Practice Advisory for the Prevention and Management of Operating Room Fires

An Updated Report by the American Society of Anesthesiologists Task Force on Operating Room Fires

PRACTICE *Advisories* are systematically developed reports that are intended to assist decision-making in areas of patient care. Advisories provide a synthesis and analysis of expert opinion, clinical feasibility data, open-forum commentary, and consensus surveys. Practice Advisories developed by the American Society of Anesthesiologists (ASA) are not intended as standards, guidelines, or absolute requirements, and their use cannot guarantee any specific outcome. They may be adopted, modified, or rejected according to clinical needs and constraints and are not intended to replace local institutional policies.

Practice Advisories are not supported by scientific literature to the same degree as standards or guidelines because of the lack of sufficient numbers of adequately controlled studies. Practice Advisories are subject to periodic update or revision as warranted by the evolution of medical knowledge, technology, and practice.

- What other guideline statements are available on this topic?
  - This Practice Advisory updates the "Practice Advisory for Prevention and Management of Operating Room Fires," adopted by the American Society of Anesthesiologists in 2007 and published in 2008*
- Why was this Advisory developed?
  - In October 2011, the Committee on Standards and Practice Parameters elected to collect new evidence to determine whether recommendations in the existing Practice Advisory were supported by current evidence
- How does this Advisory differ from existing guidelines?
  - New evidence presented includes an updated evaluation of scientific literature. The new findings did not necessitate a change in recommendations
- Why does this Advisory differ from existing guidelines?
  - The American Society of Anesthesiologists Advisory differs from the existing guidelines because it provides updated evidence obtained from recent scientific literature

This document updates the "Practice Advisory for Prevention and Management of Operating Room Fires: A Report by the American Society of Anesthesiologists Task Force on Operating Room Fires," adopted by the ASA in 2007 and published in 2008.*

Methodology

A. Definition of Operating Room Fires, High-risk Procedures, and Operating Room Fire Drills

Fire requires the presence of three components, known as the "fire triad:" (1) an oxidizer, (2) an ignition source, and (3) fuel.

Key Concept

An oxidizer-enriched atmosphere occurs when there is any increase in oxygen concentration above room air level, and/or the presence of any concentration of nitrous oxide.

- *Oxidizers* used in the operating room (OR) are oxygen and nitrous oxide. An oxidizer-enriched atmosphere increases the likelihood and intensity of combustion. An oxidizer-enriched atmosphere commonly exists within closed or semiclosed breathing systems, including the patient's airway. It can also be created locally when the configuration of the drapes and open

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* American Society of Anesthesiologists: Practice advisory for the prevention and management of operating room fires. Anesthesiology 2008; 108:786–801.

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- oxygen sources (*e.g.*, masks, nasal cannula) promote the trapping or pooling of an oxidizer-enriched atmosphere (*i.e.*, oxygen or a mixture of oxygen and nitrous oxide).
- *Ignition* sources include, but are not limited to, electrosurgical or electrocautery devices, lasers, heated probes, drills and burrs, argon beam coagulators, fiberoptic light cables, and defibrillator paddles or pads.

Fuel sources include, but are not limited to, tracheal tubes; sponges; drapes; gauze; alcohol-containing solutions (*e.g.*, certain prepping solutions); solutions containing other volatile compounds such as ether or acetone; oxygen masks; nasal cannulae; the patient's hair; dressings; ointments; gowns; gastrointestinal tract gases; blankets; suction catheters; flexible endoscopes; fiberoptic cable coverings; gloves; and packaging materials.†For this Advisory, OR fires are defined as fires that occur on or near patients who are under anesthesia care, including surgical fires, airway fires, and fires within the airway circuit. A surgical fire is defined as a fire that occurs on or in a patient. An airway fire is a specific type of surgical fire that occurs in a patient's airway. Airway fires may or may not include fire in the attached breathing circuit.

A *high-risk* procedure is defined as one in which an ignition source (*e.g.*, electrosurgery) can come in proximity to an oxidizer-enriched atmosphere (*e.g.*, oxygen and/or nitrous oxide), thereby increasing the risk of fire. Examples of high-risk procedures include, but are not limited to, tonsillectomy, tracheostomy, removal of laryngeal papillomas, cataract or other eye surgery, burr hole surgery, or removal of lesions on the head, neck, or face. When administered in an open system, supplemental oxygen in the OR is defined as a high-risk situation.

An *OR fire drill* is defined as a formal and periodic rehearsal of the OR team's planned response to a fire. In this Advisory, the OR fire drill is characterized as a "formal and periodic rehearsal" to indicate that it takes place during dedicated education time, *not during patient care*. In other words, an OR fire drill is *not the same* as a discussion or plan about fire management that takes place during direct patient care.

B. Purpose

The purposes of this Advisory are to: (1) identify situations conducive to fire, (2) prevent the occurrence of OR fires, (3) reduce adverse outcomes associated with OR fires, and (4) identify the elements of a fire response protocol. Adverse outcomes associated with OR fires may include major or minor burns, inhalation injuries, infection, disfigurement, and death. Related adverse outcomes may include psychological trauma, prolonged hospitalization, delay or cancellation of surgery, additional hospital resource utilization, and liability.

C. Focus

This Advisory focuses on a specific care setting and subset of fires. The specific care setting is any OR or procedure area where anesthesia care is provided. The specific subset is fires that occur on the patient, in the airway, or in the breathing circuit. This Advisory does not address fires away from the patient (*e.g.*, in a trash can), institutional preplanning for fire, or the responses of fire personnel.

D. Application

This Advisory is intended for use by anesthesiologists or other individuals working under the supervision of an anesthesiologist. Because prevention of OR fires requires close collaboration and prompt coordination between anesthesiologists, surgeons, and nurses, some responsibilities are shared among the disciplines. When shared responsibilities are described in this Advisory, the intent is to give the anesthesiologist a starting point for participating in the allocation and understanding of shared responsibilities. The Advisory may also serve as a resource for other physicians and healthcare professionals (*e.g.*, technicians, safety officers, hospital administrators, biomedical engineers, industry representatives).

E. Task Force Members and Consultants

The original Advisory was developed by an ASA-appointed Task Force of nine members. These individuals included four anesthesiologists in private and academic practice from various geographic areas of the United States, an otolaryngologist, a perioperative registered nurse, a professional engineer/fire investigator, and two consulting methodologists from the ASA Committee on Standards and Practice Parameters.

The Task Force developed the original Advisory by means of a seven-step process. First, consensus was reached on the criteria for evidence of effective perioperative interventions for the prevention and management of OR fires. Second, original published articles relevant to OR fires were evaluated. Third, a panel of expert consultants was asked to: (1) participate in opinion surveys on the effectiveness of various strategies for fire prevention, detection, and management, and (2) review and comment on a draft of the Advisory developed by the Task Force. Fourth, opinions about the Advisory were solicited from a random sample of active members of the ASA. Fifth, the Task Force held an open-forum at a major national meeting‡ to solicit input on its draft recommendations. Sixth, the consultants were surveyed to assess their opinions on the feasibility of implementing this Advisory. Seventh, all available information was used to build consensus within the Task Force to create the final document. A summary of recommendations may be found in appendix 1.

† Some of these items only burn in an oxidizer-enriched atmosphere.
‡ Society for Ambulatory Anesthesia, 22nd Annual Meeting; San Diego, California, May 5, 2007.

F. Availability and Strength of Evidence

Preparation of this update used the same methodological process as was used in the original Advisory to evaluate literature-based evidence. Opinion-based evidence obtained from the original Advisory is reported in this update. The protocol for reporting each source of evidence is described below.

Scientific Evidence

Scientific evidence used in the development of this updated Advisory is based on findings from literature published since the original Advisory was approved in 2007. Literature citations are obtained from PubMed and other healthcare databases, direct Internet searches, Task Force members, liaisons with other organizations, and from hand searches of references located in reviewed articles.

