PRACTICE Guidelines are systematically developed recommendations that assist the practitioner and patient in making decisions about health care. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints, and are not intended to replace local institutional policies. In addition, Practice Guidelines developed by the American Society of Anesthesiologists (ASA) are not intended as standards or absolute requirements, and their use cannot guarantee any specific outcome. Practice Guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide basic recommendations that are supported by a synthesis and analysis of the current literature, expert and practitioner opinion, open forum commentary, and clinical feasibility data.

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** APPROVAL OF THE FINISHED GUIDELINES BY PARTICIPATING ORGANIZATIONS IS PENDING. ORGANIZATIONS CHOOSING TO CO-SPONSOR WILL BE LISTED IN THE TITLE. ORGANIZATIONS CHOOSING TO ENDORSE WILL BE LISTED IN THE SECOND FOOTNOTE ON THIS PAGE.**
This document is a revision of the “Practice Guidelines for Management of the Difficult Airway: A Report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway,” adopted by the ASA in 2012 and published in 2013.1

Methodology

Definition of Difficult Airway

For these Practice Guidelines, a difficult airway includes, but is not limited to the clinical situation in which an anticipated or unanticipated difficulty or failure is experienced with one or more of the following: facemask ventilation, laryngoscopy, ventilation using a supraglottic airway (SGA), tracheal intubation, and extubation. These clinical situations are further defined as follows:

Difficult facemask ventilation - It is not possible to provide adequate ventilation (e.g., confirmed by end-tidal carbon dioxide detection), because of one or more of the following problems: inadequate mask seal, excessive gas leak, or excessive resistance to the ingress or egress of gas.

Difficult laryngoscopy - It is not possible to visualize any portion of the vocal cords after multiple attempts at laryngoscopy.

Difficult supraglottic airway (SGA) ventilation - It is not possible to provide adequate ventilation because of one or more of the following problems: difficult SGA placement, SGA placement requiring multiple attempts, inadequate SGA seal, excessive gas leak, or excessive resistance to the ingress or egress of gas.

Difficult or failed tracheal intubation - Tracheal intubation requires multiple attempts, or tracheal intubation fails after multiple attempts.

Difficult or failed tracheal extubation – The loss of airway patency and adequate ventilation after removal of a tracheal tube from a patient with a known or suspected difficult airway (i.e., an “at risk” extubation).

Inadequate ventilation: Indicators of inadequate ventilation include absent or inadequate exhaled carbon dioxide, absent or inadequate chest movement, absent or inadequate breath sounds, auscultatory signs of severe obstruction, cyanosis, gastric air entry or dilatation, decreasing or inadequate oxygen saturation, absent or inadequate spirometric measures of exhaled gas flow, lung ultrasound, and hemodynamic changes associated with hypoxemia or hypercarbia (e.g., hypertension, tachycardia, bradycardia, arrhythmia).
PRACTICE GUIDELINES FOR DIFFICULT AIRWAY MANAGEMENT

Purposes of the Guidelines

The purposes of these Guidelines are to guide the management of patients with difficult airways, optimize first attempt success of airway management, improve patient safety during airway management and minimize/avoid adverse events. The principal adverse outcomes associated with the difficult airway include (but are not limited to) death, brain injury, cardiopulmonary arrest, airway trauma, and damage to the teeth. The appropriate choice of medications and techniques for anesthesia care and airway management is dependent upon the experience, training, and preference of the individual practitioner, requirements or constraints imposed by associated medical issues of the patient, type of procedure or environment in which airway management takes place. The choice of agents, techniques and devices may be limited by federal, state, or municipal regulations or statutes.

Focus

These Guidelines focus specifically on the management of the difficult airway encountered with mask ventilation, tracheal intubation or SGA placement during procedures requiring general anesthesia, deep sedation, moderate sedation or regional anesthesia, or elective airway management without a procedure. Procedures include diagnostic, elective and emergency procedures, and invasive airway access. Airway management during cardiopulmonary resuscitation is not addressed by these guidelines. The Guidelines are intended for adult and pediatric patients with either anticipated or unanticipated difficult airways, obstetric patients, intensive care (ICU) patients, and critically ill patients. The Guidelines do not address patients at risk of aspiration without anatomically difficult airways, patients where difficult airways are not encountered, or physiologically difficult airways that are not anatomically difficult.††

These Guidelines do not address education, training, or certification requirements for practitioners who provide anesthesia and airway management. Some aspects of the Guidelines may be relevant in other clinical contexts. The Guidelines do not represent an exhaustive consideration of all manifestations of the difficult airway or all possible approaches to management.

†† These include, but are not limited to patients at increased risk for cardiorespiratory deterioration with airway management due to underlying conditions such as hypoxemia, hypotension, severe metabolic acidosis, or right ventricular failure.
Application

These Guidelines are intended for use by anesthesiologists and all other individuals who perform anesthesia care or airway management (e.g., anesthesiologist assistants and nurse anesthetists). The Guidelines are intended to apply to all airway management and anesthetic care delivered in inpatient (e.g., perioperative, non-operating room, emergency department, and critical care settings); and ambulatory settings (e.g., ambulatory surgery centers, office-based surgery and procedure centers performing invasive airway procedures). Excluded are prehospital settings and individuals who do not deliver anesthetic care or perform airway management.

These guidelines are also intended to serve as a resource for other physicians and patient care personnel who are involved in the care of difficult airway patients, including those involved in local policy development.

Task Force Members

In 2019, the ASA Committee on Standards and Practice Parameters requested that these guidelines be updated. This update is a revision developed by an ASA–appointed task force of 15 members, including physician anesthesiologists in both private and academic practices from the United States, India, Ireland, Italy, and Switzerland, an independent consulting methodologist and an ASA staff methodologist. Conflict of interest documentation regarding current or potential financial and other interests pertinent to the practice guideline were disclosed by all task force members and managed.‡‡

Process and Evaluation of Evidence

These updated Guidelines were developed by means of a six-step process. First, consensus was reached on the criteria for evidence. Second, a comprehensive literature search was conducted by an independent librarian to identify citations relevant to the evidence criteria. Third, original published articles from peer-reviewed journals relevant to difficult airway management were evaluated and added to literature included in the previous update. Fourth, consultants who had expertise or interest in difficult airway management and who practiced or worked in various settings (e.g., private and academic practice) were asked to participate in opinion surveys addressing the appropriateness, completeness, and feasibility of implementation of the draft recommendations and to review and comment on a draft of the

‡‡ Additional conflict of interest information is located after Appendix 2 in this document.
Guidelines. Fifth, additional opinions were solicited from random samples of active members of the ASA and participating organizations. Sixth, all available information was used to build consensus to finalize the Guidelines. A summary of recommendations is provided in appendix 1.

Preparation of these updated Guidelines followed a rigorous methodological process, described in more detail in appendix 2 and other related publications.2-5 Criteria for literature acceptance included randomized controlled trials (RCTs), prospective nonrandomized comparative studies (e.g., quasi-experimental, cohort), retrospective comparative studies (e.g., case-control studies), observational studies (e.g., correlational or descriptive statistics), case reports and case series from peer-review journals. Literature exclusion criteria included: (1) patients or practitioners described in the study that were specifically excluded or not identified by evidence criteria in the evidence model; (2) interventions were excluded or not identified in the evidence model; (3) the study contained insufficient or no outcome data, or reported outcomes were not relevant to the evidence model; (4) articles with no original data, including review articles, descriptive letters or editorials, (5) systematic reviews, secondary data, meta-analysis,§§ or other articles with no original data, (6) abstracts, letters or articles not published in a peer-review journal, (7) studies outside of designated search dates, (8) duplicate data are presented in a different reviewed article, or (9) retracted publications.

Within the text of these Guidelines, literature classifications are reported for each intervention as follows: Category A level 1, meta-analysis of randomized controlled trials (RCTs); Category A level 2, multiple RCTs; and Category A level 3, a single RCT. Category B level 1, nonrandomized studies with group comparisons; Category B level 2, nonrandomized studies with associative findings; Category B level 3, nonrandomized studies with descriptive findings, and Category B level 4, case series or case reports. Statistically significant outcomes (P < 0.01) are designated as either beneficial (B) or harmful (H) for the patient; statistically nonsignificant findings are designated as equivocal (E).*** When available, category A evidence is given precedence over category B evidence for any particular outcome. The lack of sufficient

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§§ All meta-analyses are conducted by the ASA methodology group. Meta-analyses from other sources are reviewed but not included as evidence in this document. A minimum of five independent RCTs (i.e., sufficient for fitting a random-effects model) is required for meta-analysis.

*** A complete bibliography used to develop this updated Advisory, arranged alphabetically by author, is available as Supplemental Digital Content 1, http://links.lww.com/ALN/XXXXXXXX.
scientific evidence in the literature is reported in the text of the Guidelines as “insufficient
evidence.”†††

Survey findings from task force appointed expert consultants, and samples of the
memberships of ASA and participating organizations‡‡‡ are reported in appendix 2. Survey
responses for each recommendation are reported using a 5-point scale based on median values
from strongly agree to strongly disagree.

Guidelines

Evaluation of the Airway

Airway evaluation topics include (1) risk assessment to predict a difficult airway or risk of
aspiration, and (2) airway examination (bedside and advanced) when a difficult airway is known
or suspected.

Risk assessment includes evaluation of information obtained from a patient’s history or
medical records, such as demographic information, clinical conditions, diagnostic tests,
patient/family interviews or questionnaires. An airway examination is intended to identify the
presence of upper airway pathologies or anatomical anomalies when a difficult airway is known
or suspected. Issues addressed in these Guidelines include: (1) measurement of facial and jaw
features, (2) anatomical measurements and landmarks, (3) imaging with ultrasound or virtual
laryngoscopy/bronchoscopy (MRI/CT reconstruction), (4) 3D printing, and (5) bedside
endoscopy.

Literature Findings.

