

**OR FIRE  
SAFETY**

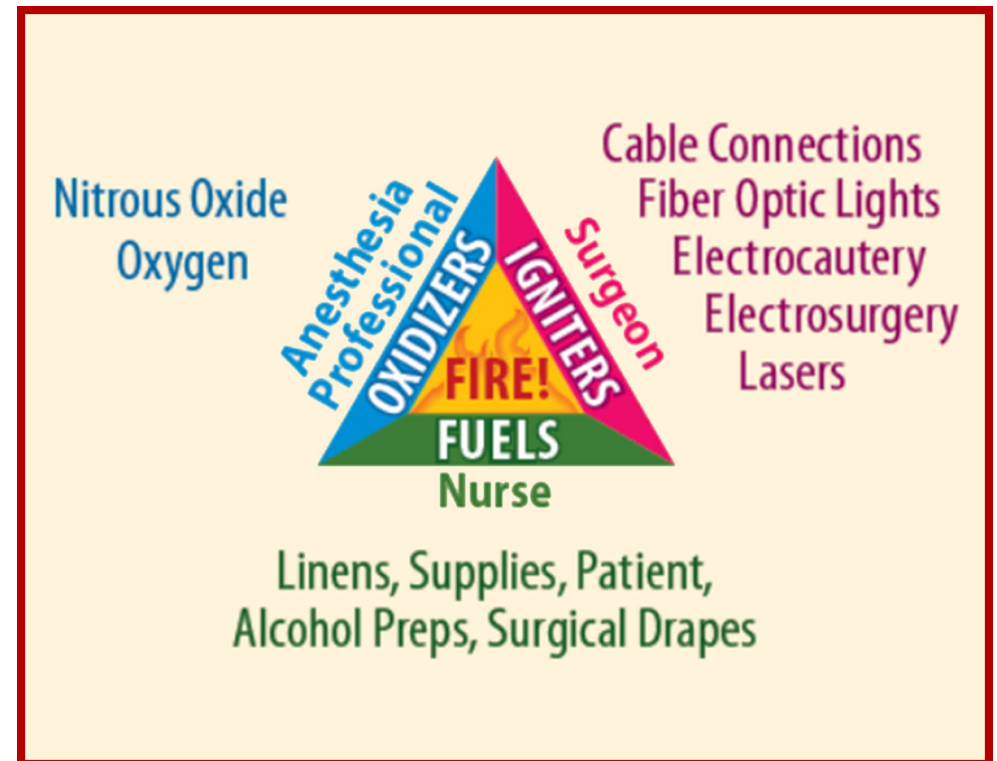


# OR FIRE SAFETY

## FIRE TRIANGLE

### Three things are needed to start a OR FIRE

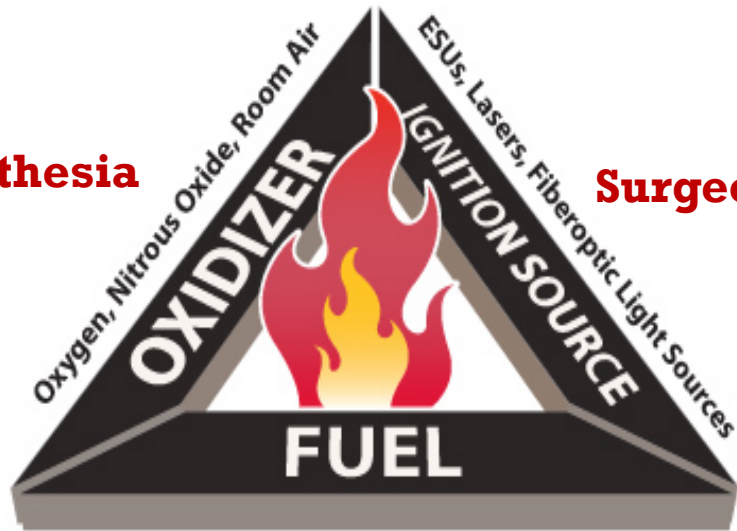
1. **Ignition source** for example: electrosurgical units (ESUs), lasers, and fiber-optic light sources
2. **Fuel source** for example: surgical drapes, alcohol-based skin preparation agents, the patient
3. **Oxidizer** for example: oxygen, nitrous oxide, room air