Findings from the aggregated literature are reported in the text of the Advisory by evidence category, level, and direction. Evidence categories refer specifically to the strength and quality of the *research design* of the studies. Category A evidence represents results obtained from randomized controlled trials (RCTs), and Category B evidence represents observational results obtained from nonrandomized study designs or RCTs without pertinent controls. When available, Category A evidence is given precedence over Category B evidence in the reporting of results. These evidence categories are further divided into evidence levels. Evidence levels refer specifically to the strength and quality of the summarized study *findings* (*i.e.*, statistical findings, type of data, and the number of studies reporting/replicating the findings) within the two evidence categories. For this document, only the highest level of evidence is included in the summary report for each intervention. Finally, a directional designation of benefit, harm, or equivocality for each outcome is indicated in the summary report.

Category A

RCTs report comparative findings between clinical interventions for specified outcomes. Statistically significant ($P <$ 0.01) outcomes are designated as beneficial (B) or harmful (H) for the patient; statistically nonsignificant findings are designated as equivocal (E).

Level 1: The literature contains a sufficient number of RCTs to conduct meta-analysis, and meta-analytic findings from these aggregated studies are reported as evidence.§

Level 2: The literature contains multiple RCTs, but the number of RCTs is not sufficient to conduct a viable meta-analysis for the purpose of this Advisory. Findings from these RCTs are reported as evidence.

Level 3: The literature contains a single RCT, and findings from this study are reported as evidence.

Category B

Observational studies or RCTs without pertinent comparison groups may permit *inference* of beneficial or harmful relationships among clinical interventions and outcomes. Inferred findings are given a directional designation of beneficial (B), harmful (H), or equivocal (E). For studies that report statistical findings, the threshold for significance is $P < 0.01$.

Level 1: The literature contains observational comparisons (*e.g.*, cohort, case–control research designs) between clinical interventions for a specified outcome.

Level 2: The literature contains observational studies with associative statistics (*e.g.*, relative risk, correlation, sensitivity/specificity).

Level 3: The literature contains noncomparative observational studies with descriptive statistics (*e.g.*, frequencies, percentages).

Level 4: The literature contains case reports.

Insufficient Evidence

The *lack* of sufficient scientific evidence in the literature may occur when the evidence is either unavailable (*i.e.*, no pertinent studies found) or inadequate. Inadequate literature cannot be used to assess relationships among clinical interventions and outcomes, since such literature does not permit a clear interpretation of findings due to methodological concerns (*e.g.*, confounding in study design or implementation) or does not meet the criteria for content as defined in the "Focus" of the Advisory.

Opinion-based Evidence

All opinion-based evidence relevant to each topic (*e.g.*, survey data, open-forum testimony, Web-based comments, letters, editorials) is considered in the development of this Advisory. However, only the findings obtained from formal surveys are reported.

Category A: Expert Opinion

Survey findings from Task Force–appointed expert consultants obtained during development of the original Advisory are summarized in the text and reported in appendix 2, table 2.

Category B: Membership Opinion

Survey findings from a random sample of active ASA members obtained during development of the original Advisory are summarized in the text and reported in appendix 2, table 3.

Survey responses from expert and membership sources are recorded using a five-point scale and summarized based on median values.‖

§ Practice Advisories lack the support of a sufficient number of adequately controlled studies required to conduct an appropriate meta-analysis. Therefore, Category A1 evidence is not reported in this document.

‖ When an equal number of categorically distinct responses are obtained, the median value is determined by calculating the arithmetic mean of the two middle values. Ties are calculated by a predetermined formula.

Strongly Agree: Median score of 5 (At least 50% of the responses are 5)

Agree: Median score of 4 (At least 50% of the responses are 4 or 4 and 5)

Equivocal: Median score of 3 (At least 50% of the responses are 3, or no other response category or combination of similar categories contain at least 50% of the responses)

Disagree: Median score of 2 (At least 50% of responses are 2 or 1 and 2)

Strongly Disagree: Median score of 1 (At least 50% of responses are 1)

Category C: Informal Opinion

Open-forum testimony during the development of the original Advisory, Internet-based comments, letters, and editorials are all informally evaluated and discussed during the formulation of Advisory statements. When warranted, the Task Force may add educational information or cautionary notes based on this information.

Advisories

I. Education

OR fire safety education includes, but is not limited to, knowledge of institutional fire safety protocols and participation in institutional fire safety education. Case reports indicate that lack of education can result in severe injury and death from uncontrolled OR fire.[1,2] (*Category B4-B evidence*)

The consultants and ASA members strongly agree that every anesthesiologist should have knowledge of institutional fire safety protocols for the OR and should participate in OR fire safety education. The consultants and ASA members strongly agree that OR fire safety education for the anesthesiologist should emphasize the risk created by an oxidizer-enriched atmosphere.

Advisory for Education. All anesthesiologists should have fire safety education, specifically for OR fires, with emphasis on the risk created by an oxidizer-enriched atmosphere.

II. OR Fire Drills

A case report indicates that OR fire drills and simulation training can result in improved staff response to a fire.[3] (*Category B4-B evidence*)

The consultants strongly agree and ASA members agree that all anesthesiologists should periodically participate in OR fire drills with the entire OR team. The consultants and ASA members strongly agree that participation should take place during dedicated educational time, not during patient care.

Advisory for OR Fire Drills. Anesthesiologists should periodically participate in OR fire drills with the entire OR team. This formal rehearsal should take place during dedicated educational time, not during patient care.

III. Preparation

Preparation for OR fires includes (1) determining whether a high-risk situation exists and (2) a team discussion of the strategy for the prevention and management of an OR fire in a high-risk situation. The literature is insufficient regarding whether a preoperative determination of a high-risk situation or a team discussion of OR fire strategy reduces the incidence or severity of an OR fire.

The consultants strongly agree and ASA members agree that anesthesiologists should participate with the entire OR team in assessing the risk of an OR fire for each case and determining whether a high-risk situation exists. The consultants strongly agree and ASA members agree that all team members should jointly agree on how a fire will be prevented and managed for each particular procedure. The consultants and ASA members strongly agree that a protocol for the prevention and management of fires should be posted in each location where a procedure is performed.

Advisory for Preparation. For every case, the anesthesiologist should participate with the entire OR team (*e.g.*, during the surgical pause) in determining whether a high-risk situation exists. If a high-risk situation exists, all team members—including the anesthesiologist—should take a joint and active role in agreeing on how a fire will be prevented and managed. Each team member should be assigned a specific fire management task to perform in the event of a fire (*e.g.*, removing the tracheal tube, stopping the flow of airway gases). Each team member should understand that his or her preassigned task should be performed immediately if a fire occurs, without waiting for another team member to take action. When a team member has completed a preassigned task, he or she should help other team members perform tasks that are not yet complete.

In every OR and procedure area where a fire triad can coexist (*i.e.*, an oxidizer-enriched atmosphere, an ignition source, and fuel), an easily visible protocol for the prevention and management of fires should be displayed (fig. 1).

Equipment for managing a fire should be readily available in every procedural area where a fire triad may exist. Table 1 provides an example of fire management equipment that should be in or near the OR or procedural area.

IV. Prevention of OR Fires

Prevention of OR fires includes (1) minimizing or avoiding an oxidizer-enriched atmosphere near the surgical site, (2) safely managing ignition sources, and (3) safely managing fuels.

Minimizing or Avoiding an Oxidizer-enriched Atmosphere Near the Surgical Site. Nonrandomized comparative studies indicate that a wide range of material ignites more readily in an oxygen-enriched atmosphere than in room air (*Category B1-H evidence*).[4–8] Case reports indicate that improper drape configuration can lead to OR fires resulting in serious patient injury (*Category B4-H evidence*).[9–13] One nonrandomized comparative study with awake volunteer subjects showed that an open configuration of surgical drapes can result in reduced oxygen buildup, decreasing the risk of fire (*Category B1-B evidence*).[14] This study also indicated that replacing oxygen with compressed air or discontinuing supplemental oxygen for a period of time reduces oxygen buildup without significantly reducing patient oxygen saturation levels. Similarly, one RCT reported no differences in patient oxygen saturation when compressed air is compared with supplemental oxygen for sedated patients (*Category A3-E evidence*).[15] A laboratory report indicates that lower concentrations of oxygen administered to patients increases the time to ignition of surgical drapes (*Category B1-B evidence*).[16] A case report indicates that leakage around an uncuffed tracheal tube resulted in an electrocautery-induced fire (*Category B4-H evidence*).[17] The literature is insufficient to evaluate whether avoidance of nitrous oxide for *high-risk* procedures, insufflating with room air, or scavenging with suction in or around the airway affects the risk of OR fires.