Patient demographic characteristics evaluated for difficult airway risk prediction included
age, sex, body mass index, weight and height. Clinical characteristics assessed included a
history of difficult intubation, snoring, obstructive sleep apnea, and diabetes, findings from
diagnostic tests (e.g., radiography, computed tomography), patient interviews and
questionnaires. Measurement of facial and jaw features included mouth opening, the ability to
prognath, head and neck mobility, prominent upper incisors, presence of a beard, and an upper
lip bite test. Anatomical measures included Mallampati and Modified Mallampati scores, Wilson
Risk-Sum scores, thyromental distance, sternomental distance, interincisor distance, neck
circumference, ratio of neck circumference to thyromental distance, ratio of height to

††† A more detailed description of the definition of insufficient evidence is described in Appendix 2.
‡‡‡ See Appendix 2 and Supplemental Digital Content 2, http://links.lww.com/ALN/XXXXXXX for tables
reporting a complete listing of survey findings.
thyromental distance, hyomental distance, and hyomental distance ratio. Measurements obtained from ultrasound included skin-to-hyoid distance, tongue volume, and distance from skin to epiglottis.

Observational studies reported comparative demographic findings for difficult versus non-difficult airway patients as well as sensitivity, specificity, positive predictive, negative predictive and accuracy values for difficult laryngoscopy, SGA use, and tracheal intubation. Findings for the above patient characteristics were shown to have very high predictive and comparative variability, with sensitivity, specificity and significance values ranging from low to very high across all patient demographic measures§§§ (Category B2-E evidence). No single characteristic was identified as consistently being more predictive than another, and multivariate measures intended to predict difficult airways were too few and diverse among the studies to determine a common set of predictors.

Case reports identified difficult laryngoscopy or difficult intubation occurring among patients with a variety of acquired or congenital disease states (e.g., ankylosing spondylitis, degenerative osteoarthritis, Treacher-Collins, Klippel-Feil, Down syndrome, mucopolysaccharidosis, and airway masses) (Category B4-H evidence).§§§ A table showing range values for univariate predictors for demographic and clinical characteristics is available as Supplemental Digital Content 2, http://links.lww.com/ALN/XXXXXXXX.

Observational studies reported comparative findings for facial and jaw features and anatomical measurement for difficult versus non-difficult airway patients as well as sensitivity, specificity, positive predictive and accuracy values for difficult laryngoscopy and intubation. Findings for facial and jaw features, anatomical measurements, and ultrasound anatomical measurements§§§§ were shown to have very high predictive and comparative variability, with sensitivity, specificity and significance values ranging from low to very high across all patient measures (Category B2-E evidence). No single characteristic was identified as consistently being more predictive than another, and multivariate measures intended to predict difficult airways were too few and diverse among the studies to determine a common set of predictors.

A prospective cohort study reported improved laryngeal views (during tongue protrusion) when transnasal endoscopy was added to the preoperative bedside evaluation (Category B2-B evidence), and an observational study utilizing preoperative endoscopic examination as an added airway assessment tool reported that airway management plans were revised in 26% of

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§§§ A table showing range values for univariate predictors for demographic and clinical characteristics is available as Supplemental Digital Content 2, http://links.lww.com/ALN/XXXXXXXX.
patients based on the results of this examination *(Category B3-B evidence).*\(^{198}\) Observational studies and case reports indicated that radiography and computed tomography scans identified anatomical characteristics such as laryngeal deviations, cervical abnormalities, fractures, and abscesses that may suggest a potential difficult airway *(Category B3-B and B4-B evidence).*\(^{87,199-202}\) Observational studies indicated that patient questionnaires may identify patients at risk of difficult ventilation and intubation *(Category B3-B evidence).*\(^{152,203,204}\)

The literature was insufficient to evaluate the predictive value of virtual laryngoscopy/bronchoscopy (MRI/CT reconstruction) or 3-D printing.

**Survey Findings.** The consultants and members of participating organizations strongly agree with recommendations to assure that an airway risk assessment is performed by the person(s) responsible for airway management whenever feasible before the initiation of anesthetic care or airway management, and with the recommendation to conduct an airway physical examination before the initiation of anesthetic care or airway management.

**Recommendations for Evaluation of the Airway.**

- **Before the initiation of anesthetic care or airway management,** assure that an airway risk assessment is performed by the person(s) responsible for airway management whenever feasible to identify patient, medical, surgical, environmental, and anesthetic factors *(e.g., risk of aspiration)* that may indicate the potential for a difficult airway.
  
  - When available in the patient’s medical record, evaluate demographic information, clinical conditions, diagnostic test findings, patient/family interviews, and questionnaire responses.
  
  - Assess multiple demographic and clinical characteristics to determine a patient’s potential for a difficult airway or aspiration.

- **Before the initiation of anesthetic care or airway management,** conduct an airway physical examination to further identify physical characteristics that may indicate the potential for a difficult airway.
  
  - The physical examination may include assessment of facial features,**** and assessment of anatomical measurements and landmarks.††††

**** Examples of facial features include mouth opening, the ability to prognath, head and neck mobility, prominent upper incisors, presence of a beard, and the upper lip bite test.  
†††† Examples of anatomical measures include Mallampati and Modified Mallampati scores, Wilson Risk-Sum scores, thyromental distance, sternomental distance, interincisor distance, neck circumference, ratio of neck circumference to thyromental distance, ratio of height to thyromental distance, hyomental
Additional evaluation to characterize the likelihood or nature of the anticipated airway difficulty may include bedside endoscopy, virtual laryngoscopy/bronchoscopy (MRI/CT reconstruction, or 3D printing).††††

- Assess multiple airway features to determine a patient’s potential for a difficult airway or aspiration.

Preparation for Difficult Airway Management

Topics related to interventions intended to prepare for difficult airway management include:

1. the availability of equipment for airway management (e.g., items for anesthetizing locations, portable storage unit, cart or trolley for difficult airway management),
2. informing the patient with a known or suspected difficult airway,
3. preoxygenation,
4. patient positioning,
5. sedative administration,
6. local anesthesia,
7. supplemental oxygen during difficult airway management,
8. patient monitoring,
9. human factors.§§§§

Literature Findings. Although the need for immediate access to difficult airway management equipment is a well-accepted practice, the literature is insufficient to directly evaluate outcomes associated with the availability of such equipment. In addition, the literature is insufficient to evaluate outcomes associated with informing the patient of a known or suspected difficult airway, preoxygenation, administration of sedatives or local anesthesia, or patient monitoring. One randomized controlled trial comparing the ramped with sniffing positions reported equivocal findings (p > 0.01) for laryngoscopic view and intubation success (Category A3-E evidence). A nonrandomized study comparing the sniffing position with head and neck raised beyond the sniffing position reported improved laryngeal views with the raised position (Category B-2 B evidence).

Survey Findings. The consultants and members of participating organizations strongly agree with recommendations to: assure that a skilled individual is present or immediately available to assist with airway management if a difficult airway is known or suspected; inform the patient or responsible person of the special risks and procedures pertaining to management of the difficult airway; and administer oxygen before initiating management of the difficult airway, and to deliver supplemental oxygen throughout the process of difficult airway management.

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†††† In addition to airway evaluation, 3D printing may be a useful means of testing methods for device insertion or for practitioner training.

§§§§ Human factors are generally considered part of airway preparation as well as management and post event airway care.
including extubation.

**Recommendations for Preparation for Difficult Airway Management.**

- Assure that airway management equipment is available in the room.****
- Assure that a portable storage unit that contains specialized equipment for difficult airway management is immediately available.†††††
- If a difficult airway is known or suspected:
  - Assure that a skilled individual is present or immediately available to assist with airway management when feasible.
  - Inform the patient or responsible person of the special risks and procedures pertaining to management of the difficult airway.
  - Administer oxygen before initiating management of the difficult airway, ‡‡‡‡‡ and deliver supplemental oxygen whenever feasible throughout the process of difficult airway management, including extubation.§§§§§
- Assure that, at a minimum, monitoring according to the ASA Standards for Basic Anesthesia Monitoring are followed immediately before, during and after airway management of all patients******

**Anticipated Difficult Airway Management**

Airway management of an anticipated difficult airway consists of interventions addressing awake tracheal intubation, anesthetized tracheal intubation, or both awake and anesthetized intubation.

**Awake tracheal intubation:** Studies with observational findings report successful awake fiberoptic intubation in 88–100% of anticipated difficult airway patients (*Category B3-B evidence*).²⁰⁷-²¹⁰ Case reports for awake intubation (e.g., blind tracheal intubation, intubation through supraglottic devices, optically guided intubation) also report success with anticipated difficult airway patients (*Category B4-B evidence*).²¹¹-²¹³

***** See Table 1 for examples of appropriate airway equipment.
††††† See Table 2 for an example of specialized equipment for a portable storage unit.
‡‡‡‡‡ The uncooperative or pediatric patient may impede opportunities for oxygen administration.
§§§§§ Opportunities for supplemental oxygen administration include (but are not limited to) oxygen delivery by nasal cannulae, facemask, or SGA insufflation.
****** This recommendation does not preclude local or institutional policies that require more stringent monitoring.
Anesthetized tracheal intubation:

The literature is insufficient to evaluate the benefit or harm of the use of cricoid pressure (i.e., Sellick maneuver), pressure limited mask ventilation versus ablation of spontaneous ventilation, maintenance of spontaneous ventilation versus ablation of spontaneous ventilation, administration of neuromuscular blockade to improve mask ventilation, or rocuronium with sugammadex versus suxamethonium or succinylcholine for airway management of anticipated difficult airway patients.

Both awake and anesthetized intubation: Interventions addressed for anticipated difficult airway patients receiving either awake or anesthetized airway management include (1) airway maneuvers, (2) noninvasive airway management devices, (3) combination techniques, (4) invasive airway management interventions, and (5) extracorporeal membrane oxygenation.