# OR FIRE SAFETY

## FIRE TRIANGLE

**Anesthesia**

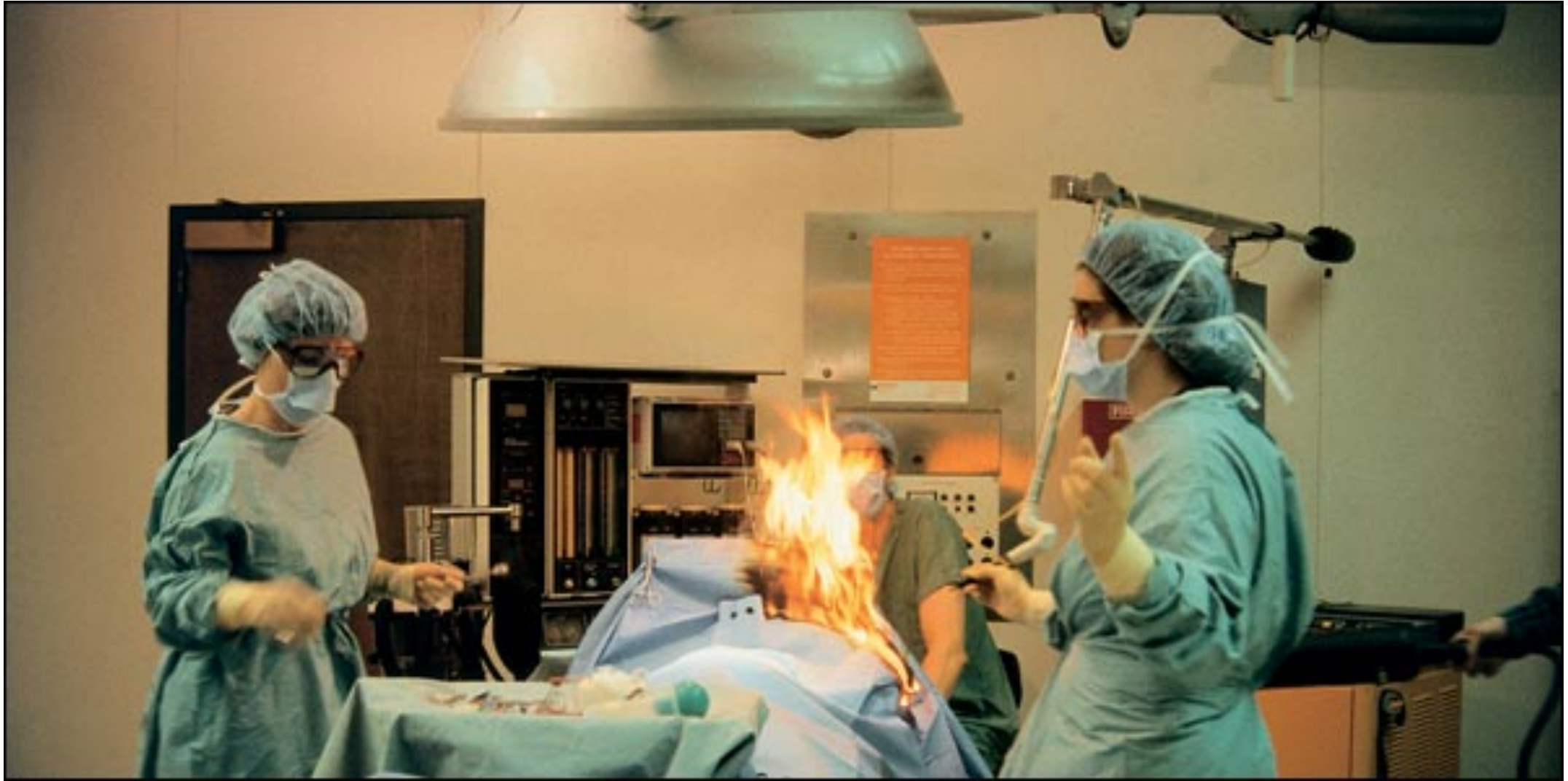


**Surgeon**

**Nurse**







# OR FIRE SAFETY

- **Fuel:** Anything that can burn, including almost everything that comes in contact with the patient or that is used on or in the patient, as well as the patients themselves. Fumes from an alcohol based prep. 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 a fuel source.
- **Ignition Source:** That which provides the heat energy that can start a fire should the energy be directed onto or come in contact with some fuel, either in ambient air or in an oxidizer-enriched atmosphere: examples include cautery pencil, light cord, 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 electrocautery devices; argon beam coagulators; and defibrillators.
- **Oxidizer:** Gases that can support combustion: examples include air, 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.



# TOP 10 THINGS TO KNOW ABOUT OR FIRES

1. **KNOW THE RISK:** Fires in the operating room are rare but potentially life-threatening.
2. **HOW FIRES HAPPEN:** Three things have to be present for a fire to start. This “Fire Triangle” includes heat, a source of “fuel” (something that will burn) and oxygen.
3. **SURGICAL FIRES ARE PREVENTABLE:** Surgical fires do not have to happen and can be avoided with proper precautions and communication by the surgical team.
4. **HEAD AND NECK SURGERY:** Procedures in the head and neck area pose a greater risk of fire due to the potential for an oxygen-rich environment around a patient’s face from a breathing mask.
5. **PRE-OPERATIVE SKIN CLEANSERS:** Skin “preps” often contain alcohol, which is flammable. Skin cleaners may pool in the skin folds, drapes –especially on overweight patients – so these cleansers need time to dry before surgery begins. While a prep is wet it can still emit fumes – fumes fuel fires.
6. **DRAPING:** Surgical drapes can catch fire and they can hide the “pooling” of liquid alcohol skin preps. Drapes can also trap alcohol vapors from skin preps, which can ignite if exposed to heat and oxygen.
7. **DEVICES USED TO CUT TISSUE:** Tools such as electrocautery (tissue-cutting) units (Bovie), lasers, fiber-optic lights and cables can generate heat or sparks and cause a fire.
8. **FACIAL HAIR:** Hair on the face may need to be covered with water soluble jelly – this is important for head and neck surgeries and for patients with beards, moustaches and thick eyebrows.
9. **ROOM AIR:** If possible, the patient should be kept on room air and not highly concentrated oxygen. If extra oxygen is needed, it should be the lowest concentration that is safe for the patient.
10. **STAFF TRAINING:** Staff training is effective in preventing, recognizing and putting out surgical fires.