Safely Managing Ignition Sources. Case reports indicate that electrocautery or electrosurgical devices and lasers are common sources of ignition for many OR fires, particularly when used in an oxidizer-enriched atmosphere (*Category B4-H evidence*).[2,9,11,13,18–71] A case report indicated that an OR fire occurred during oxygen administration by mask when the anesthesiologist was not informed of the impending use of electrocautery (*Category B4-H evidence*).[72]

Safely Managing Fuels. Case reports indicate that alcohol-based skin-prepping agents generate volatile vapors that ignite easily, suggesting that insufficient drying time after application of alcohol-based skin-prepping agents is a cause of fires on patients (*Category B4-H evidence*).[11,73–79] Observational comparative studies show that laser-resistant tracheal tubes, when exposed to a laser beam, are less likely to ignite or melt than conventional tracheal tubes (*Category B1-B evidence*).[80–91] Case reports indicate that dry sponges and gauze are common sources of fuel (*Category B4-H evidence*).[2,21,35,38,46,48,57,66,68,92] Observational comparative studies demonstrate that the flammability of sponges, cottonoids, or packing material is reduced when wet rather than dry or partially dry.[93–96] (*Category B1-B evidence*)

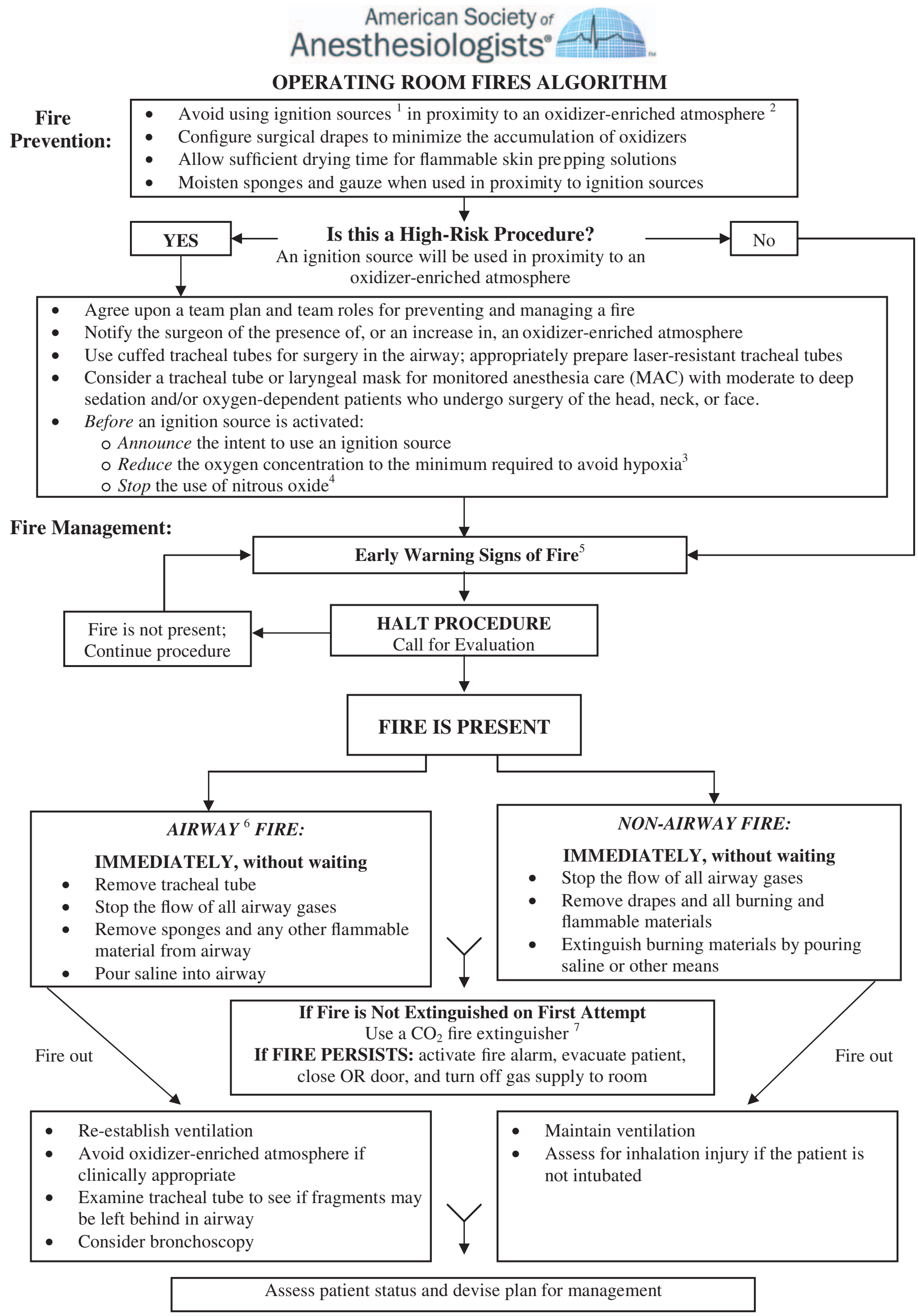
For *all procedures*, the consultants and ASA members strongly agree that flammable skin-prepping solutions should be dry before draping. They strongly agree that surgical drapes should be configured to prevent oxygen from accumulating under the drapes or from flowing into the surgical site. They strongly agree that sponges should be moistened when used near an ignition source, particularly when used in or near the airway.

For *high-risk procedures* (*i.e.*, proximity of an ignition source and an oxidizer-enriched atmosphere), the consultants and ASA members strongly agree that anesthesiologists should collaborate with the procedure team for the purpose of preventing and managing a fire. They strongly agree that the surgeon should be notified whenever an ignition source is in proximity to an oxidizer-enriched atmosphere, or when the concentration of oxidizer has increased. They strongly agree that the F_{IO_2} (delivered to the patient) should be kept as low as clinically feasible when an ignition source is in proximity to an oxygen-enriched atmosphere. They strongly agree that the reduction of F_{IO_2} (delivered to the patient) should be guided by monitoring patient oxygenation (*e.g.*, pulse oximetry). Task Force members agree that the reduction of F_{IO_2} should be monitored, if feasible, by measuring inspired, expired, and/or delivered oxygen concentration. They strongly agree that the use of nitrous oxide should be avoided in settings that are considered high risk for fire. The consultants strongly agree and ASA members agree that oxygen or nitrous oxide buildup may be minimized by either insufflating with medical air or scavenging the operating field with suction.

For *laser surgery*, consultants and ASA members strongly agree that laser resistant tracheal tubes should be used, and that the tube choice should be appropriate for the procedure and laser. They both strongly agree that the tracheal cuff of the laser tube should be filled with saline rather than air, when feasible. The consultants strongly agree and the ASA members agree that saline in tracheal tube cuff should be tinted with methylene blue to act as a marker for cuff puncture by a laser.

Surgery inside the airway can bring an ignition source into close proximity with an oxidizer-enriched atmosphere, thereby creating a high-risk situation. For cases involving surgery inside the airway, consultants and ASA members both agree that a cuffed tracheal tube should be used instead of an uncuffed tracheal tube when medically appropriate. Because an increased F_{IO_2} is often necessary during tracheostomy, the Task Force strongly agrees that surgeons should be advised not to enter the trachea with an ignition source such as an electrosurgical device. If an electrosurgical device must be used, the anesthesiologist should request that the surgeon provide adequate warning to allow the concentration of oxidizer to be minimized before the trachea is entered. Consultants and ASA members were asked to report the time that they believe is needed to reduce oxygen or nitrous oxide concentration to a safe level before using an ignition source. For patients being ventilated with a tracheal tube, consultants report a range of time of less than 1–5 min (average = 1.8 min), and ASA members report a range of time of less than 1–10 min (average = 2.9 min). For patients wearing *a face mask or nasal cannula*, both the consultants and ASA members report a range of time of less than 1–5 min (average = 1.7 min for consultants, and average = 2.3 min for ASA members). The consultants and ASA members both agree that the oropharynx should be scavenged with suction during oral procedures.