Examples of airway maneuvers include external laryngeal manipulation (e.g., backward/upward/right pressure [BURP] maneuver), jaw thrust, or chin lift. An observational study reports successful intubation using gentle pressure to the shaft of the tracheal tube with the hand in 78% of cases after first-attempt intubation failure (Category B3-B evidence).\(^\text{214}\) Two case reports indicated that use of a BURP maneuver resulted in successful intubation of difficult airway patients (Category B4-B evidence).\(^\text{215,216}\)

Noninvasive devices for airway management of patients with anticipated difficult airways include rigid laryngoscopic blades of alternative design and size; adjuncts (e.g., introducers, bougies, stylets, alternative tracheal tubes), videolaryngoscopes; fiberoptic laryngoscopes or bronchoscopes (includes flexible intubation scopes); supraglottic airway devices (SGAs); lighted stylets, light wands or optical stylets; and rigid bronchoscopes. The literature is insufficient to evaluate which devices are most effective when attempted first after failed intubation, nor is the literature sufficient to evaluate the most effective order of devices to be used for attempted intubation of an anticipated difficult airway.

Rigid laryngoscopic blades of alternative design and size: One RCT comparing a levering laryngoscope to a standard laryngoscope reported no differences in laryngoscopic view, but shorter times to intubation and fewer intubation maneuvers needed for successful intubation with the levering laryngoscope (Category A3-B evidence).\(^\text{217}\) Case reports observed intubation success with alternative laryngoscopic blades (Category B4-B evidence).\(^\text{218,219}\)

Adjuncts (e.g., introducers, bougies, stylets, alternative tracheal tubes Intubating stylets or tube changers). Observational studies report intubation success ranging from 87%-100% of
patients (Category B3-B evidence), and case reports indicate intubation success with bougies and stylets (Category B4-B evidence).

**Videolaryngoscopes:** Meta-analyses of RCTs comparing video-assisted laryngoscopy with direct laryngoscopy in patients with predicted difficult airways report improved laryngeal views, a higher frequency of successful intubations, a higher frequency of first attempt intubations and fewer intubation maneuvers with video-assisted laryngoscopy (Category A1-B evidence); findings for time to intubation were equivocal (Category A1-E evidence). One RCT comparing channel-guided videolaryngoscopes with non-channel-guided videolaryngoscopes reported equivocal findings for laryngeal view, intubation success, first-attempt intubation, time to intubation, and needed intubation maneuvers (Category A3-E evidence). RCTs reported equivocal findings for laryngoscopic view, intubation success, first attempt intubation success, and time to intubation when hyperangulated videolaryngoscopes were compared with non-angulated videolaryngoscopes for anticipated difficult airways (Category A2-E evidence).

Observational studies report intubation success rates for videolaryngoscopes ranging from 85% to 100% of patients and first attempt successful intubation rates ranging from 51% to 100% (Category B3-B evidence). Case reports indicate videolaryngoscope intubation successes with a wide range of difficult airway conditions (Category B4-B evidence). Adverse outcomes that may occur include sore throat, laryngospasm, lip, dental, or mucosal injuries (Category B4-H evidence).

**Fiberoptic laryngoscopes or bronchoscopes:** A nonrandomized comparative study comparing intubation with a fiberoptic bronchoscope with direct laryngoscopy reported equivocal findings for complicated intubations (Category B2-E evidence). Studies with observational findings report fiberoptic intubation success rates ranging from 78%-100% (Category B3-B evidence). Case reports indicate successful intubation occurring with fiberoptic intubation techniques (Category B4-B evidence).

**Supraglottic airway (SGA) devices:**

Observational studies report successful SGA insertion and intubation ranging from 65%-100% of anticipated difficult airway patients, with three studies reporting oxygen

††††† See Appendix XX for meta-analysis details.
desaturation occurring in 1.8%-3.3% of patients after SGA placement (Category B3-B evidence). Case reports observed successful ventilation and intubation with various SGAs (Category B4-B evidence).339-383

RCTs comparing fiberoptic intubation with the SGA versus standard fiberoptic intubation reported a higher frequency of first attempt intubation success with the SGA, (Category A2-B evidence); findings were equivocal for overall successful intubation and time to intubation (Category A2-E evidence).384-387 An RCT comparing second generation SGAs with first generation SGAs reported faster times to intubation with second generation SGAs (Category A2-B evidence).388 RCTs reported equivocal findings for overall successful intubation (Category A2-E evidence).388,389

Lighted stylets, light wands or optical stylets: An RCT comparing intubation with a lightwand versus blind intubation for patients with anticipated difficult airways reported a significantly higher frequency of successful intubations and shorter intubation times for the lightwand (Category A3-B evidence).390 Two RCTs reported shorter intubation times when lighted stylets were compared with direct laryngoscopy (Category A2-B evidence); findings were equivocal for successful intubation and first attempt success (Category A2-E evidence).235,391 One RCT comparing lighted stylets with fiberoptic bronchoscopy reported shorter intubation times with lighted stylets (Category A3-B evidence).392

Observational studies reported successful intubation ranging from 84.9%-100% of anticipated difficult airway patients when lighted stylets or light wands were used (Category B3-B evidence); Case reports observed successful intubations with lighted stylets, lightwands and optical stylets (Category B4-B evidence).398-406

Rigid bronchoscope: The literature is insufficient to evaluate the benefit or harm of the rigid bronchoscope for patients with anticipated difficult airways.

Combination techniques: Examples of combination techniques include: (1) direct or video laryngoscopy combined with either optical/video stylet, flexible/fiberoptic scope, airway exchange catheter, retrograde placed guide wire or SGA placement, and (2) SGA combined with either optical/video stylet, flexible/fiberoptic scope (with or without hollow guide catheter).

An RCT comparing a lightwand combined with direct laryngoscopy versus a lightwand alone for intubation reported equivocal findings for successful intubation, first attempt success, time to intubation, and number of intubation attempts (Category A3-E evidence).407

Observational studies report successful intubation with combination techniques ranging from 80%-90% and first attempt success rates ranging from 50%-100% of anticipated difficult
airway patients\textsuperscript{408-410,414} (Category B3-B evidence). Case reports also report successful intubation occurring with various combinations of techniques (Category B4-B evidence).\textsuperscript{415-432} Invasive airway management interventions for anticipated difficult airway management include retrograde wire-guided intubation, front-of-neck percutaneous or surgical cricothyrotomy/tracheostomy, awake cricothyrotomy/tracheostomy, and extracorporeal membrane oxygenation. Case reports indicate successful intubations when retrograde wire-guided intubation was performed for patients with anticipated difficult airways (Category B4-B evidence).\textsuperscript{433-437} A case report observes successful percutaneous tracheostomy with an anticipated difficult airway patient (Category B3-B evidence).\textsuperscript{438} The literature is insufficient to evaluate awake cricothyrotomy/tracheostomy, and Extracorporeal Membrane Oxygenation for anticipated difficult airway patients.

\textbf{Survey Findings.} The consultants and members of participating organizations strongly agree with the recommendation to identify a strategy for (1) awake intubation, (2) the patient who can be adequately ventilated but is difficult to intubate, (3) the patient who cannot be ventilated or intubated, and (4) alternative approaches to airway management failure. The consultants strongly agree, and members of participating organizations agree or strongly agree with recommendations to: perform awake intubation, when appropriate, if the patient is suspected to be a difficult intubation, and difficult ventilation (face mask/SGA) is anticipated; perform awake intubation, when appropriate, if the patient is suspected to be a difficult intubation, and increased risk of aspiration is anticipated; and perform awake intubation, when appropriate, if the patient is suspected to be a difficult intubation and the patient is likely incapable of tolerating a brief apneic episode. The consultants and members of participating organizations strongly agree with the recommendation to perform awake intubation, when appropriate, if the patient is suspected to be a difficult intubation and difficulty with emergency invasive airway rescue is anticipated.

The consultants and members of participating organizations strongly agree with the recommendation to identify a preferred sequence of noninvasive devices to use for airway management if a noninvasive approach is selected. The consultants strongly agree, and members of participating organizations agree or strongly agree that if difficulty is encountered with individual techniques, combination techniques may be performed. The consultants and members of participating organizations strongly agree with the recommendation to be aware of the passage of time, number of attempts, and oxygen saturation. The consultants strongly agree, and members of participating organizations agree or strongly agree with the
recommendation to provide and test mask ventilation between attempts. The consultants and members of participating organizations strongly agree with recommendations to: limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications; identify a preferred intervention if an elective invasive approach to the airway is selected; assure that an invasive airway is performed by an individual trained in invasive airway techniques whenever possible; and identify an alternative invasive intervention if the selected invasive approach fails or is not feasible.

Recommendations for Anticipated Difficult Airway Management.

- Have a preformulated strategy for management of the anticipated difficult airway.
  - This strategy will depend, in part, on the anticipated surgery, the condition of the patient, the age of the patient, and the skills and preferences of the anesthesiologist.
  - Identify a strategy for: (1) awake intubation,‡‡‡‡‡‡ (2) the patient who can be adequately ventilated but is difficult to intubate, (3) the patient who cannot be ventilated or intubated, and (4) difficulty with emergency invasive airway rescue.
  - When appropriate, perform awake intubation if the patient is suspected to be a difficult intubation and one or more of the following apply: (1) difficult ventilation (face mask/SGA), (2) increased risk of aspiration, (3) the patient is likely incapable of tolerating a brief apneic episode, or (4) there is expected difficulty with emergency invasive airway rescue.§§§§§§
  - Proceed with airway management after induction of general anesthesia when the benefits are judged to outweigh the risks.
  - For either awake or anesthetized intubation, airway maneuver(s) may be attempted to facilitate intubation.
  - Before attempting intubation of the anticipated difficult airway, determine the benefit of a noninvasive versus invasive approach to airway management.
    - If a noninvasive approach is selected, identify a preferred sequence of noninvasive devices to use for airway management.*******

‡‡‡‡‡‡ Awake intubation may not be feasible in some pediatric patients.
§§§§§§ Any one factor alone (i.e., assessed difficulty with intubation, or ventilation, increased risk of aspiration or desaturation) may be of sufficient clinical importance to warrant an awake intubation.
******* These devices include rigid laryngoscopic blades of alternative designs and sizes (with adequate face mask ventilation after induction); adjuncts (e.g., introducers, bougies, stylets, alternative tracheal tubes, and supraglottic airways), video/video-assisted laryngoscopy; fiberoptic laryngoscopes or bronchoscopes (includes flexible intubation scopes); supraglottic airway devices (SGAs); lighted stylets, light wands, or optical stylets; alternative optical laryngoscopes; and rigid bronchoscopes.
• If difficulty is encountered with individual techniques, combination techniques may be performed.