# WAIT TO DRAPE!

Dry time  
for alcohol-based  
preps



Wait a minimum of 3 minutes on hairless skin.

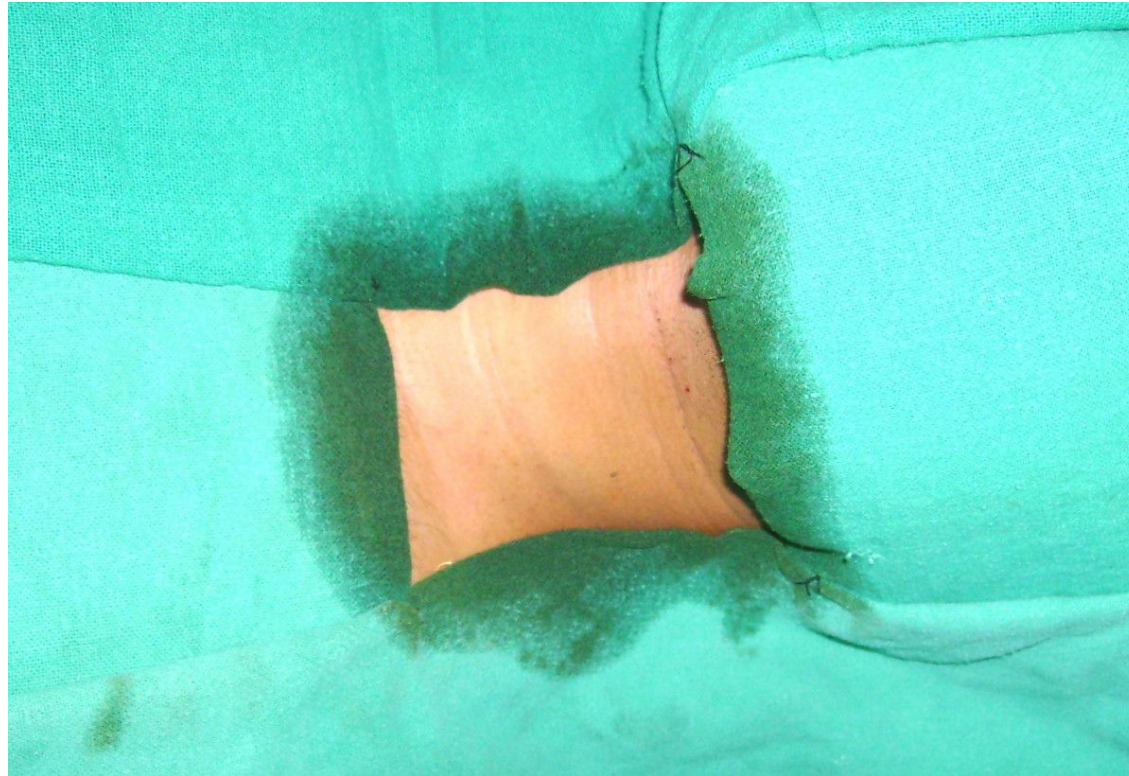
*Do not drape or use ignition source until solution is completely dry.  
When used on hair, it may take up to 1 hour to dry.*





# EXAMPLE OF HOW A FIRE CAN DEVELOP

If the prep is alcohol based and the towels are impregnated as illustrated – cautery near the drape can ignite a fire from the fumes emanating from the still wet towel, and from the alcohol in the wet towel.



# FIRE RISK ASSESSMENT

## SURGICAL SITE FIRE RISK ASSESSMENT

Alcohol-based prep solution has had a sufficient drying time (minimum 3 minutes)

Yes     No     N/A

### ASSESS THE RISK

	(Circle appropriate option)	
	YES	NO
* Surgical Site or incision is above the Xiphoid	1	0
* Open Oxygen Source (patient receiving supplemental oxygen via any variety of face mask or nasal cannula)	1	0
* Available ignition source (ie., electrosurgery unit, laser, defibrillator, burr, fiber-optic source etc.)	1	0
TOTAL SCORE		

SCORING    3 High Risk  
                   2 Low Risk with potential to convert to High Risk  
                   1 Low Risk

### FIRE RISK PROTOCOLS

#### SCORE 3 HIGH RISK

The Circulating Nurse and Anesthesia Provider take these precautions.