Surgery around the face, head, or neck can bring an ignition source into close proximity with an oxidizer-enriched atmosphere, thereby creating a high-risk situation. When monitored anesthesia care is considered for surgery around the face, head, or neck, the Task Force strongly agrees that two specific factors should be considered: (1) the *required depth*



1 Ignition sources include but are not limited to electrosurgery or electrocautery units and lasers.
2 An oxidizer-enriched atmosphere occurs when there is any increase in oxygen concentration above room air level, and/or the presence of any concentration of nitrous oxide.
3 After minimizing delivered oxygen, wait a period of time (*e.g.,* 1-3 min) before using an ignition source. For oxygen dependent patients, *reduce* supplemental oxygen delivery to the minimum required to avoid hypoxia. Monitor oxygenation with pulse oximetry, and if feasible, inspired, exhaled, and/or delivered oxygen concentration.
4 After stopping the delivery of nitrous oxide, wait a period of time (*e.g.,* 1-3 min) before using an ignition source.
5 Unexpected flash, flame, smoke or heat, unusual sounds (*e.g.,* a "pop," snap or "foomp") or odors, unexpected movement of drapes, discoloration of drapes or breathing circuit, unexpected patient movement or complaint.
6 In this algorithm, airway fire refers to a fire in the airway or breathing circuit.
7 A CO_2 fire extinguisher may be used on the patient if necessary.

Fig. 1. Operating room fires algorithm.

of sedation and (2) *oxygen dependence*. The Task Force agrees that a sealed gas delivery device (*e.g.*, cuffed tracheal tube or laryngeal mask) should be considered *if moderate or deep sedation is required or used, or if the patient exhibits oxygen dependence.* If neither factor is present, an open gas delivery device (*e.g.*, face mask or nasal cannula) may be considered. If an open gas delivery system is used, the Task Force agrees that before an ignition source is activated around the face, head, or neck, the surgeon should give the adequate notice that the ignition source will be activated. The anesthesiologist should: (1) *stop* the delivery of supplemental oxygen or *reduce* the delivery to the minimum required to avoid hypoxia and (2) *wait* a few minutes between decreasing the flow of supplemental oxygen and approving the activation of the ignition source. In the unlikely event of nitrous oxide delivery with an open system (*e.g.*, face mask or nasal cannula), the Task Force agrees that the anesthesiologist should (1) *stop* the delivery of nitrous oxide and (2) *wait* a few minutes between stopping the nitrous oxide and approving the activation of the ignition source.

Advisory for Prevention of OR Fires. To the extent that is medically appropriate, the following basic principles should be applied to the management of oxidizers, ignition sources, and fuels:

- The anesthesiologist should collaborate with all members of the procedure team *throughout the procedure* to minimize the presence of an oxidizer-enriched atmosphere in proximity to an ignition source.#
- Surgical drapes should be configured to minimize the accumulation of oxidizers (oxygen and nitrous oxide) under the drapes and from flowing into the surgical site.
- Flammable skin-prepping solutions should be dry before draping.
- Gauze and sponges should be moistened when used in proximity to an ignition source.

For *high-risk* procedures, the anesthesiologist should notify the surgeon whenever there is a potential for an ignition source to be in proximity to an oxidizer-enriched atmosphere, or when there is an increase in oxidizer concentration at the surgical site. Any reduction in supplied oxygen to the patient should be assessed by monitoring (1) pulse oximetry and, if feasible, (2) inspired, exhaled, and/or delivered oxygen concentration.

For *laser procedures,* a laser-resistant tracheal tube should be used, and the tube should be chosen to be resistant to the laser used for the procedure (*e.g.*, carbon dioxide, Nd:YAG, Ar, Er:YAG, KTP). The tracheal cuff of the laser tube should be filled with saline and colored with an indicator dye such as methylene blue. *Before* activating a laser, the surgeon should give the anesthesiologist adequate notice that the ignition source is about to be activated. The anesthesiologist should (1) *reduce* the delivered oxygen concentration to the minimum required to avoid hypoxia, (2) *stop* the use of nitrous oxide, and (3) *wait* a few minutes after reducing the oxidizer-enriched atmosphere before approving activation of the laser.

For cases involving an *ignition source* and *surgery inside the airway,* cuffed tracheal tubes should be used when clinically appropriate. The anesthesiologist should advise the surgeon against entering the trachea with an ignition source (*e.g.*, electrosurgery unit). *Before* activating an ignition source inside the airway, the surgeon should give the anesthesiologist adequate notice that the ignition source is about to be activated. The anesthesiologist should (1) *reduce* the delivered oxygen concentration to the minimum required to avoid hypoxia, (2) *stop* the use of nitrous oxide, and (3) *wait* a few minutes after reducing the oxidizer-enriched atmosphere before approving the activation of the ignition source. In some cases (*e.g.*, surgery in the oropharynx), scavenging with suction may be used to reduce oxidizer enrichment in the operative field.

For cases involving *moderate or deep sedation*, *an ignition source, and surgery around the face, head, or neck*, the anesthesiologist and surgeon should develop a plan that accounts for the level of sedation and the patient's need for supplemental oxygen.

- If *moderate or deep sedation is required or used*, or if the patient exhibits *oxygen dependence*, the anesthesiologist and surgeon should consider a sealed gas delivery device (*e.g.*, cuffed tracheal tube or laryngeal mask).**
- If *moderate or deep sedation is not required*, and the patient does *not exhibit oxygen dependence*, an open gas delivery device (*e.g.*, face mask or nasal cannula) may be considered.†† Before activating an ignition source around the face, head, or neck, the surgeon should give the anesthesiologist adequate notice that the ignition source is about to be activated. The anesthesiologist should (1) *stop* the delivery of supplemental oxygen or *reduce* the delivered oxygen concentration to the minimum required to avoid hypoxia and (2) *wait* a few minutes after reducing the oxidizer-enriched atmosphere before approving the activation of the ignition source.

Note: When administered in an open system, supplemental oxygen creates a high-risk situation in the OR (see "Definition" section above). When it is necessary to administer supplemental oxygen to treat decreasing oxygen saturation, a sealed-gas delivery system will reduce the risk of ignition. Routine delivery of supplemental oxygen in an open system is to be avoided.

** The Task Force recognizes that exceptions may occur when patient verbal responses are required during surgery (*e.g.*, carotid artery surgery, neurosurgery, pacemaker insertion) or when open oxygen delivery is required to keep the patient safe.

†† If a patient is not oxygen dependent and can maintain a safe blood oxygen saturation level, only room air is likely necessary for open gas delivery.

V. Management of OR Fires

Management of OR fires includes (1) recognizing the early signs of fire, (2) halting the procedure, (3) making appropriate attempts to extinguish the fire, (4) following an evacuation protocol when medically appropriate, and (5) delivering postfire care to the patient.

Case reports indicate that early signs of a fire may include a flame or flash, unusual sounds, odors, smoke, or heat (*Category B4-H evidence*).[11,17,23,24,44,45,49,55,64,78,79,97–105] Case reports indicate that removing the tracheal tube and stopping the flow of oxygen can minimize patient injury (*Category B4-B evidence*).[45,55,106,107] A case report demonstrated that pouring saline into the patient's tracheal tube was effective in extinguishing the fire (*Category B4-B evidence*).[31] One case of a patient death from an OR fire indicated that fire extinguishers were available but not used by the OR staff on the patient (*Category B4-H evidence*).[2] A case report of a nonairway fire indicates that removing the drapes and all flammable and burning materials from the patient reduces burn injury (*Category B4-B evidence*).[108]

When early warning signs of a fire are noted, the consultants and ASA members strongly agree that there should be an immediate halt to the procedure. When a fire is definitely present, the consultants and ASA members strongly agree that there should be an immediate announcement of fire, followed by an immediate halt to the procedure.

For a fire in the *airway or breathing circuit,* the consultants and ASA members strongly agree that, as quickly as possible, the tracheal tube should be removed and all flammable and burning materials should be removed from the airway. The consultants strongly agree and ASA members agree that the delivery of all airway gases should stop, and they both agree that saline should be poured into the patient's airway to extinguish any residual embers and cool the tissues.