• Be aware of the passage of time, number of attempts, and oxygen saturation.

• Provide and test mask ventilation between attempts, when feasible.

• Limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications.

• If an elective invasive approach to the airway is selected, identify a preferred intervention.

• Assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.

• If the selected approach fails or is not feasible, identify an alternative invasive intervention.

o Initiate extracorporeal membrane oxygenation when/if appropriate and available.

Unanticipated and Emergency Difficult Airway Management

Airway management of an unanticipated or emergency difficult airway consists of interventions addressing (1) calling for help, (2) optimization of oxygenation, (3) use of a cognitive aid, (4) noninvasive airway management devices, (5) combination techniques, (6) invasive airway management interventions, and (7) extracorporeal membrane oxygenation.

Literature Findings. The literature is not sufficient to evaluate patient outcomes associated with the immediate access to airway management support equipment or calling for help, although the necessity of these interventions is obvious. The literature is also insufficient to

Combination techniques may include, but are not limited to: (1) direct or video laryngoscopy combined with either optical/video stylet, flexible/fiberoptic scope, airway exchange catheter, retrograde placed guide wire or SGA placement, and (2) SGA combined with either optical/video stylet, flexible/fiberoptic scope (with or without hollow guide catheter), retrograde placed guide wire.

These interventions may include, but are not limited to, one of the following techniques: surgical cricothyroidotomy (e.g., scalpel-bougie-tube), needle cricothyroidotomy with a pressure regulated device, large bore cannula cricothyroidotomy or surgical tracheostomy, retrograde wire guided intubation, and percutaneous tracheostomy.

See list of alternative approaches above.
evaluate outcomes associated with use of a cognitive aid or algorithm for unanticipated or
emergency difficult airways.

Case reports have observed successful emergency ventilation via tube exchangers using
expiratory ventilatory assistance after multiple failed intubation attempts (Category B4-B
evidence).439,440

Devices for noninvasive airway management of patients with unanticipated or emergency
difficult airways include rigid laryngoscopic blades of alternative designs and sizes; adjuncts
(e.g., introducers, bougies, stylets, alternative tracheal tubes), videolaryngoscopes; fiberoptic
laryngoscopes or bronchoscopes (includes flexible intubation scopes); supraglottic airway
devices (SGAs); lighted stylets, light wands, or optical stylets; and rigid bronchoscopes.

The literature is insufficient to evaluate outcomes associated with rigid laryngoscopic blades
of alternative designs and sizes for patients with unanticipated or emergency difficult airways.
Observational findings from a randomized trial reports a first attempt intubation success rate for
difficult airways of 96% with bougies, and 82% with stylets and tracheal tubes in an emergency
department (Category B3-B evidence).441 Case reports observed intubation successes with
bougies, introducers and stylets for patients with unanticipated or emergency difficult airways
(Category B4-B evidence).110,442-448

Nonrandomized studies comparing videolaryngoscopes with direct laryngoscopy report
equivocal findings for intubation success with difficult airways in emergency departments
(Category B1-E evidence).6,449,450 Observational studies report successful videolaryngoscope
guided intubation rates after failed intubation ranging from 92%-100% for unanticipated and
emergency difficult airways (Category B4-B evidence).451-454 Case reports also observed
successful intubation with videolaryngoscopes in unanticipated and emergency difficult airways
(Category B4-B evidence).186,455-458 A retrospective observational study reported a fiberoptic
bronchoscopy success rate of 78% for intubation rescue after failed direct laryngoscopy
(Category B3-B evidence).451 Case reports of fiberoptic bronchoscopy and fiberoptic
nasotracheal intubation report successful rescue intubations for unanticipated and emergency
difficult airways (Category B4-B evidence).459-463

A retrospective observational study reported a 78% successful rescue intubation rate,451
and another observational study reported 94.1% successful rescue ventilation with supraglottic
airway placement (Category B3-B evidence).464 Case reports also observed successful rescue
ventilation and intubation using supraglottic airways for unanticipated and emergency difficult
airways (Category B4-B evidence).465-480
A retrospective observational study reported a success rate with a lighted stylet of 77% for intubation rescue after failed direct laryngoscopy (Category B3-B evidence).\textsuperscript{451} Case reports observed successful intubations with lighted stylets after failed direct laryngoscopies for emergency airways (Category B4-B evidence).\textsuperscript{481,482} A case report indicated successful intubation with a rigid bronchoscope in an emergency airway obstruction case (Category B4-B evidence).\textsuperscript{483}

An observational study reported successful intubation in 97.7%, first-attempt success in 86.4%, and successful ventilation in 100% of unanticipated difficult airway patients using a combination of a supraglottic airway and lightwand (Category B3-B evidence).\textsuperscript{484} Case reports also observed intubation success for unanticipated and emergency airway patients when combination techniques were used (Category B4-B evidence).\textsuperscript{485-493}

The literature is insufficient to evaluate which of the above devices are most effective when attempted first after failed intubation, nor is the literature sufficient to evaluate the most effective order of devices to be used for attempted intubation of an unanticipated or emergency difficult airway.

Invasive airway management interventions for unanticipated and emergency difficult airway management include retrograde wire-guided intubation, front-of-neck percutaneous or surgical cricothyrotomy/tracheostomy, awake cricothyrotomy/tracheostomy, jet ventilation, and extracorporeal membrane oxygenation.

A case series of two patients reported successful intubation using retrograde wire-guided intubation after failed intubation through a SGA (Category B4-B evidence).\textsuperscript{494} Observational findings from an RCT comparing percutaneous dilatational tracheotomy with percutaneous cricothyrotomy reported successful procedure rates of 97.6% and 95.3% (Category B3-B evidence).\textsuperscript{496} and case reports also observed successful percutaneous procedures (Category B4-B evidence).\textsuperscript{496-498}

A retrospective observational study reported restoration of oxygen saturation levels to above 90% when rescue transtracheal jet ventilation was used (Category B3-B evidence),\textsuperscript{499} and case reports observed improvements in oxygen saturation levels with supraglottic jet oxygenation in “cannot intubate, cannot ventilate” situations (Category B4-B evidence).\textsuperscript{500,501} Case reports observed oxygen saturations of 72%-100% with the use of extracorporeal membrane oxygenation for difficult airways before intubation attempts in emergency procedures (Category B4-B evidence).\textsuperscript{502,503}
Survey Findings. The consultants and members of participating organizations strongly agree with recommendations to: determine the benefit of waking and/or restoring spontaneous breathing upon encountering an unanticipated difficult airway; determine the benefit of a noninvasive versus invasive approach to airway management; and identify a preferred sequence of noninvasive devices to use for airway management if a noninvasive approach is selected.

The consultants strongly agree, and members of participating organizations agree or strongly agree that if difficulty is encountered with individual techniques, combination techniques may be performed. The consultants and members of participating organizations strongly agree with recommendations to: be aware of the passage of time, number of attempts, and oxygen saturation; provide and test mask ventilation between attempts; limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications; identify a preferred intervention if an invasive approach to the airway is necessary (i.e., cannot intubate, cannot ventilate); assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible; assure that an invasive airway is performed as rapidly as possible; and identify an alternative invasive intervention if the selected invasive approach fails or is not feasible.

Recommendations for Unanticipated and Emergency Difficult Airway Management.

- Call for help.
- Optimize oxygenation
- When appropriate, refer to an algorithm††††† and/or cognitive aid.
- Upon encountering an unanticipated difficult airway:
  - Determine the benefit of waking and/or restoring spontaneous breathing.
  - Determine the benefit of a noninvasive versus invasive approach to airway management.
  - If a noninvasive approach is selected, identify a preferred sequence of noninvasive devices to use for airway management.‡‡‡‡‡‡‡‡

††††† Examples include low or high flow nasal oxygen during efforts securing a tube
‡‡‡‡‡‡‡‡ These devices include rigid laryngoscopic blades of alternative design and size (with adequate face mask ventilation after induction); adjuncts (e.g., introducers, bougies, stylets, alternative tracheal tubes, and supraglottic airways), video/video-assisted laryngoscopy; fiberoptic laryngoscopes or bronchoscopes (includes flexible intubation scopes); supraglottic airway devices (SGAs); lighted stylets, light wands, or optical stylets; alternative optical laryngoscopes; and rigid bronchoscopes.
If difficulty is encountered with individual techniques, combination techniques may be performed.

Be aware of the passage of time, number of attempts, and oxygen saturation.

Provide and test mask ventilation between attempts, when feasible.

Limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications.

- If an invasive approach to the airway is necessary (i.e., cannot intubate, cannot ventilate), identify a preferred intervention.
  - Assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.
  - Assure that an invasive airway is performed as rapidly as possible.
  - If the selected invasive approach fails or is not feasible, identify an alternative invasive intervention.

- Initiate Extracorporeal Membrane Oxygenation (ECMO) when/if appropriate and available.

**Confirmation of tracheal intubation.**

**Literature Findings.** Studies with observational findings report that capnography or end-tidal carbon dioxide monitoring confirms tracheal intubation in 88.5%–100% of difficult airway patients (*Category B3-B evidence*). Case reports also observed intubation confirmation with capnography (*Category B4-B evidence*). The literature is insufficient to evaluate whether visualization (any technique), flexible bronchoscopy, ultrasonography, or radiography can be effective in confirming appropriate tracheal intubation.

**Survey Findings.** The consultants and members of participating organizations strongly agree with the recommendation to confirm tracheal intubation using capnography or end-tidal carbon dioxide monitoring. The consultants strongly agree, and members of participating organizations agree or strongly agree with the recommendation that, when uncertain about the location of the tracheal tube, to determine whether to either remove it and attempt ventilation or use additional techniques to confirm positioning of the tube.

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These interventions may include surgical cricothyroidotomy (e.g., scalpel-bougie technique), surgical tracheostomy, needle cricothyrotomy with pressure regulated ventilation (e.g., transtracheal jet ventilation or other pressure regulated techniques), large bore cannula cricothyroidotomy (including Seldinger guided techniques). See list of alternative approaches above.
Recommendations for Confirmation of Tracheal Intubation.