##### Circulating Nurse

- Verifies fire triangle, including verbal confirmation of the oxygen percentage
- Ensure appropriate draping techniques to minimize oxygen concentration under the drapes
- Minimizes ESU setting
- Assesses that enough time has been allowed for fumes of alcohol based prep solutions to dissipate (minimum of 3 minutes)
- Encourages use of wet sponges
- Ensures a basin of sterile saline and bulb syringe are available for fire suppression

##### Anesthesia Provider

Ensures that a syringe full of saline is in reach for procedures conducted within the oral cavity  
 Documents oxygen concentration and flows  
 Uses the MAC circuit for oxygen administration initially at FIO2 of 0.3 using fresh gas flows of at least 12L/min.

#### SCORE 2 LOW RISK WITH POTENTIAL TO CONVERT TO HIGH RISK

Standard fire safety precautions are followed with the potential to convert to high-risk precautions if necessary.

##### Standard Precautions are to:

- Observe alcohol-based prep drying times (minimum of 3 minutes)
- Protect heat sources (e.g. using the ESU pencil holster)
- Use standard draping procedure

#### SCORE 1 LOW RISK

Standard fire safety precautions are followed



# FIRE RISK SCORE BASED PROTOCOLS



## Fire Risk Assessment Protocols

<p style="color: red; text-align: center;">Low Risk Score = 0 to 2</p> <p style="text-align: center;"><b>Routine Fire Protocol</b></p>	<p style="color: red; text-align: center;">High Risk Score = 3</p> <p style="text-align: center;"><b>High Risk Fire Protocol</b></p>	<p style="text-align: center;"><b>Head–Neck–Upper Chest Fire Protocol</b></p>
<ul style="list-style-type: none"> <li>○ Check all electrical equipment before use</li> <li>○ Avoid using flammable prep solutions</li> <li>○ Ensure that all flammable prepping solutions are completely dry and fumes have dissipated (minimum of 3 min.) before applying surgical drapes.</li> <li>○ Do not allow prep solutions to pool on, around, or beneath the patient.</li> <li>○ Close open bottles of flammable agents and remove all bowls of volatile solutions from the sterile field as soon as possible after use.</li> <li>○ Assess the flammability of all materials used in, on, or around the patient.</li> <li>○ Utilize standard draping procedure.</li> <li>○ Protect all heat sources when not in use (cautery pencil holster, etc).</li> <li>○ Activate heat source only when active tip is in line of sight.</li> <li>○ Deactivate the unit before tip leaves the surgical site.</li> <li>○ Properly position multiple foot controls and remove when not in use.</li> </ul>	<ul style="list-style-type: none"> <li>○ All Routine Protocol measures</li> <li>○ Arrange drapes to minimize oxygen buildup underneath</li> <li>○ Consider closed airway circuit</li> <li>○ Consider using Air ONLY</li> <li>○ Start with 30% FiO2</li> <li>○ Keep oxygen concentrations below 30% if this can be safely accomplished.</li> <li>○ Use an adherent incise drape, if possible, to help isolate head, face, neck, and upper-chest incisions from oxygen-enriched atmospheres and from flammable vapors beneath the drapes.</li> <li>○ Check with patient for hairspray and make-up use</li> <li>○ Minimize the cautery setting.</li> <li>○ Use wet sponges as appropriate.</li> <li>○ Have a basin of sterile saline/water and/or bulb syringe readily available for suppression purposes.</li> <li>○ Have a syringe full of saline readily available for anesthesia for procedures within the oral cavity.</li> </ul>	<ul style="list-style-type: none"> <li>○ High Risk protocol measures</li> <li>○ Stop supplemental oxygen at least 1 minute before and during use of cautery / Laser</li> <li>○ Coat facial hair near surgical site with water soluble lubricating jelly</li> <li>○ Inspect drapes for Tenting – avoid Oxygen build up, arrange drapes to diffuse Oxygen away.</li> <li>○ Scavenge excess Oxygen with the use of suction</li> <li>○ For oropharyngeal surgery, use wet sponges-gauzes</li> <li>○ For upper-airway surgery use Laser-resistant Tracheal tubes</li> </ul>

### Fire Risk Assessment Scoring

Yes (1) No (0) – procedure site; is above xyphoid or 12inches form O<sub>2</sub> source