For a fire *elsewhere on or in the patient,* the consultants agree and ASA members are equivocal regarding whether the delivery of all airway gases should stop. They both strongly agree that all burning and flammable materials (including all drapes) should be removed from the patient, and that all burning materials in, on, or around the patient should be extinguished (*e.g.*, with saline, water, or a fire extinguisher).

Seventy-one percent of the consultants and 77% of the ASA members indicated that the preferred means for safely responding to an OR fire is for each team member to immediately perform a fire management task *in a predetermined sequence*. Twenty-nine percent of the consultants and 23% of the ASA members indicated that the preferred means of safely responding to an OR fire is for each team member to immediately perform a preassigned task, *without waiting* for others to act. The Task Force believes that a predetermined sequence of tasks can be attempted when a fire occurs, but that *team members should not wait for each other if there are impediments to following the predetermined sequence of tasks in a rapid manner.* The Task Force agrees that a team member who has completed a preassigned task may assist another team member whose task is not yet complete.

If the first attempt to extinguish the fire in, on, or around the patient is not successful, the consultants and ASA members both agree that a carbon dioxide fire extinguisher should be used. If fire persists after use of a carbon dioxide fire extinguisher, consultants and ASA members both strongly agree that the fire alarm should be activated and the patient should be evacuated, if feasible. The consultants and ASA members both agree that the door to the room should be closed and not reopened. The consultants strongly agree and the ASA members agree that the medical gas supply to the room should be turned off after evacuation.

The consultants and ASA members strongly agree that after a fire has been extinguished, the patient's status should be assessed and a plan devised for ongoing care of the patient. When an *airway or breathing circuit fire* has been extinguished, consultants and ASA members both agree that ventilation should be reestablished, avoiding supplemental oxygen and nitrous oxide, if possible. Both the consultants and ASA members strongly agree that the tracheal tube should be examined to assess whether fragments have been left behind in the airway. The consultants strongly agree and ASA members agree that rigid bronchoscopy should be considered to assess thermal injury, look for tracheal tube fragments, and aid in the removal of residual materials. If the fire did not involve the airway and the patient was not intubated before the fire, the consultants and ASA members both strongly agree that the patient should be assessed for injury related to smoke inhalation.

Advisory for Management of OR Fires. When an early warning sign is noted, halt the procedure and call for an evaluation of fire. Early signs of a fire may include unusual sounds (*e.g.*, a "pop, snap, or foomp"), unusual odors, unexpected smoke, unexpected heat, unexpected movement of drapes, discoloration of drapes or breathing circuit, unexpected patient movement or complaint, and unexpected flash or flame.

When a fire is definitely present, immediately announce the fire, halt the procedure, and initiate fire management tasks.

Team members should perform their preassigned fire management tasks as quickly as possible. Before the procedure, the team may identify a predetermined order for performing the tasks. If a team member cannot rapidly perform his or her task in the predetermined order, other team members should perform their tasks *without waiting*. When a team member has completed a preassigned task, he or she should help other members perform tasks that are not yet complete.

The following lists are shown in an order that the team may wish to consider in its discussion of a predetermined sequence.

For a fire in the *airway or breathing circuit*, as fast as possible:‡‡

- Remove the tracheal tube.
- Stop the flow of all airway gases.
- Remove all flammable and burning materials from the airway.
- Pour saline or water into the patient's airway.

For a fire *elsewhere on or in the patient*, as fast as possible:

- Stop the flow of all airway gases.
- Remove all drapes, flammable, and burning materials from the patient.
- Extinguish all burning materials in, on, and around the patient (*e.g.*, with saline, water, or smothering).

If the *airway or breathing circuit* fire is extinguished:

- Reestablish ventilation by mask, avoiding supplemental oxygen and nitrous oxide, if possible.
- Extinguish and examine the tracheal tube to assess whether fragments were left in the airway. Consider bronchoscopy (preferably rigid) to look for tracheal tube fragments, assess injury, and remove residual debris.
- Assess the patient's status and devise a plan for ongoing care.

If the fire *elsewhere on or in the patient* is extinguished:

- Assess the patient's status and devise a plan for ongoing care of the patient.
- Assess for smoke inhalation injury if the patient was not intubated.

If the fire is *not* extinguished after the first attempt (*e.g.*, after performing the preassigned tasks):

- Use a carbon dioxide fire extinguisher in, on, or around the patient.
- If the fire persists after use of the carbon dioxide fire extinguisher:
    - Activate the fire alarm.
    - Evacuate the patient, if feasible, following institutional protocols.
    - Close the door to the room to contain the fire and do not reopen it or attempt to reenter the room.
    - Turn off the medical gas supply to the room.

‡‡ Some experts and educators recommend an initial step that involves two simultaneous actions: *removal* of the tracheal tube and *stopping* the flow of medical gases (*e.g.*, by disconnecting the breathing circuit at the Y-piece or the inspiratory gas limb). The intent is to prevent a "blowtorch" effect caused by continued gas flow through a burning tracheal tube. This blowtorch effect can spread fire to other locations on or near the patient and may cause additional burns on the patient or other members of the OR team. The Task Force has carefully considered this concern and agrees that these simultaneous actions represent an ideal response. However, the Task Force is concerned that in actual practice, the simultaneous actions may be difficult to accomplish or may result in delay when one team member waits for another. Therefore, the Task Force recommends that the actions take place as fast as possible.

Follow local regulatory reporting requirements (*e.g.*, report fires to your local fire department and state department of health). Treat every fire as an adverse event, following your institutional protocol.

Appendix 1: Summary of Advisory Statements

I. Education

- All anesthesiologists should have fire safety education, specifically for operating room (OR) fires, with emphasis on the risk created by an oxidizer-enriched atmosphere.

II. OR Fire Drills

- Anesthesiologists should periodically participate in OR fire drills, with the entire OR team. This formal rehearsal should take place during dedicated educational time, not during patient care.

III. Preparation

- For every case, the anesthesiologist should participate with the entire OR team (*e.g.*, during the surgical pause) in assessing and determining whether a high-risk situation exists.
- If a high-risk situation exists, all team members—including the anesthesiologist—should take a joint and active role in agreeing on how a fire will be prevented and managed.
- Each team member should be assigned a specific fire management task to perform in the event of a fire (*e.g.*, removing the tracheal tube, turning off the airway gases).
- Each team member should understand that his or her preassigned task should be performed immediately if a fire occurs, without waiting for another team to take action.
- When a team member has completed a preassigned task, he or she should help other team members to perform tasks that are not yet complete.
- In every operating room and procedure area where a fire triad can coexist (*i.e.*, an oxidizer-enriched atmosphere, an ignition source, and fuel), an easily visible protocol for the prevention and management of fires should be displayed.
- Equipment for managing a fire should be readily available in every procedural location where a fire triad may exist.

IV. Prevention

- The anesthesiologist should collaborate with all members of the procedure team *throughout the procedure* to minimize the presence of an oxidizer-enriched atmosphere in proximity to an ignition source.
- For *all procedures*:
    - Surgical drapes should be configured to minimize the accumulation of oxidizers (oxygen and nitrous oxide) under the drapes and from flowing into the surgical site.
    - Flammable skin-prepping solutions should be dry before draping.

- Gauze and sponges should be moistened before use in proximity to an ignition source.