- Confirm tracheal intubation using capnography or end-tidal carbon dioxide monitoring.
  - When uncertain about the location of the tracheal tube, determine whether to either remove it and attempt ventilation or use additional techniques to confirm positioning of the tracheal tube.†††††††††

Extubation of the Difficult Airway

An extubation strategy includes interventions that may be used to facilitate airway management associated with extubation of a difficult airway. Extubation intervention topics addressed by these Guidelines include: (1) assessment of patient readiness for extubation, (2) the presence of a skilled individual to assist with extubation, (3) selection of an appropriate time and location for extubation, (4) planning for possible reintubation, (5) elective tracheostomy, (6) awake extubation or SGA removal, (7) supplemental oxygen throughout the extubation process, and (8) extubation with an airway exchange catheter or supraglottic airway. The Task Force regards the concept of an extubation strategy as a logical extension of the intubation strategy.

Literature Findings. A retrospective observational study comparing successfully extubated patients with patients who failed extubation observed differences in duration of intubation; conditions associated with failed extubation included airway granulations and subglottic stenosis (Category B1-H evidence).507 A retrospective observational study reported that staged extubation and reintubation with a Cook airway exchange catheter was successful in 92% of known or presumed difficult extubation patients.508 A prospective cohort study reported that staged extubation with a Cook staged extubation set was easy in 26% and moderately difficult in 65% of ICU patients with anticipated difficult airways; heart rate significantly increased during extubation (Category B3-E evidence).509 A case report indicated successful extubation with an airway exchange catheter (Category B3-B evidence).510 Another case report observed an esophageal misplacement of an airway exchange catheter during extubation of a difficult airway patient (Category B3-H evidence).511

The literature is insufficient to evaluate the benefits of the presence of a skilled individual to assist with extubation, selection of an appropriate time and location for extubation, awake extubation or SGA removal, supplemental oxygen, planning for possible reintubation, and elective tracheostomy for difficult airway patients.

††††††††† Additional techniques include, but are not limited to visualization (any technique), flexible bronchoscopy, ultrasonography or radiography.
Survey Findings. The consultants and members of participating organizations strongly agree with recommendations to: have a preformulated strategy for extubation and subsequent airway management; assure that a skilled individual is present to assist with extubation; and select an appropriate time and location for extubation when possible. The consultants strongly agree and members of participating organizations agree or strongly agree with recommendations to: assess the relative clinical merits and feasibility of the short-term use of an airway exchange catheter and/or SGA that can serve as a guide for expedited reintubation; and evaluate the risks and benefits of elective surgical tracheostomy before attempting extubation. The consultants and members of participating organizations strongly agree with recommendations to: evaluate the risks and benefits of awake extubation \textit{versus} extubation before the return to consciousness and assess the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.

Recommendations for Extubation of the Difficult Airway

\begin{itemize}
  \item Have a preformulated strategy for extubation and subsequent airway management.
    \begin{itemize}
      \item This strategy will depend, in part, on the surgery/procedure, other perioperative circumstances, the condition of the patient, and the skills and preferences of the clinician.
    \end{itemize}
  \item Assess patient readiness for extubation.
  \item Assure that a skilled individual is present to assist with extubation when feasible.
  \item Select an appropriate time and location for extubation when possible.
  \item Assess the relative clinical merits and feasibility of the short-term use of an airway exchange catheter and/or SGA that can serve as a guide for expedited reintubation.\footnote{These interventions are considered advanced techniques.}
    \begin{itemize}
      \item Minimize the use of an airway exchange catheter with pediatric patients.
    \end{itemize}
  \item Before attempting extubation, evaluate the risks and benefits of elective surgical tracheostomy.
  \item Evaluate the risks and benefits of awake extubation \textit{versus} extubation before the return to consciousness and assess the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.
\end{itemize}
to consciousness.

- When feasible, use supplemental oxygen throughout the extubation process.
- Assess the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.

**Follow up Care**

Follow-up care includes the topics of: (1) post-extubation care (i.e., steroids, racemic epinephrine) (2) post-extubation counseling (i.e., informing and advising the patient or responsible individual of the occurrence and potential complications associated with a difficult airway), (3) documentation of difficult airway and management in the medical record and to the patient, and (4) registration with a difficult airway notification service.

**Literature Findings.** The literature is insufficient to evaluate the benefits of post-extubation steroids or epinephrine, counseling, documentation in the medical record, or registration with a difficult airway notification service. A case report of a difficult airway patient who was awakened after failed intubation indicated that records of previous difficult intubations were unavailable (*Category B4-H evidence*).

**Survey Findings.** The consultants and members of participating organizations strongly agree with the recommendation to: inform the patient (or responsible person) of the airway difficulty that was encountered to provide the patient (or responsible person) with information to guide and facilitate the delivery of future care; and to document the presence and nature of the airway difficulty in the medical record to guide and facilitate the delivery of future care.

**Recommendations for Follow up Care.**

- Use post-extubation steroids and/or racemic epinephrine when appropriate.
- Inform the patient (or responsible person) of the airway difficulty that was encountered to provide the patient (or responsible person) with a role in guiding and facilitating the delivery of future care.
  - The information conveyed may include (but is not limited to) the presence of a difficult airway, the apparent reasons for difficulty, how the intubation was accomplished, and the implications for future care.
• Document the presence and nature of the airway difficulty in the medical record to guide and facilitate the delivery of future care.

• Instruct the patient to register with an emergency notification service when appropriate and feasible.

References


Aspects of documentation includes, but is not limited to: (1) a description of the airway difficulties that were encountered, distinguishing between difficulties encountered in facemask or SGA ventilation and difficulties encountered in tracheal intubation and (2) a description of the various airway management techniques that were used, indicating the extent to which each of the techniques served either a beneficial or detrimental role in management of the difficult airway.


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PRACTICE GUIDELINES FOR DIFFICULT AIRWAY MANAGEMENT


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Appendix 1: Summary of Recommendations.

Recommendations for Evaluation of the Airway.

- Before the initiation of anesthetic care or airway management, assure that an airway risk assessment is performed by the person(s) responsible for airway management whenever feasible to identify patient, medical, surgical, environmental, and anesthetic factors (e.g., risk of aspiration) that may indicate the potential for a difficult airway.
  - When available in the patient's medical record, evaluate demographic information, clinical conditions, diagnostic test findings, patient/family interviews, and questionnaire responses.
  - Assess multiple demographic and clinical characteristics to determine a patient’s potential for a difficult airway or aspiration.
- Before the initiation of anesthetic care or airway management, conduct an airway physical examination to further identify physical characteristics that may indicate the potential for a difficult airway.
  - The physical examination may include assessment of facial features,†††††††††† and assessment of anatomical measurements and landmarks.††††††††††††
  - Additional evaluation to characterize the likelihood or nature of the anticipated airway difficulty may include bedside endoscopy, virtual laryngoscopy/bronchoscopy (MRI/CT reconstruction, or 3D printing.‡‡‡‡‡‡‡‡‡‡
- Assess multiple airway features to determine a patient’s potential for a difficult airway or aspiration.

Recommendations for Preparation for Difficult Airway Management.

- Assure that airway management equipment is available in the room.§§§§§§§§§§
- Assure that a portable storage unit that contains specialized equipment for difficult airway management is immediately available.********
- If a difficult airway is known or suspected:
  - Assure that a skilled individual is present or immediately available to assist with airway management when feasible.
  - Inform the patient or responsible person of the special risks and procedures pertaining to management of the difficult airway.
  - Administer oxygen before initiating management of the difficult airway,†††††††††††† and deliver supplemental oxygen whenever feasible throughout the process of difficult airway management.

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†††††††††† Examples of facial features include mouth opening, the ability to prognath, head and neck mobility, prominent upper incisors, presence of a beard, and the upper lip bite test.
†††††††††††† Examples of anatomical measures include Mallampati and Modified Mallampati scores, Wilson Risk-Sum scores, thyromental distance, sternomental distance, interincisor distance, neck circumference, ratio of neck circumference to thyromental distance, ratio of height to thyromental distance, hyomental distance, and hyomental distance ratio. Measurements obtained from ultrasound included skin-to-hyoid distance, tongue volume, and distance from skin to epiglottis.
‡‡‡‡‡‡‡‡‡‡ In addition to airway evaluation, 3D printing may be a useful means of testing methods for device insertion or for practitioner training.
§§§§§§§§§§ See Table 1 for examples of appropriate airway equipment.
******** See Table 2 for an example of specialized equipment for a portable storage unit.
†††††††††††† The uncooperative or pediatric patient may impede opportunities for oxygen administration.
airway management, including extubation.

- Assure that, at a minimum, monitoring according to the ASA Standards for Basic Anesthesia Monitoring are followed immediately before, during and after airway management of all patients.

**Recommendations for Anticipated Difficult Airway Management.**

- Have a preformulated strategy for management of the anticipated difficult airway.
  - This strategy will depend, in part, on the anticipated surgery, the condition of the patient, and the skills and preferences of the anesthesiologist.
  - Identify a strategy for: (1) awake intubation, (2) the patient who can be adequately ventilated but is difficult to intubate, (3) the patient who cannot be ventilated or intubated, and (4) difficulty with emergency invasive airway rescue.
  - When appropriate, perform awake intubation if the patient is suspected to be a difficult intubation and one or more of the following apply: (1) difficult ventilation (face mask/SGA), (2) increased risk of aspiration, (3) the patient is likely incapable of tolerating a brief apneic episode, or (4) there is expected difficulty with emergency invasive airway rescue.
  - Proceed with airway management after induction of general anesthesia when the benefits are judged to outweigh the risks.
  - For either awake or anesthetized intubation, airway maneuver(s) may be attempted to facilitate intubation.
  - Before attempting intubation of the anticipated difficult airway, determine the benefit of a noninvasive versus invasive approach to airway management.
    - If a noninvasive approach is selected, identify a preferred sequence of noninvasive devices to use for airway management.
    - If difficulty is encountered with individual techniques, combination techniques may be performed.
    - Be aware of the passage of time, number of attempts, and oxygen saturation.
    - Provide and test mask ventilation between attempts, when feasible.
    - Limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications.