Yes (1) No (0) – Open O<sub>2</sub> source; Face mask or NC used

Yes (1) No (0) - Ignition source; cautery, fiberoptic light.. used

Score = \_\_\_\_\_



# OR FIRE SAFETY 101

## **GOAL:** Prevent OR related fires from happening:

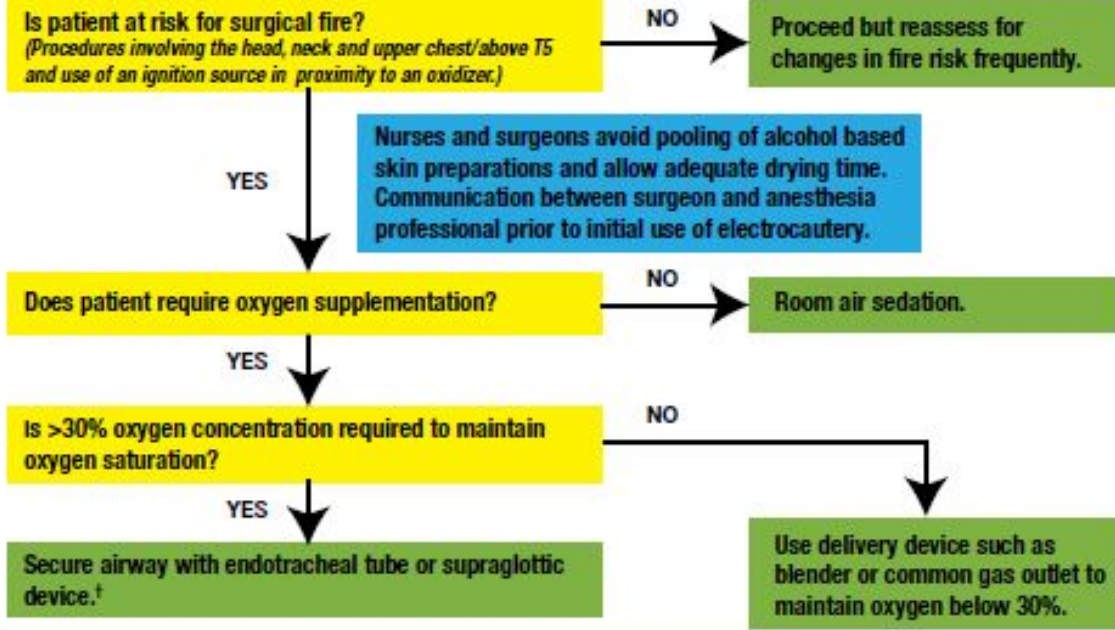
- If open oxygen is running (NC, mask) **ALL OR staff is made aware** - Fire risk is increased
- If case is above the neck or Fire Score is 3 - special fire safety precautions are initiated - Check Fire Risk Protocol for prompts in next slides
- Know where OR ABC fire extinguisher is – use
- know where OR CO<sub>2</sub> fire extinguisher is – USE ON PATIENT when patient is on fire and has an open wound/cavity (does not leave residue)
- know where OR gas panel shut off valves are located (Panel in front of each OR)
- In case of Fire, immediate steps: Shut oxygen flow supply, remove flammable materials from fire site/off patient, use water, assist anesthesia







## Fire Prevention Algorithm\*



† Although securing the airway is preferred, for cases where using a device is undesirable or not feasible, oxygen accumulation may be minimized by air insufflation over the face and open draping to provide wide exposure of the surgical site to the atmosphere.



# ONLY WE CAN PREVENT THE FIRES

## COMMUNICATION



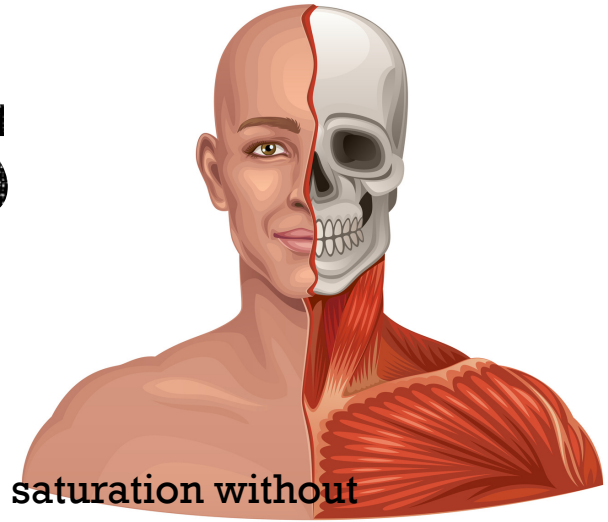
### At the Start of Each Surgery:

- Enriched O<sub>2</sub> and N<sub>2</sub>O atmospheres can vastly increase flammability of drapes, plastics, and hair. Be aware of possible O<sub>2</sub> enrichment under the drapes near the surgical site and in the fenestration, especially during head/face/neck/upper-chest surgery.
- Do not apply drapes until all flammable preps have fully dried; soak up spilled or pooled agent.
- Fiber-optic light sources can start fires: Complete all cable connections before activating the source. Place the source in standby mode when disconnecting cables. Do not allow a lighted end of a light cord to touch drapes/towels.
- Moisten sponges to make them ignition resistant in oropharyngeal and pulmonary surgery.