- For *high-risk* procedures:
  - The anesthesiologist should notify the surgeon whenever there is a potential for an ignition source to be in proximity to an oxidizer-enriched atmosphere or when there is an increase in oxidizer concentration at the surgical site.
  - Any reduction in supplied oxygen to the patient should be assessed by monitoring (1) pulse oximetry and, if feasible, (2) inspired, exhaled, and/or delivered oxygen concentration.
- For *laser procedures*:
  - A laser-resistant tracheal tube should be used.
- The laser-resistant tracheal tube used should be chosen to be resistant to the laser used for the procedure (*e.g.*, carbon dioxide, Nd:YAG, Ar, Er:YAG, KTP).
  - The tracheal cuff of the laser tube should be filled with saline and colored with an indicator dye such as methylene blue.
  - Before activating a laser:
- The surgeon should give the anesthesiologist adequate notice that the laser is about to be activated.
- The anesthesiologist should:
  - *Reduce* the delivered oxygen concentration to the minimum required to avoid hypoxia.
  - *Stop* the use of nitrous oxide.
  - *Wait* a few minutes after reducing the oxidizer-enriched atmosphere before approving activation of the laser.
- For cases involving an *ignition source* and *surgery inside the airway*:
  - Cuffed tracheal tubes should be used when clinically appropriate.
  - The anesthesiologist should advise the surgeon against entering the trachea with an ignition source (*e.g.*, electrosurgery unit).
  - *Before* activating an ignition source inside the airway:
- The surgeon should give the anesthesiologist adequate notice that the ignition source is about to be activated.
- The anesthesiologist should:
  - *Reduce* the delivered oxygen concentration to the minimum required to avoid hypoxia.
  - *Stop* the use of nitrous oxide.
  - *Wait* a few minutes after reducing the oxidizer-enriched atmosphere before approving the activation of the ignition source.
  - In some cases (*e.g.*, surgery in the oropharynx), scavenging with suction may be used to reduce oxidizer enrichment in the operative field
- For cases *involving moderate or deep sedation, an ignition source, and surgery around the face, head, or neck*:
  - The anesthesiologist and surgeon should develop a plan that accounts for the level of sedation and the patient's need for supplemental oxygen.
- If moderate or deep sedation is required or used, or if the patient exhibits oxygen dependence, the anesthesiologist and surgeon should consider a sealed gas delivery device (*e.g.*, cuffed tracheal tube or laryngeal mask).
- If moderate or deep sedation is not required, and the patient does *not exhibit oxygen dependence*, an open gas delivery device (*e.g.*, face mask or nasal cannula) may be considered.
  - *Before* activating an ignition source around the face, head, or neck:
- The surgeon should give the anesthesiologist adequate notice that the ignition source is about to be activated.
- The anesthesiologist should:
  - *Stop* the delivery of supplemental oxygen or *reduce* the delivered oxygen concentration to the minimum required to avoid hypoxia.
  - *Wait* a few minutes after reducing the oxidizer-enriched atmosphere before approving the activation of the ignition source.

V. Management of OR Fires

- When an early warning sign is noted, halt the procedure and call for an evaluation of fire.
- When a fire is definitely present, immediately announce the fire, halt the procedure, and initiate fire management tasks.
- Team members should perform their preassigned fire management tasks as quickly as possible:
  - Before the procedure, the team may identify a predetermined order for performing the tasks.
  - If a team member cannot rapidly perform his or her task in the predetermined order, other team members should perform their tasks without waiting.
  - When a team member has completed a preassigned task, he or she should help other members to perform tasks that are not yet complete.
- For a fire in the *airway or breathing circuit*, as fast as possible:
  - Remove the tracheal tube.
  - Stop the flow of all airway gases.
  - Remove all flammable and burning materials from the airway.
  - Pour saline or water into the patient's airway.
- For a fire *elsewhere on or in the patient*, as fast as possible:
  - Stop the flow of all airway gases.
  - Remove all drapes, flammable, and burning materials from the patient.

- Extinguish all burning materials in, on, and around the patient (*e.g.*, with saline, water, or smothering).

- If the *airway or breathing circuit* fire is extinguished:
  - Reestablish ventilation by mask, avoiding supplemental oxygen and nitrous oxide, if possible.
  - Extinguish and examine the tracheal tube to assess whether fragments were left in the airway.

- Consider bronchoscopy (preferably rigid) to look for tracheal tube fragments, assess injury, and remove residual debris.
  - Assess the patient's status and devise a plan for ongoing care.

- If the fire *elsewhere on or in the patient* is extinguished:
  - Assess the patient's status and devise a plan for ongoing care of the patient.
  - Assess for smoke inhalation injury if the patient was not intubated.

- If the fire is *not* extinguished after the first attempt (*e.g.*, after performing the preassigned tasks):
  - Use a carbon dioxide fire extinguisher in, on, or around the patient.
  - If the fire persists after use of the carbon dioxide fire extinguisher:
  - Activate the fire alarm.
  - Evacuate the patient if feasible, following institutional protocols.
  - Close the door to the room to contain the fire and do not reopen it or attempt to reenter the room.
  - Turn off the medical gas supply to the room.
  - Follow local regulatory reporting requirements (*e.g.*, report fires to your local fire department and state department of health).
  - Treat every fire as an adverse event, following your institutional protocol.

Appendix 2: Methods and Analyses

A. State of the Literature

For this updated Advisory, a review of studies used in the development of the original Advisory was combined with a review of studies published subsequent to approval of the original Advisory. The updated literature review was based on evidence regarding the efficacy of specific perioperative activities associated with the prevention and management of OR fires. The evidence linkage interventions are listed below.§§

Education

Fire safety education, with an emphasis on an oxidizer-enriched atmosphere

OR Fire Drills

Periodic participation in OR fire drills.

Preparation

Display an easily visible protocol for the prevention and management of fires.
Preoperative determination of a high-risk situation.
OR team discussion of OR fire strategy.

Prevention

Minimizing or avoiding an oxidizer-enriched atmosphere near the surgical site.
Configuring surgical drapes to minimize the accumulation of oxidizers.
Reducing the concentration of supplied oxygen for high-risk procedures.
Avoidance of nitrous oxide for *high-risk* procedures.
Insufflating with room (medical) air during cases in or around the airway.
Scavenging with suction during cases in or around the airway.
Cuffed *versus* uncuffed tracheal tubes for cases in or around the airway.

Safely Managing Ignition Sources

Electrocautery
Electrosurgical devices
Lasers

Safely Managing Fuels

Drying of flammable skin-prepping solutions.
Laser-resistant *versus* nonlaser-resistant tracheal tubes during laser surgery.
Moistening of sponges and gauze when used in proximity to an ignition source.
Filling the tracheal cuff of the laser tube with saline colored with an indicator dye.

Management

Early signs of a fire include a flame or flash, unusual sounds, odors, smoke, or heat (observational).
Removing the tracheal tube and stopping the flow of oxygen minimize patient injury after an *airway or breathing circuit* fire.
Pouring saline into the patient's tracheal tube is effective in extinguishing an airway fire.

The updated electronic search covered a 6-yr period from 2007 through 2012. The manual search covered a 10-yr period from 2003 through 2012. Over 100 new citations that addressed topics related to the evidence linkages were identified. These articles were reviewed and combined with pre-2007 articles used in the original Advisory, resulting in a total of 124 articles that contained direct linkage-related evidence.

No evidence linkage contained sufficient literature with well-defined experimental designs and statistical information to conduct an analysis of aggregated studies (*i.e.*, meta-analysis).

§§ Unless otherwise specified, outcomes for the listed interventions refer to the occurrence of fire or adverse sequelae.

A complete bibliography used to develop this updated Advisory, organized by section, is available as Supplemental Digital Content 2, http://links.lww.com/ALN/A905.

In the original Advisory, interobserver agreement among Task Force members and two methodologists was established by interrater reliability testing. Agreement levels using a κ statistic for two-rater agreement pairs were as follows: (1) type of study design, κ = 0.63–0.82; (2) type of analysis, κ = 0.40–0.87; (3) evidence linkage assignment, κ = 0.84–1.00; and (4) literature inclusion for database, κ = 0.69–1.00. Three-rater chance-corrected agreement values were: (1) study design, Sav = 0.69, Var (Sav) = 0.013; (2) type of analysis, Sav = 0.57, Var (Sav) = 0.031; (3) linkage assignment, Sav = 0.89, Var (Sav) = 0.004; and (4) literature database inclusion, Sav = 0.79, Var (Sav) = 0.025. These values represent moderate to high levels of agreement. For the updated Advisory, the same two methodologists involved in the original Advisory conducted the literature review.