‡‡‡‡‡‡‡‡‡‡‡ Opportunities for supplemental oxygen administration include (but are not limited to) oxygen delivery by nasal cannulae, facemask, or SGA insufflation.

§§§§§§§§§§§ This recommendation does not preclude local or institutional policies that require more stringent monitoring.

************ Any one factor alone (i.e., assessed difficulty with intubation, or ventilation, increased risk of aspiration or desaturation) may be of sufficient clinical importance to warrant an awake intubation.

†††††††††††† These devices include rigid laryngoscopic blades of alternative design and size (with adequate face mask ventilation after induction); adjuncts (e.g., introducers, bougies, stylets, alternative tracheal tubes, and supraglottic airways), video/video-assisted laryngoscopy; fiberoptic laryngoscopes or bronchoscopes (includes flexible intubation scopes); supraglottic airway devices (SGAs); lighted stylets, light wands, or optical stylets; alternative optical laryngoscopes; and rigid bronchoscopes.

‡‡‡‡‡‡‡‡‡‡‡‡ Combination techniques may include, but are not limited to: (1) direct or video laryngoscopy combined with either optical/video stylet, flexible/fiberoptic scope, airway exchange catheter, retrograde placed guide wire or SGA placement, and (2) SGA combined with either optical/video stylet, flexible/fiberoptic scope (with or without hollow guide catheter), retrograde placed guide wire.
PRACTICE GUIDELINES FOR DIFFICULT AIRWAY MANAGEMENT

If an elective invasive approach to the airway is selected, identify a preferred intervention.

- Assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.
- If the selected approach fails or is not feasible, identify an alternative invasive intervention.
  - Initiate extracorporeal membrane oxygenation when/if appropriate and available.

Recommendations for Unanticipated and Emergency Difficult Airway Management.

- Call for help.
- Optimize oxygenation.
- When appropriate, refer to an algorithm and/or cognitive aid.
- Upon encountering an unanticipated difficult airway:
  - Determine the benefit of waking and/or restoring spontaneous breathing.
  - Determine the benefit of a noninvasive versus invasive approach to airway management.
  - If a noninvasive approach is selected, identify a preferred sequence of noninvasive devices to use for airway management.
    - If difficulty is encountered with individual techniques, combination techniques may be performed.
    - Be aware of the passage of time, number of attempts, and oxygen saturation.
    - Provide and test mask ventilation between attempts, when feasible.
    - Limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications.
- If an invasive approach to the airway is necessary (i.e., cannot intubate, cannot ventilate), identify a preferred intervention.
  - Assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.
  - Assure that an invasive airway is performed as rapidly as possible.
  - If the selected invasive approach fails or is not feasible, identify an alternative invasive intervention.

§§§§§§§§§§§§ These interventions may include, but are not limited to, one of the following techniques:
surgical cricothyroidotomy (e.g., scalpel-bougie-tube), needle cricothyroidotomy with a pressure regulated device, large bore cannula cricothyroidotomy or surgical tracheostomy, retrograde wire guided intubation, and percutaneous tracheostomy.

************* See list of alternative approaches above.

††††††††††††† Examples include low or high flow nasal oxygen during efforts securing a tube
‡‡‡‡‡‡‡‡‡‡‡‡‡ See Figures 1 and 2 for examples of algorithms.

§§§§§§§§§§§§§ These devices include rigid laryngoscopic blades of alternative design and size (with adequate face mask ventilation after induction); adjuncts (e.g., introducers, bougies, stylets, alternative tracheal tubes, and supraglottic airways), video/video-assisted laryngoscopy; fiberoptic laryngoscopes or bronchoscopes (includes flexible intubation scopes); supraglottic airway devices (SGAs); lighted stylets, light wands, or optical stylets; alternative optical laryngoscopes; and rigid bronchoscopes.

************** These interventions may include surgical cricothyroidotomy (e.g., scalpel-bougie technique), surgical tracheostomy, needle cricothyrotomy with pressure regulated ventilation (e.g., transtracheal jet ventilation or other pressure regulated techniques), large bore cannula cricothyroidotomy (including Seldinger guided techniques)

††††††††††††††† See list of alternative approaches above.
Initiate Extracorporeal Membrane Oxygenation (ECMO) when/if appropriate and available.

**Recommendations for Confirmation of Tracheal Intubation.**

- Confirm tracheal intubation using capnography or end-tidal carbon dioxide monitoring.
  - When uncertain about the location of the tracheal tube, determine whether to either remove it and attempt ventilation or use additional techniques to confirm positioning of the tracheal tube.‡‡‡‡‡‡‡‡‡‡‡‡‡‡

**Recommendations for Extubation of the Difficult Airway**

- Have a preformulated strategy for extubation and subsequent airway management.
  - This strategy will depend, in part, on the surgery/procedure, other perioperative circumstances, the condition of the patient, and the skills and preferences of the clinician.
- Assess patient readiness for extubation.
- Assure that a skilled individual is present to assist with extubation when feasible.
- Select an appropriate time and location for extubation when possible.
- Assess the relative clinical merits and feasibility of the short-term use of an airway exchange catheter and/or SGA that can serve as a guide for expedited reintubation.§§§§§§§§§§§§§§
  - Minimize the use of an airway exchange catheter with pediatric patients.
- Before attempting extubation, evaluate the risks and benefits of elective surgical tracheostomy.
- Evaluate the risks and benefits of awake extubation versus extubation before the return to consciousness.
- When feasible, use supplemental oxygen throughout the extubation process.
- Assess the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.

**Recommendations for Follow up Care.**

- Use post-extubation steroids and/or racemic epinephrine when appropriate.
- Inform the patient (or responsible person) of the airway difficulty that was encountered to provide the patient (or responsible person) with a role in guiding and facilitating the delivery of future care.
  - The information conveyed may include (but is not limited to) the presence of a difficult airway, the apparent reasons for difficulty, how the intubation was accomplished, and the implications for future care.
- Document the presence and nature of the airway difficulty in the medical record to guide and facilitate the delivery of future care.***************

‡‡‡‡‡‡‡‡‡‡‡‡‡‡ Additional techniques include, but are not limited to visualization (any technique), flexible bronchoscopy, ultrasonography or radiography.

§§§§§§§§§§§§§§ These interventions are considered advanced techniques.

*************** Aspects of documentation includes, but is not limited to: (1) a description of the airway difficulties that were encountered, distinguishing between difficulties encountered in facemask or SGA ventilation and difficulties encountered in tracheal intubation and (2) a description of the various airway management techniques that were used, indicating the extent to which each of the techniques served either a beneficial or detrimental role in management of the difficult airway.
• Instruct the patient to register with an emergency notification service when appropriate and feasible.
Appendix 2: Methods and Analyses

For these updated guidelines, a systematic search and review of peer reviewed published literature was conducted, with scientific findings summarized and reported below and in the document. Assessment of conceptual issues, practicality and feasibility of the guideline recommendations was also evaluated, with opinion data collected from surveys and other sources. Both the systematic literature review and the opinion data are based on evidence linkages, or statements regarding potential relationships between interventions and outcomes associated with difficult airway management. The evidence model below guided the search, providing inclusion and exclusion information regarding patients, procedures, practice settings, providers, clinical interventions, and outcomes. After review of all evidentiary information, the task force placed each recommendation into one of three categories: (1) provide the intervention or treatment, (2) the intervention or treatment may be provided to the patient based on circumstances of the case and the practitioner’s clinical judgment, or (3) do not provide the intervention or treatment. The policy of the ASA Committee on Standards and Practice Parameters is to update practice guidelines every 5 years. The ASA Committee on Standards and Practice Parameters reviews all practice guidelines at the ASA annual meeting and determines update and revision timelines.

Evidence Model

Patients

- Inclusion criteria:
  - Patients with or at risk of difficult mask ventilation
  - Patients with or at risk of difficult laryngoscopy (direct or indirect)
  - Patients with or at risk of difficult ventilation using a supraglottic airway (SGA)
  - Patients with or at risk or difficult/failed tracheal intubation
  - Patients with or at risk of difficult/failed extubation
  - Anticipated difficult airway patients
  - Unanticipated difficult airway patients
  - Adult patients
  - Pediatric patients including infants and neonates
  - Obstetric patients
  - ICU/Critically ill patients

- Exclusion criteria
  - Patients where difficult airways are not encountered

††††††††††††††† Patients “at risk” refers to difficult laryngoscopy where it is not possible to visualize any portion of the vocal cords after multiple attempts.
Physiologically difficult airways that are not anatomically difficult

**Procedures**
- Inclusion criteria:
  - Procedures requiring general anesthesia
  - Procedures requiring sedation or regional anesthesia
  - Elective/emergency airway management without a procedure
  - Diagnostic procedures
  - Elective procedures
  - Emergency procedures
  - Invasive airway access
- Exclusion criteria:
  - Airway management during cardiopulmonary resuscitation

**Practice Settings**
- Inclusion criteria:
  - In-hospital
    - Perioperative care settings
    - Non-operating room anesthetic setting (NORA)
    - Emergency department setting
    - ICU/Critical care setting
  - Ambulatory surgery centers (ASC)
  - Office based procedure/anesthesia (OBA) locations
  - Out of hospital or pre-hospital (i.e., field) setting (limited to front of neck/invasive airway access)
- Exclusion criteria:
  - Out of hospital or pre-hospital (i.e., field) setting

**Providers**
- Inclusion criteria:
  - Anesthesia care providers
    - Anesthesiologists
    - Anesthesiologist assistants
    - Nurse anesthetists
- Exclusion criteria:
  - Individuals who do not deliver anesthetic care and airway management

**Interventions**
- Evaluation of the Airway.
  - Risk prediction (for difficult airway or aspiration) obtained from history/medical records