# ONLY WE CAN PREVENT THE FIRES

## COMMUNICATION



### **During Head, Face, Neck, and Upper-Chest Surgery:**

- Use only air for open delivery to the face if the patient can maintain a safe blood O<sub>2</sub> saturation without supplemental O<sub>2</sub>.
- If the patient cannot maintain a safe blood O<sub>2</sub> saturation without extra O<sub>2</sub>, secure the airway with a laryngeal mask airway or tracheal tube. Exceptions: Where patient verbal responses may be required during surgery (e.g., carotid artery surgery, neurosurgery, pacemaker insertion) and where open O<sub>2</sub> delivery is required to keep the patient safe:
  - At all times, deliver the minimum O<sub>2</sub> concentration necessary for adequate oxygenation.
  - Begin with a 30% delivered O<sub>2</sub> concentration and increase as necessary.
  - For unavoidable open O<sub>2</sub> delivery above 30%, deliver 5 to 10 L/min of air under drapes to wash out excess O<sub>2</sub>.
  - Stop supplemental O<sub>2</sub> at least one minute before and during use of electrosurgery, electrocautery, or laser, if possible. Surgical team communication is essential for this recommendation
  - Use an adherent incise drape, if possible, to help isolate the incision from possible O<sub>2</sub>-enriched atmospheres beneath the drapes
  - Keep fenestration towel edges as far from the incision as possible
  - Arrange drapes to minimize O<sub>2</sub> buildup underneath.
  - Coat head hair and facial hair (e.g., eyebrows, beard, moustache) within the fenestration with water-soluble surgical lubricating jelly to make it nonflammable.
  - For coagulation, use bipolar electrosurgery, not monopolar electrosurgery





# ONLY WE CAN PREVENT THE FIRES

## COMMUNICATION

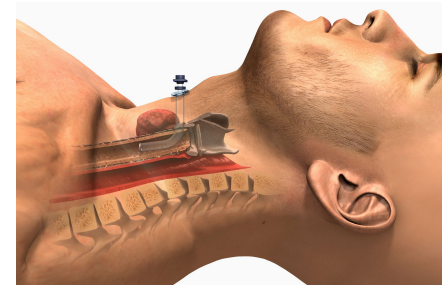


### **During Oropharyngeal Surgery (e.g., tonsillectomy):**

- Scavenge deep within the oropharynx with a metal suction cannula to catch leaking O<sub>2</sub> and N<sub>2</sub>O.
- Moisten gauze or sponges and keep them moist, including those used with uncuffed tracheal tubes.

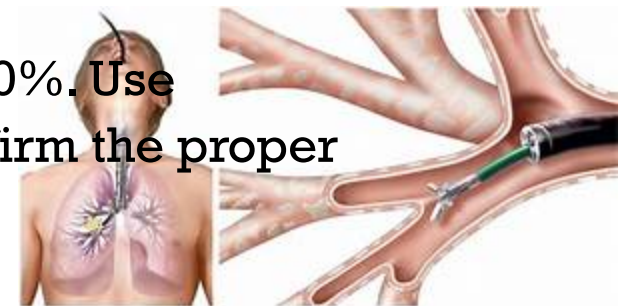
### **During Tracheostomy:**

- Do not use electrosurgery to cut into the trachea



### **During Bronchoscopic Surgery:**

- If the patient requires supplemental O<sub>2</sub>, keep the delivered O<sub>2</sub> below 30%. Use inhalation/exhalation gas monitoring (e.g., with an O<sub>2</sub> analyzer) to confirm the proper concentration.



Flexible Bronchoscopy and Biopsy

# ONLY WE CAN PREVENT THE FIRES

## COMMUNICATION

### **When Using Electrosurgery, Electrocautery, or Laser:**

- The surgeon should be made aware of open O<sub>2</sub> use. Surgical team discussion about preventive measures before use of electrosurgery, electrocautery, and laser is indicated.
- Activate the unit only when the active tip is in view (especially if looking through a microscope or endoscope).
- Deactivate the unit before the tip leaves the surgical site.
- Place electrosurgical electrodes in a holster or another location off the patient when not in active use (i.e., when not needed within the next few moments).
- Place lasers in standby mode when not in active use.
- Do not place rubber catheter sleeves over electrosurgical electrodes.



# IGNITION SOURCES

## RISK STRATEGY MANAGEMENT

### Electrosurgical Unit (ESU):

- Use the lowest possible power setting.
- Place the patient return electrode on a large muscle mass close to the surgical site.
- Large reusable return electrodes should be used according to the manufacturer's instructions.
- Always use a safety holster.
- Do not coil active electrode cords.
- Inspect the active electrode to ensure integrity.
- Do not use ESU in the presence of flammable solutions.
- Ensure that electrical cords and plugs are not frayed or broken.
- Do not place fluids on top of the ESU.
- Do not use the ESU near oxygen or nitrous oxide.
- Ensure that the ESU active electrode tip fits securely into the active electrode hand piece.