B. Consensus-based Evidence

For the original Advisory, consensus was obtained from multiple sources, including: (1) survey opinion from consultants who were selected based on their knowledge or expertise in OR fire prevention and management, (2) survey opinions solicited from a random sample of active members of the American Society of Anesthesiologists, (3) testimony from attendees of a publicly held open-forum at a national anesthesia meeting, (4) Internet commentary, and (5) Task Force opinion and interpretation. The survey rate of return was 52% (n = 38 of 73) for the consultants, and 64 surveys were received from a random sample of active American Society of Anesthesiologists members. Results of the surveys are reported in tables 2 and 3 and in the text of the Advisory.

For the original Advisory, the consultants were asked to indicate which, if any, of the evidence linkages would change their clinical practices if the Advisory was instituted. The rate of return was 18% (n = 13 of 73). The percent of responding consultants expecting a change in their practice associated with each linkage topic were as follows: (1) education = 77%, (2) OR fire drills = 69%, (3) team discussion of fire strategy = 69%, (4) minimizing or avoiding an oxidizer-enriched atmosphere near the surgical site = 38%, (5) managing ignition sources = 38%, (6) managing fuels = 31%, (7) identification of a *high-risk* procedure = 85%, (8) management of a

Table 1. Operating Room Fire Equipment and Supplies That Should be Immediately Available*

Several containers of sterile saline
A carbon dioxide fire extinguisher
Replacement tracheal tubes, guides, face masks
Rigid laryngoscope blades; this may include a rigid fiberoptic laryngoscope
Replacement airway breathing circuits and lines
Replacement drapes, sponges

* Some facilities or locations may benefit from assembling a portable cart containing equipment and supplies that expedite the immediate response to an operating room fire. The contents of such a cart will vary depending on local conditions and resources. If the items needed for an immediate response to an operating room fire are already available, there may be no added benefit to assembling a portable cart.

Table 2. Consultant Survey Responses†

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Education:						
1a. Every anesthesiologist should have knowledge of institutional fire safety protocols for the OR	38	92.1*	7.9	0.0	0.0	0.0
1b. Every anesthesiologist should participate in OR fire safety education	38	81.6*	15.8	2.6	0.0	0.0
1c. OR fire safety education for the anesthesiologist should emphasize the risk of an oxidizer-enriched atmosphere	38	81.6*	18.4	0.0	0.0	0.0
OR fire drills:						
2a. All anesthesiologists should periodically participate in OR fire drills with the entire OR team	38	60.5*	31.6	5.3	2.6	0.0
2b. Participation in an OR fire drill should take place during dedicated educational time, not during patient care	38	50.0*	34.2	5.3	10.5	0.0

(*continued*)

Table 2. (*Continued*)

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Preparation:						
3. Anesthesiologists should participate with the entire OR team in assessing the risk of an OR fire for each case and determining whether a high-risk situation exists	38	57.9*	29.0	2.6	10.5	0.0
4. All team members should agree on how an OR fire will be prevented and managed for each particular procedure	38	60.5*	29.0	7.9	2.6	0.0
5. Hospitals and procedure units should post a protocol for the prevention and management of fires in each location where a procedure is performed	38	50.0*	26.3	18.4	5.3	0.0
Prevention for all procedures:						
6. Flammable skin-prepping solutions should be dry before draping	38	86.8*	13.2	0.0	0.0	0.0
7. Surgical drapes should be configured to prevent oxygen from accumulating under the drapes or from flowing into the surgical site	38	76.3*	18.4	2.6	2.6	0.0
8. Sponges should be moistened, particularly when used in or near the airway	38	63.2*	15.8	21.0	0.0	0.0
Prevention for high-risk procedures‡:						
9. Anesthesiologists should collaborate with the procedure team for the purpose of preventing and managing a fire	38	84.2*	15.8	0.0	0.0	0.0
10. The surgeon should be notified of an increase in or the presence of an oxidizer-enriched atmosphere in which an ignition source will be used	38	84.2*	15.8	0.0	0.0	0.0
11a. Oxygen levels should be kept as low as clinically feasible while the ignition source is in proximity to the oxygen-enriched atmosphere	38	81.6*	13.2	2.6	0.0	2.6
11b. The reduction of F_{IO_2} should be guided by monitoring patient oxygenation	38	86.8*	7.9	5.3	0.0	0.0
12. The use of nitrous oxide should be avoided in settings that are considered high risk for OR fire	38	52.6*	26.3	15.8	5.3	0.0
13. Oxygen or nitrous oxide buildup may be minimized by either insufflating with room air or scavenging the operating field with suction	38	50.0*	36.8	10.5	2.6	0.0
Prevention during cases in or around the airway:						
14. Cuffed tracheal tubes should be used instead of uncuffed tracheal tubes	38	39.5	31.6*	23.7	5.2	0.0
15. The oropharynx should be scavenged with suction during oral procedures	38	42.1	23.7*	28.9	5.3	0.0
16. The sufficient amount of time needed to reduce oxygen or nitrous oxide concentrations to a safe level before using an ignition source *in the airway*	mean = 1.76 min		range = 0.25–5 min			
17. The sufficient amount of time needed to reduce oxygen or nitrous oxide concentrations to a safe level before using an ignition source for patients wearing *a face mask or nasal cannula*	mean = 1.67 min		range = 0.15–5 min			

(*continued*)

Table 2. *(Continued)*

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Prevention during laser surgery:						
18. Laser-resistant tracheal tubes appropriate to the procedure and laser should be used	38	68.4*	29.0	2.6	0.0	0.0
19a. Tracheal tube cuffs should be filled with saline rather than air, when feasible	38	71.1*	26.3	2.6	0.0	0.0
19b. Saline in tracheal tube cuffs should be tinted with methylene blue to act as a marker for cuff puncture by a laser	38	50.0*	39.5	10.5	0.0	0.0
Management of operating room fires:						
20. When early warning signs of a fire are noted, the procedure should be halted immediately	38	78.9*	15.8	5.3	0.0	0.0
21. When a fire is definitely present, the fire should be immediately announced and the procedure should halt	38	92.1*	7.9	0.0	0.0	0.0
22. For a fire in the *airway or breathing circuit*:						
a. The tracheal tube should be removed as quickly as possible	38	78.9*	13.2	7.9	0.0	0.0
b. All flammable and burning materials should be removed from the airway as quickly as possible	38	94.7*	5.3	0.0	0.0	0.0
c. The delivery of all airway gases should stop	38	73.7*	18.4	5.3	2.6	0.0
d. Saline should be poured into the patient's airway to extinguish any residual embers and cool the tissues	38	47.4	21.0*	21.0	7.9	2.6
23. For a fire *elsewhere on or in the patient*:						
a. The delivery of all airway gases should stop	38	47.4	13.1*	23.7	15.8	0.0
b. All burning and flammable materials (including all drapes) should be removed from the patient	38	89.5*	10.5	0.0	0.0	0.0
c. All burning materials in, on, and around the patient should be extinguished (*e.g.*, with saline, water, or a fire extinguisher)	38	86.8*	13.2	0.0	0.0	0.0
24. The preferred means of safely responding to an OR fire is:						
a. For each team member to immediately respond without waiting for others to act	Agree = 29%					
b. To immediately initiate a predetermined sequence of responses	Agree = 71%					
25. If the first attempt to extinguish the fire is not successful, a carbon dioxide fire extinguisher should be used	38	39.5	39.5*	13.1	7.9	0.0
26. If the fire persists after use of a carbon dioxide fire extinguisher:						
a. The fire alarm should be activated	38	79.0*	10.5	10.5	0.0	0.0
b. The patient should be evacuated, if feasible	38	60.5*	34.2	5.3	0.0	0.0
c. The door to the room should be closed and not reopened	38	47.4	23.7*	26.3	2.6	0.0
d. The medical gas supply to the room should be turned off	38	60.5*	18.4	21.1	0.0	0.0

(continued)

Table 2. (*Continued*)

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
27. After a fire has been extinguished, the patient's status should be assessed and a plan devised for ongoing care of the patient	38	84.2*	10.5	2.6	0.0	2.6
28. When the *airway or breathing circuit fire* has been extinguished:						
a. Ventilation should be reestablished, avoiding supplemental oxygen and nitrous oxide, if possible	38	47.4	31.6*	10.5	10.5	0.0
b. The tracheal tube should be examined to assess whether fragments may be left behind in the airway	38	81.6*	18.4	0.0	0.0	0.0
c. Rigid bronchoscopy should be considered to assess thermal injury and look for tracheal tube fragments and other residual materials	38	68.4*	23.7	5.3	0.0	2.6
29. If the fire did not involve the airway and the patient was not intubated before the fire, the patient should be assessed for injury related to smoke inhalation	38	60.5*	36.8	2.7	0.0	0.0

* Median; † N = the number of consultants who responded to each item; ‡ a *high-risk* procedure is defined as one in which an ignition source may be in proximity to an oxidizer-enriched atmosphere.