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These include, but are not limited to hypoxemia, hypotension, severe metabolic acidosis, and right ventricular failure
- Demographic conditions (e.g., age, sex)
- Clinical conditions (e.g., BMI, previous difficult airway, diabetes, obesity)
- Diagnostic test findings (e.g., radiography, computed tomography, magnetic resonance imaging, bedside endoscopy findings)
- Patient interview/questionnaires (e.g., MACOCHA, STOP-BANG)
  - Airway assessment/exam (bedside and advanced) when a difficult airway is known or suspected.
    - Assessment of facial features (e.g., mouth opening, nose slope, neck slope, ratio of brow to nose to chin, full beard)
    - Upper lip bite test
    - Anatomical measurements and landmarks (e.g., Mallampati/modified Mallampati, Wilson Risk Sum score, SARI scores, neck circumference, neck mobility (neck radiation changes), prognathism, ruler or finger measurements of thyromental, sternomental, or temporomandibular distance)
- Imaging
  - Ultrasound
  - Virtual laryngoscopy/bronchoscopy (MRI/CT reconstruction)
- 3D printing
- Bedside endoscopy
- Direct laryngoscopy (e.g., Cormac-Lehane grades)
- Bronchoscopy
- Nasopharyngoscopy

- Preparation for Difficult Airway Management.
  - Availability of equipment for airway management (i.e., items for anesthetizing locations, portable storage unit, cart or trolley for difficult airway management)
  - Availability of an assigned individual to provide assistance when a difficult airway is encountered (from previous evidence model)
  - Informing the patient with a known or suspected difficult airway
  - Preoxygenation
    - Preoxygenation versus room air
      - Three to 5 minutes of O₂ (-5 to -3 min at tidal volume, FiO₂ = 1) versus 1 minute (-1 min at tidal volume, FiO₂ = 1)
      - Three to 5 minutes of O₂ (-5 to -3 min at tidal volume, FiO₂ = 1) versus 4/8/12 deep breaths at forced vital capacity in one min or the shortest time lag, FiO₂ = 1
      - Three minutes of preoxygenation to reach an end-tidal oxygen concentration ≥ 0.90 (EtO₂ ≥ 0.9)
      - Preoxygenation using non-invasive ventilation (pressure support with positive end expiratory pressure)
  - Patient positioning (e.g., sniffing, sitting, head/neck extension, head-elevated laryngoscopy [HELP], ramped)
  - Sedative versus hypnotic administration
  - Local anesthesia versus no local anesthesia
  - Supplemental oxygen during airway management

*Methods to deliver preoxygenation include oxygen delivery with nasal cannulae, facemask (including humidified nasal cannula and CPAP) or SGA insufflation.*

***************Methods to deliver supplemental oxygen include oxygen delivery with nasal cannulae, facemask (including humidified nasal cannula and CPAP), or SGA insufflation.
Patient monitoring (according to ASA standards)

- Anticipated difficult airway management.
  - Awake tracheal intubation (any device)
    - Awake/sedated intubation versus intubation after induction
    - Awake/sedated versus anesthetized intubation in patients with full stomach
  - Anesthetized tracheal intubation
    - Rapid sequence induction/intubation
      - With versus without cricoid pressure (Sellick maneuver)
      - Pressure limited mask ventilation versus ablation of spontaneous ventilation
    - Maintenance of spontaneous ventilation versus ablation of spontaneous ventilation
    - Administration of neuromuscular blockade to improve mask ventilation
    - Rocuronium with sugammadex versus suxamethonium or succinylcholine
  - Both awake and anesthetized intubation
    - Airway maneuvers (e.g., jaw thrust chin lift, external laryngeal manipulation, backwards/upwards/rightwards pressure)
  - Airway management devices
    - Rigid laryngoscopic blades of alternative design and size: with adequate face mask ventilation after induction (alternatives to standard blades such as Macintosh, Miller)
    - Adjuncts – introducers, bougies, stylets, alternative tracheal tubes
    - Video/video-assisted laryngoscopy
      - Video/video-assisted laryngoscopy versus direct laryngoscopy
      - Video/video-assisted laryngoscopy versus fiberoptic laryngoscopy
      - Channel-guided versus non-channel-guided videolaryngoscopes
      - Hyperangulated versus non-angulated devices
    - Fiberoptic laryngoscope/bronchoscope (includes flexible intubation scopes)
      - Fiberoptic guided intubation vs blind tracheal or nasotracheal intubation
      - Fiberoptic guided intubation vs rigid laryngoscopic intubation
  - Supraglottic airway
    - Standard supraglottic airway (SGA, SAD, SGD, EGD, LMA)
      - SGA versus face mask for ventilation
      - Intubation with an SGA versus intubation without an SGA
      - Intubating techniques with an SGA
        - Laryngoscopic intubation with SGA versus blind intubation with SGA
        - Fiberoptic intubation with SGA versus standard laryngoscopic intubation with SGA
        - Optically/image guided intubation with SGA versus standard laryngoscopic intubation with SGA
    - Lighted stylet, light wand, optical stylet
      - Lighted stylet, light wand or optical stylet versus blind intubation
      - Lighted stylet, light wand or optical stylet versus laryngoscopic intubation
    - Rigid bronchoscope
      - Intubating supraglottic airway (SGA, ISAD, ISGD, IEGD, ILMA)

†††††††††††††††† Channel-guided devices include Airtraq, Kingvision, and Pentax videolaryngoscopes. Non-channel guided devices include Glidescope, C-MAC, and McGrath videolaryngoscopes.
Intubation with an SGA versus intubation without an SGA

Intubating techniques with an SGA
- Laryngoscopic intubation with SGA versus blind intubation with SGA
- Fiberoptic intubation with SGA versus standard laryngoscopic intubation with SGA
- Optically/image guided intubation with SGA versus standard laryngoscopic intubation with SGA

Second versus first generation SGA

Additional airway management interventions (with anticipated failure of airway management devices)
- Retrograde wire-guided intubation
- Front of neck access (FONA)
- Cricothyrotomy (percutaneous)
- Cricothyrotomy (surgical)
- Tracheostomy/tracheotomy
- Scalpel bougie technique or scalpel bougie tube technique vs needle cannula technique
- Awake/sedated cricothyrotomy/tracheostomy for FONA
- Extracorporeal membrane oxygenation (ECMO)

Combination techniques

Unanticipated difficult airway management.

- Call for help
- Maximize oxygenation
  - Nasal oxygen during efforts securing a tube (NO DESAT)
  - Expiratory ventilatory assistance
  - High flow nasal cannula oxygen (HFNO)/transnasal humidified rapid insufflation ventilatory exchange (THRIVE)
- Use of a cognitive aid (e.g., VORTEX approach)
- Airway management devices
  - Rigid bronchoscope
  - Rigid laryngoscopic blades of alternative design and size: with adequate face mask ventilation after induction (alternatives to standard blades such as Macintosh, Miller)
  - Lighted stylet, light wand, optical stylet
    - Lighted stylet, light wand or optical stylet versus blind intubation
    - Lighted stylet, light wand or optical stylet versus laryngoscopic intubation
  - Fiberoptic laryngoscope/bronchoscope (includes flexible intubation scopes)
    - Fiberoptic guided intubation vs blind tracheal or nasotracheal intubation
    - Fiberoptic guided intubation vs rigid laryngoscopic intubation
  - Video/video-assisted laryngoscopy

Combination techniques include: (1) direct laryngoscopy with SGA, bougie, optical stylet, flexible scope/fiberoptic scope, airway exchange catheter or retrograde intubation, (2) videolaryngoscopes with SGA, bougie, optical stylet, flexible scope/fiberoptic scope, airway exchange catheter or retrograde intubation, (3) flexible scope/fiberoptic scope with SGA, airway exchange catheter, retrograde intubation or cricothyrotomy, (4) optical stylet with SGA, bougie, flexible scope/fiberoptic scope or retrograde intubation, (5) airway exchange catheter with SGA, retrograde intubation, or cricothyrotomy.
• Video/video-assisted laryngoscopy versus direct laryngoscopy
• Video/video-assisted laryngoscopy versus fiberoptic laryngoscopy
• Hyperangulated versus non-angulated devices
• Channel-guided versus non-channel-guided videolaryngoscopes
• Alternative optical laryngoscopes
  ▪ Adjuncts – introducers, bougies, stylets, alternative tracheal tubes
□ Supraglottic airway
  ▪ Standard supraglottic airway (SGA, SAD, SGD, EGD, LMA)
    ▪ SGA versus face mask for ventilation
    ▪ Intubation with an SGA versus intubation without an SGA
    ▪ Intubating techniques with an SGA
      ▪ Laryngoscopic intubation with SGA versus blind intubation with SGA
      ▪ Fiberoptic intubation with SGA versus standard laryngoscopic intubation with SGA
      ▪ Optically/image guided intubation with SGA versus standard laryngoscopic intubation with SGA
  ▪ Intubating supraglottic airway (SGA, ISAD, ISGD, IEGD, ILMA)
    ▪ Intubation with an SGA versus intubation without an SGA
    ▪ Intubating techniques with an SGA
      ▪ Laryngoscopic intubation with SGA versus blind intubation with SGA
      ▪ Fiberoptic intubation with SGA versus standard laryngoscopic intubation with SGA
      ▪ Optically/image guided intubation with SGA versus standard laryngoscopic intubation with SGA
  ▪ Second versus first generation SGA
    ▪ Additional airway management interventions (with anticipated failure of airway management devices)
      ▪ Retrograde wire-guided intubation
      ▪ Front of neck access (FONA)
      ▪ Cricothyrotomy (percutaneous)
      ▪ Cricothyrotomy (surgical)
      ▪ Tracheostomy/tracheotomy
      ▪ Scalpel bougie technique or scalpel bougie tube technique vs needle cannula technique
      ▪ Awake/sedated cricothyrotomy/tracheostomy for FONA
      ▪ Extracorporeal membrane oxygenation (ECMO)
      ▪ Jet ventilation
      ▪ Combination techniques
  ▪ Emergency (cannot oxygenate or ventilate) difficult airway management.
    ▪ Call for help
    ▪ Maximize oxygenation
      ▪ Nasal oxygen during efforts securing a tube (NO DESAT)
      ▪ Expiratory ventilatory assistance
      ▪ High flow nasal cannula oxygen (HFNO)/transnasal humidified rapid insufflation ventilatory exchange (THRIVE)
    ▪ Use of a cognitive aid (e.g., VORTEX approach)
    ▪ Airway management devices
Rigid bronchoscope