# IGNITION SOURCES

## RISK STRATEGY MANAGEMENT

### Electrosurgical Unit (ESU) contd.:

- Ensure that any connectors and adaptors used are intended to connect to the ESU and fit securely.
- Do not bypass ESU safety features.
- Ensure that the alarm tone is always audible.
- Remove any contaminated or unused active accessories from the sterile field.
- Keep the active electrode tip clean.
- Use wet sponges or towels to help retard fire potential.
- Never alter a medical device
- Do not use rubber catheters or protective covers as insulators on the active electrode tip.
- Use cut or blend instead of coagulation when possible.
- Do not open the circuit to activate the ESU.
- Ensure that the active electrode is not activated in close proximity to another metal object that could conduct heat or cause arcing
- After prepping, allow prep to dry and fumes to dissipate. Wet prep and fumes trapped beneath drapes can ignite.



# IGNITION SOURCES

## RISK STRATEGY MANAGEMENT



### Fiber optic Light Sources/Light Cables:

- Ensure that the light source is in good working order
- 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



# IGNITION SOURCES

## RISK STRATEGY MANAGEMENT

### 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



# IGNITION SOURCES

## RISK STRATEGY MANAGEMENT



### 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

### Electrical Equipment:

- Ensure that all equipment is periodically inspected by biomedical personnel for proper function.
- Check biomedical inspection stickers on the equipment; they should be current.
- Do not use equipment with frayed or damaged cords or plugs.
- Remove any equipment that emits smoke during use



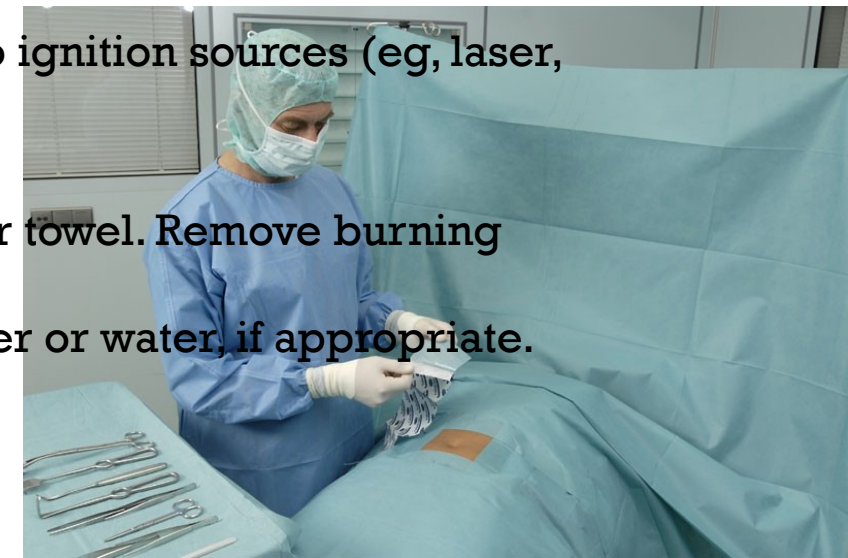
# FUEL SOURCES

## RISK STRATEGY MANAGEMENT



**Patient and staff linens:** (*Drapes Gowns Towels Lap pads Sponges Dressings Tapes Bed linens Caps/hats Shoe covers Collodion, Alcohol-based skin preparations Wound packings*):

- Assess the flammability of all materials used in, on, or around the patient.
- Linens and drapes are made of synthetic or natural fibers. They may burn or melt depending on the fiber content.
- Do not allow drapes or linens to come in contact with activated ignition sources (eg, laser, electrocautery unit [ESU], light sources)
- Do not trap volatile chemicals or chemical fumes beneath drapes
- Moisten drapes, towels, and sponges that will be in close proximity to ignition sources (eg, laser, ESU)
- Ensure that oxygen does not accumulate beneath drapes
- If drapes or linens ignite, smother out small fires with a wet sponge or towel. Remove burning material from the patient.
- Extinguish any burning material with the appropriate fire extinguisher or water, if appropriate.





# FUEL SOURCES

## RISK STRATEGY MANAGEMENT



### **Surgical Prep Solutions:**

- Use flammable prep solutions with caution
- Do not allow prep solutions to pool on, around, or beneath the patient.
- After prepping, allow prep to dry and fumes to dissipate. Wet prep and fumes trapped beneath drapes can ignite.
- Do not activate ignition sources in the presence of flammable prep solutions.
- Do not allow drapes that will remain in contact with the patient to absorb flammable prep solutions