OR = operating room.

Table 3. ASA Member Survey Responses†

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Education:						
1a. Every anesthesiologist should have knowledge of institutional fire safety protocols for the OR	142	74.6*	24.7	0.7	0.0	0.0
1b. Every anesthesiologist should participate in OR fire safety education	142	55.6*	38.7	5.6	0.0	0.0
1c. OR fire safety education for the anesthesiologist should emphasize the risk of an oxidizer-enriched atmosphere	142	73.9*	22.5	3.5	0.0	0.0
OR fire drills:						
2a. All anesthesiologists should periodically participate in OR fire drills with the entire OR team	142	42.3	40.1*	12.0	5.6	0.0
2b. Participation in an OR fire drill should take place during dedicated educational time, not during patient care	142	54.9*	31.0	10.6	2.1	1.4
Preparation:						
3. Anesthesiologists should participate with the entire OR team in assessing the risk of an OR fire for each case and determining whether a high-risk situation exists	142	38.7	45.8*	8.5	3.5	3.5

(*continued*)

Table 3. (*Continued*)

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
4. All team members should agree on how an OR fire will be prevented and managed for each particular procedure	142	39.4	38.0*	13.4	7.8	1.4
5. Hospitals and procedure units should post a protocol for the prevention and management of fires in each location where a procedure is performed	142	51.4*	36.6	8.5	2.8	0.7
Prevention for all procedures:						
6. Flammable skin-prepping solutions should be dry before draping	142	68.3*	21.8	9.2	0.7	0.0
7. Surgical drapes should be configured to prevent oxygen from accumulating under the drapes or from flowing into the surgical site	142	64.8*	28.2	6.3	0.7	0.0
8. Sponges should be moistened, particularly when used in or near the airway	142	63.4*	30.3	5.6	0.7	0.0
Prevention for high-risk‡ procedures:						
9. Anesthesiologists should collaborate with the procedure team for the purpose of preventing and managing a fire	142	67.6*	31.0	1.4	0.0	0.0
10. The surgeon should be notified of an increase in or the presence of an oxidizer-enriched atmosphere in which an ignition source will be used	142	66.2*	29.6	3.5	0.7	0.0
11a. Oxygen levels should be kept as low as clinically feasible while the ignition source is in proximity to the oxygen-enriched atmosphere	142	70.4*	26.1	2.1	1.4	0.0
11b. The reduction of F_{IO_2} should be guided by monitoring patient oxygenation	142	71.8*	24.7	2.8	0.7	0.0
12. The use of nitrous oxide should be avoided in settings that are considered high risk for OR fire	142	50.0*	36.6	9.2	3.5	0.7
13. Oxygen or nitrous oxide buildup may be minimized by either insufflating with room air or scavenging the operating field with suction	142	32.4	43.0*	21.8	2.8	0.0
Prevention during cases in or around the airway:						
14. Cuffed tracheal tubes should be used instead of uncuffed tracheal tubes	142	35.9	43.0*	16.2	4.9	0.0
15. The oropharynx should be scavenged with suction during oral procedures	142	22.5	27.5*	44.4	5.6	0.0

(*continued*)

Table 3. (*Continued*)

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
16. The sufficient amount of time needed to reduce oxygen or nitrous oxide concentrations to a safe level before using an ignition source *in the airway*	Mean = 3.3 min			Range = 0.08–10 min		
17. The sufficient amount of time needed to reduce oxygen or nitrous oxide concentrations to a safe level before using an ignition source for patients wearing *a face mask or nasal cannula*	Mean = 2.8 min			Range = 0.0–10 min		
Prevention during laser surgery:						
18. Laser-resistant tracheal tubes appropriate to the procedure and laser should be used	142	61.3*	35.9	2.8	0.0	0.0
19a. Tracheal tube cuffs should be filled with saline rather than air, when feasible	142	61.3*	33.1	4.9	0.7	0.0
19b. Saline in tracheal tube cuffs should be tinted with methylene blue to act as a marker for cuff puncture by a laser	142	44.4	37.3*	14.1	3.5	0.7
Management of operating room fires:						
20. When early warning signs of a fire are noted, the procedure should be halted immediately	142	78.2*	19.0	2.8	0.0	0.0
21. When a fire is definitely present, the fire should be immediately announced and the procedure should halt	142	85.9*	12.7	1.4	0.0	0.0
22. For a fire in the *airway or breathing circuit*:						
a. The tracheal tube should be removed as quickly as possible	142	59.2*	26.1	8.4	4.2	2.1
b. All flammable and burning materials should be removed from the airway as quickly as possible	142	73.9*	22.5	2.8	0.0	0.7
c. The delivery of all airway gases should stop	142	46.5	20.4*	16.9	14.1	2.1
d. Saline should be poured into the patient's airway to extinguish any residual embers and cool the tissues	142	33.1	29.6*	28.9	7.0	1.4
23. For a fire *elsewhere on or in the patient*:						
a. The delivery of all airway gases should stop	142	14.8	14.8	26.8*	39.4	4.2
b. All burning and flammable materials (including all drapes) should be removed from the patient	142	74.7*	22.5	2.8	0.0	0.0
c. All burning materials in, on, and around the patient should be extinguished (*e.g.*, with saline, water, or a fire extinguisher)	142	73.2*	26.1	0.7	0.0	0.0

(*continued*)

Table 3. (*Continued*)

	N	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
24. The preferred means of safely responding to an OR fire is:						
a. For each team member to immediately respond without waiting for others to act	Agree = 20 %					
b. To immediately initiate a predetermined sequence of responses	Agree = 80 %					
25. If the first attempt to extinguish the fire is not successful, a carbon dioxide fire extinguisher should be used	142	19.7	43.7*	36.6	0.0	0.0
26. If the fire persists after use of a carbon dioxide fire extinguisher:						
a. The fire alarm should be activated	142	58.5*	37.3	4.2	0.0	0.0
b. The patient should be evacuated, if feasible	142	52.1*	36.6	9.9	1.4	0.0
c. The door to the room should be closed and not reopened	142	30.0	28.2*	26.1	6.3	1.4
d. The medical gas supply to the room should be turned off	142	39.4	30.3*	20.4	7.0	2.8
27. After a fire has been extinguished, the patient's status should be assessed and a plan devised for ongoing care of the patient	142	78.2*	20.4	0.7	0.0	0.7
28. When the *airway or breathing circuit fire* has been extinguished:						
a. Ventilation should be re-established, avoiding supplemental oxygen and nitrous oxide, if possible	142	23.9	38.7*	11.3	21.8	4.2
b. The tracheal tube should be examined to assess whether fragments may be left behind in the airway	142	60.6*	38.0	1.4	0.0	0.0
c. Rigid bronchoscopy should be considered to assess thermal injury and look for tracheal tube fragments and other residual materials	142	43.7	39.4*	14.8	2.1	0.0
29. If the fire did not involve the airway and the patient was not intubated before the fire, the patient should be assessed for injury related to smoke inhalation	142	52.1*	42.3	4.2	1.4	0.0

* Median; † N = the number of ASA members who responded to each item; ‡ a *high-risk* procedure is defined as one in which an ignition source may be in proximity to an oxidizer-enriched atmosphere.
ASA = American Society of Anesthesiologists; OR = operating room.

high-risk procedure = 31%, and (9) OR fire management = 77%. Eighty-five percent of the respondents indicated that the Advisory would have *no effect* on the amount of time spent on a typical case, and 15% indicated that there would be an increase of 1–5 min in the amount of time spent on a typical case with the implementation of this Advisory.

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