator paddles**                                                 | Select paddles that are the correct size for the patient (eg, pediatric paddles on a child).  
Ensure that the gel recommended by the paddle manufacturer is used.  
Adhere to appropriate site selection for paddle placement.  |
Contact between the paddles and the patient should be optimal and no gaps should be present before activating the defibrillator.

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<tr>
<th>Electrical equipment</th>
<th>Ensure that all equipment is periodically inspected by biomedical personnel for proper function.</th>
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<tr>
<td></td>
<td>Check biomedical inspection stickers on the equipment; they should be current.</td>
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<td></td>
<td>Do not use equipment with frayed or damaged cords or plugs.</td>
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<td>Remove any equipment that emits smoke during use.</td>
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<tr>
<th><strong>Fuel sources</strong></th>
<th><strong>Strategies to manage</strong></th>
</tr>
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<tbody>
<tr>
<td>Patient and staff linens</td>
<td>Assess the flammability of all materials used in, on, or around the patient.</td>
</tr>
<tr>
<td>Drapes</td>
<td>Linens and drapes are made of synthetic or natural fibers. They may burn or melt depending on the fiber content.</td>
</tr>
<tr>
<td>Gowns</td>
<td>Do not allow drapes or linens to come in contact with activated ignition sources (eg, laser, electrosurgical unit [ESU], light sources).</td>
</tr>
<tr>
<td>Towels</td>
<td>Do not trap volatile chemicals or chemical fumes beneath drapes.</td>
</tr>
<tr>
<td>Lap pads</td>
<td>Moisten drapes, towels, and sponges that will be in close proximity to ignition sources (eg, laser, ESU).</td>
</tr>
<tr>
<td>Sponges</td>
<td>Ensure that oxygen does not accumulate beneath drapes.</td>
</tr>
<tr>
<td>Dressings</td>
<td>If drapes or linens ignite, smother out small fires with a wet sponge or towel. Remove burning material from the patient.</td>
</tr>
<tr>
<td>Tapes</td>
<td>Extinguish any burning material with the appropriate fire extinguisher or water, if appropriate.</td>
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<tr>
<td>Bed linens</td>
<td>Use flammable prep solutions with caution.</td>
</tr>
<tr>
<td>Caps/hats</td>
<td>Do not allow prep solutions to pool on, around, or beneath the patient.</td>
</tr>
<tr>
<td>Shoe covers</td>
<td>After prepping, allow prep to dry and fumes to dissipate. Wet prep and fumes trapped beneath drapes can ignite.</td>
</tr>
<tr>
<td>Collodian</td>
<td>Do not activate ignition sources in the presence of flammable prep solutions.</td>
</tr>
<tr>
<td>Alcohol-based skin preparations</td>
<td>Do not allow drapes that will remain in contact with the patient to absorb flammable prep solutions.</td>
</tr>
<tr>
<td>Wound packings</td>
<td>Use suction during rectal surgery to remove any intestinal gases that may be present.</td>
</tr>
<tr>
<td><strong>Prep solutions</strong></td>
<td>These products may be used before skin prep to degrease or clean the skin or as part of the dressing. These products may contain chemicals that are flammable (eg, ether in collodian). Allow all fumes to dissipate before beginning surgery. The laser or ESU should not be used after the dressing is in place.</td>
</tr>
<tr>
<td><strong>Skin degreasers, tinctures, aerosols</strong></td>
<td>The patient’s own body can be a fuel source. Coat any body hair that is in close proximity to an ignition source with a water-based jelly to retard ignition. Ensure that surgical smoke from burning patient tissue is properly evacuated. Surgical smoke can support combustion if allowed to accumulate in a small or enclosed space (eg, the back of the throat).</td>
</tr>
<tr>
<td><strong>Body tissue and patient hair</strong></td>
<td>Patient intestinal gases are flammable. Electrosurgery or laser should be used with caution whenever intestinal gases are present. Do not open the bowel with the laser or ESU when it appears gas is present. Use suction during rectal surgery to remove any intestinal gases that may be present.</td>
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| Oxygen (O₂)               | Oxygen should be used with caution in the presence of ignition sources. Oxygen is an oxidizer and is capable of supporting combustion.¹
|                           | Ensure that anesthesia circuits are free of leaks.                                    |
|                           | Pack wet sponges around the back of the throat to help retard oxygen leaks.           |
|                           | Inflate cuffed tube bladders with tinted saline (eg, methylene blue) so that inadvertent ruptures can be detected. |
|                           | Use suction to help evacuate any accumulation of O₂ in body cavities, such as the mouth or chest cavity. |
|                           | Do not use the laser or electrosurgical unit (ESU) near where O₂ is flowing.         |
|                           | Use a pulse oximeter to determine the patient’s oxygenation level and the need for oxygen. |
|                           | Allow O₂ fumes to dissipate before using the laser or ESU.                            |
|                           | O₂ should not be directed at the surgical site.                                       |
|                           | Ensure that drapes are configured to help prevent oxygen accumulation when mask or nasal O₂ is used.²-⁴ |
|                           | With a large fire turn off the gases, with an airway or tracheal fire disconnect the breathing circuit and remove the endotracheal tube.⁴ |
|                           | Stop supplemental oxygen for one minute before using electrocautery or laser for head, neck, or upper chest procedures.¹ |
| Nitrous oxide             | The strategies to manage O₂ also should be used to manage risks associated with nitrous oxide.²-⁴ |

**Notes**