### **Skin degreasers, tinctures, aerosols:**

- 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



# FUEL SOURCES

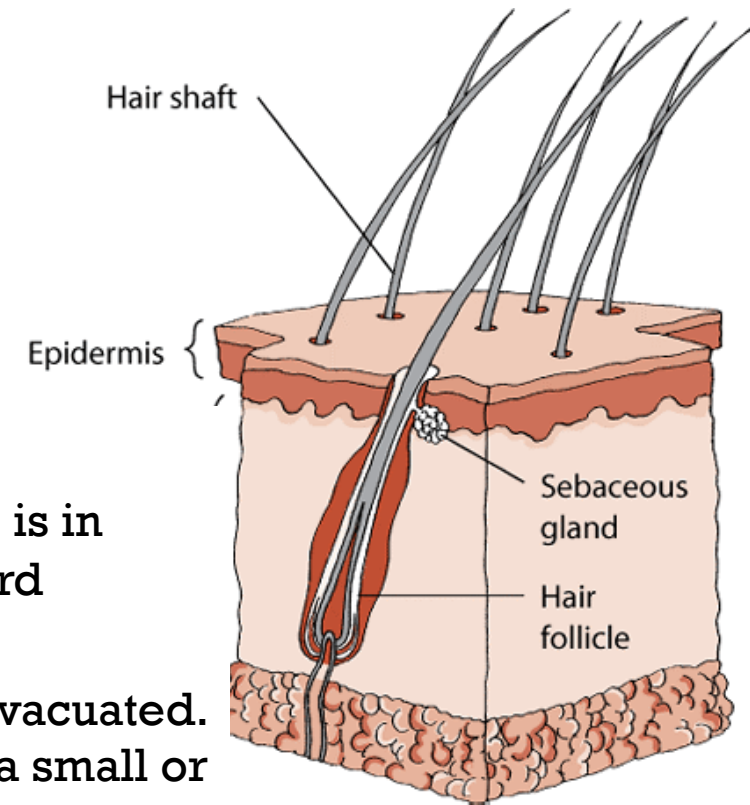
## RISK STRATEGY MANAGEMENT

### Body tissue and patient hair:

- 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)

### Intestinal gases:

- 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.

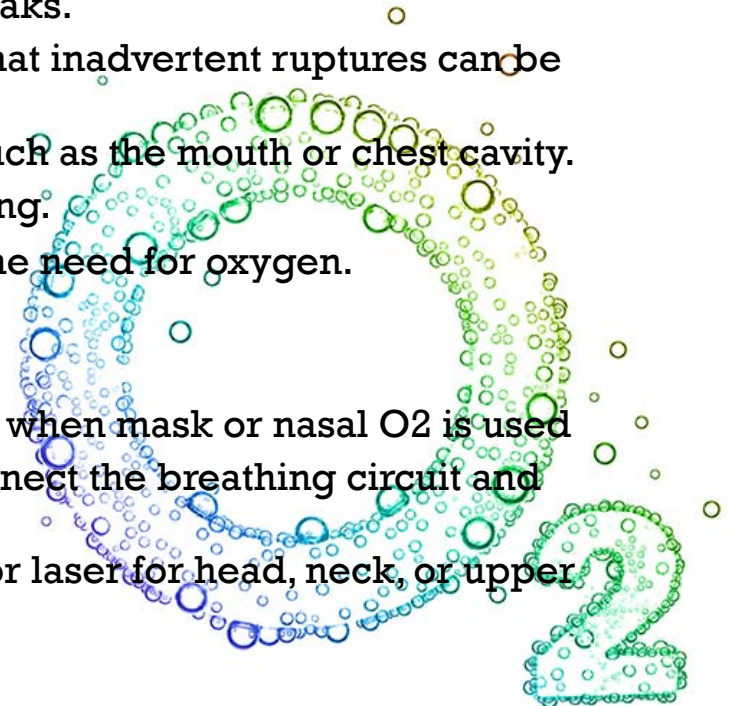


# OXIDIZER SOURCES

## RISK STRATEGY MANAGEMENT

### Oxygen:

- Oxygen should be used with caution in the presence of ignition sources. Oxygen is an oxidizer and is capable of supporting combustion
- 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 O<sub>2</sub> in body cavities, such as the mouth or chest cavity.
- Do not use the laser or electrosurgical unit (ESU) near where O<sub>2</sub> is flowing.
- Use a pulse oximeter to determine the patient's oxygenation level and the need for oxygen.
- Allow O<sub>2</sub> fumes to dissipate before using the laser or ESU.
- O<sub>2</sub> should not be directed at the surgical site
- Ensure that drapes are configured to help prevent oxygen accumulation when mask or nasal O<sub>2</sub> is used
- With a large fire turn off the gases, with an airway or tracheal fire disconnect the breathing circuit and remove the endotracheal tube
- Stop supplemental oxygen for one minute before using electrocautery or laser for head, neck, or upper chest procedures



# OXIDIZER SOURCES

## RISK STRATEGY MANAGEMENT

### Nitrous Oxide:

- The strategies to manage O<sub>2</sub> also should be used to manage risks associated with nitrous oxide



## FIRE Response in the Operating Room



# IN CASE OF OR FIRE EVACUATION

## STAFF ROLES



### **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.



# IN CASE OF OR FIRE EVACUATION

## STAFF ROLES



### **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;



# IN CASE OF OR FIRE EVACUATION

## STAFF ROLES

- 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.





# IN CASE OF OR FIRE EVACUATION

## STAFF ROLES



### **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. unplug all equipment if the fire is electrical;