Rigid laryngoscopic blades of alternative design and size: with adequate face mask ventilation after induction (alternatives to standard blades such as Macintosh, Miller)

Lighted stylet, light wand, optical stylet
  • Lighted stylet, light wand or optical stylet versus blind intubation
  • Lighted stylet, light wand or optical stylet versus laryngoscopic intubation

Fiberoptic laryngoscope/bronchoscope (includes flexible intubation scopes)
  • Fiberoptic guided intubation vs blind tracheal or nasotracheal intubation
  • Fiberoptic guided intubation vs rigid laryngoscopic intubation

Video/video-assisted laryngoscopy
  • Video/video-assisted laryngoscopy versus direct laryngoscopy
  • Video/video-assisted laryngoscopy versus fiberoptic laryngoscopy
  • Hyperangulated versus non-angulated devices
  • Channel-guided versus non-channel-guided videolaryngoscopes
  • Alternative optical laryngoscopes

Adjuncts – introducers, bougies, stylets, alternative tracheal tubes

Supraglottic airway
  • Standard supraglottic airway (SGA, SAD, SGD, EGD, LMA)
    o SGA versus face mask for ventilation
    o Intubation with an SGA versus intubation without an SGA
    o Intubating techniques with an SGA
      ▪ Laryngoscopic intubation with SGA versus blind intubation with SGA
      ▪ Fiberoptic intubation with SGA versus standard laryngoscopic intubation with SGA
      ▪ Optically/image guided intubation with SGA versus standard laryngoscopic intubation with SGA
  • Intubating supraglottic airway (SGA, ISAD, ISGD, IEGD, ILMA)
    o Intubation with an SGA versus intubation without an SGA
    o Intubating techniques with an SGA
      ▪ Laryngoscopic intubation with SGA versus blind intubation with SGA
      ▪ Fiberoptic intubation with SGA versus standard laryngoscopic intubation with SGA
      ▪ Optically/image guided intubation with SGA versus standard laryngoscopic intubation with SGA
  • Second versus first generation SGA
    o Additional airway management interventions (with anticipated failure of airway management devices)
      ▪ Retrograde wire-guided intubation
      ▪ Front of neck access (FONA)
        ▪ Cricothyrotomy (percutaneous)
        ▪ Cricothyrotomy (surgical)
        ▪ Tracheostomy/tracheotomy
        ▪ Scalpel bougie technique or scalpel bougie tube technique vs needle cannula technique
        ▪ Awake/sedated cricothyrotomy/tracheostomy for FONA
      ▪ Extracorporeal membrane oxygenation (ECMO)
      ▪ Jet ventilation


- Combination techniques

- Confirmation of successful intubation
  - Pulse oximetry (for O₂ saturation levels/desaturation/hypoxemia/hypoxia)
  - Capnography, ETCO₂ (for CO₂ levels/hypercarbia/hypercapnia)
    - Capnography versus capnometry
    - Capnography versus colorimetry
  - Visualization (any technique)
    - Flexible bronchoscopy
    - Ultrasound
    - Radiography

- Extubation
  - Assess readiness for extubation
  - Presence of a skilled individual to assist
  - Selection of ideal time and location
  - Plan for possible reintubation
  - Elective tracheostomy
  - Awake extubation or SGA removal
    - Awake tracheal tube extubation versus asleep (anesthetized) extubation
    - Awake SGA removal versus anesthetized SGA removal
    - Apnea versus spontaneous ventilation during extubation
  - Supplemental oxygen throughout extubation (e.g., by mask, blow-by, nasal cannula, CPAP, BIPAP, or high flow nasal cannula)
  - Supplemental oxygen after extubation
  - Staged extubation
    - Airway exchange catheter
    - SGA exchange catheter (Bailey maneuver)

- Follow-up Care
  - Post-extubation steroids
  - Post-extubation epinephrine
  - Post-extubation counseling (i.e., informing and advising the patient or responsible patient of the occurrence and potential complications associated with a difficult airway).
  - Documentation of difficult airway and management in the medical record and to the patient
  - Registration with an emergency notification service

- Human Factors

**Excluded Interventions:**
- Interventions not addressing any aspect of airway and anesthetic management
- Lung separation
  - Double lumen tube
  - Bronchial blocker
• Physiologically difficult airway
• Details of awake intubation techniques
• Submental intubation
• Cardiopulmonary bypass
• Effects of anesthetics/sedatives on ease of intubation/SGA insertion (e.g., propofol)
• Details of ECMO

Outcomes
• Inclusion criteria:
  o Identification of patient characteristics at risk of difficult intubation
  o Identification of patient characteristics leading to awake intubation
  o Intubation/ventilation success/failure:
    ▪ Face/bag mask ventilation (success/failure, easy/difficult)
    ▪ SGA placement (success/failure, number of attempts)
    ▪ Laryngoscopy (success/failure, number of attempts)
    ▪ Tracheal intubation (success/failure, number of attempts)
    ▪ Front of neck access ventilation
      • Percutaneous cricothyrotomy (success/failure)
      • Surgical cricothyrotomy (success/failure)
      • Tracheostomy (success/failure)
      • Scalpel bougie technique or scalpel bougie tube technique versus needle catheter technique (success/failure)
      ▪ Restoration of failed oxygenation (success/failure)
      ▪ Esophageal intubation
      ▪ Barotrauma (pneumothorax, pneumomediastinum)
      ▪ Subcutaneous emphysema
      ▪ Gastric rupture
      ▪ Tracheal rupture
      ▪ Delayed tracheal stenosis
  o Physiological outcomes (measurement of physiological functioning)
    ▪ Oxygenation/desaturation
    ▪ CO₂ levels
    ▪ Hemodynamic levels (e.g., MAP, CVP)
  o Clinical outcomes
    ▪ Hypoxemia/hypoxia
    ▪ Hypercapnia/hypercarbia
    ▪ Hemodynamic instability
    ▪ Aspiration
    ▪ Airway injury/trauma
    ▪ Soft tissue injuries/blind spot injuries
    ▪ Sore throat
    ▪ Palatal injury
    ▪ Oral/dental damage
    ▪ Cardiac events (e.g., cardiac arrest)
    ▪ Neurological injury
    ▪ Unplanned tracheotomy/surgical airway
    ▪ Neurological deficit <72 hrs
  o Permanent (long-term) outcomes
- Death
- Respiratory system damage
  - Airway trauma
  - Pneumothorax
  - Aspiration
- Nerve/brain damage
  - Nerve damage
  - Neurological/memory deficit
  - Permanent brain damage
  - Brain injury (anoxic encephalopathy)
- Cardiovascular damage
  - Cardiopulmonary arrest
- Fetal/newborn damage
- Functional deficit
  - Awareness/fright
  - Loss of employment
- Nonclinical outcomes
  - Unplanned ICU admission
  - Unplanned hospital admission
  - Surgery postponed/cancelled
  - Length of hospital stay
  - Patient satisfaction

- Exclusion criteria:
  - No exclusion criteria

**Evidence collection**
- Literature inclusion criteria:
  - Randomized controlled trials
  - Prospective nonrandomized comparative studies (e.g., quasi-experimental, cohort)
  - Retrospective comparative studies (e.g., case-control)
  - Observational studies (e.g., correlational or descriptive statistics)
  - Case reports, case series
- Literature exclusion criteria (except to obtain new citations):
  - Editorials
  - Literature reviews
  - Meta-analyses conducted by others
  - Unpublished studies
  - Studies in non-peer reviewed journals
  - Newspaper articles
- Survey evidence:
  - Expert consultant survey
  - ASA membership survey
  - Other participating organization surveys
  - Reliability survey
  - Feasibility survey
State of the Literature.

For the systematic review, potentially relevant clinical studies were identified via electronic and manual searches. Bibliographic database searches included PubMed and EMBASE. The searches covered an 8.3-yr period from January 1, 2012, through April 30, 2020. Citation searching (backward and forward) of relevant meta-analyses and other systematic reviews was also performed. No search for grey literature was conducted. Publications identified by task force members were also considered. Accepted studies from the previous guidelines were re-reviewed, covering the period of January 1, 2002, through June 31, 2012. Only studies containing original findings from peer-reviewed journals were acceptable. Editorials, letters, and other articles without data were excluded. A literature search strategy and PRISMA* flow diagram are available as Supplemental Digital Content 2, [http://links.lww.com/ALN/XXXXXXX](http://links.lww.com/ALN/XXXXXXX).

In total, 8,235 unique new citations were identified, with 744 full articles assessed for eligibility. After review, 377 were excluded, with 367 new studies meeting inclusion criteria. These studies were combined with 190 pre-2012 articles from the previous guidelines, resulting in a total of 553 articles accepted as evidence for these guidelines. In this document, 531 are referenced, with a complete bibliography of articles used to develop these guidelines, organized by section, available as Supplemental Digital Supplemental Digital Content 3, [http://links.lww.com/ALN/XXXXXXX](http://links.lww.com/ALN/XXXXXXX).

Each pertinent outcome reported in a study was classified by evidence category and level and designated as beneficial, harmful, or equivocal. Findings were then summarized for each evidence linkage and reported in the text of the updated Guideline, with summary evidence tables available as Supplemental Digital Content 4, [http://links.lww.com/ALN/XXXXXX](http://links.lww.com/ALN/XXXXXX).

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 comparison groups. When available, category A evidence is given precedence over category B evidence for any particular outcome. 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). In this document, only the highest level of evidence is included in the summary report for each intervention—outcome pair, including a designation of benefit, harm, or equivocality.
**Category A:** RCTs report comparative findings between clinical interventions for specified outcomes. Statistically significant (P < 0.01) outcomes are designated as either 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 these Guidelines. Findings from these RCTs are reported separately 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 clinical 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 nonrandomized comparisons (e.g., quasieperimental, cohort [prospective or retrospective], or case-control research designs) with comparative statistics between clinical interventions for a specified clinical outcome.
- **Level 2:** The literature contains noncomparative observational studies with associative statistics (e.g., correlation, sensitivity, and specificity).
- **Level 3:** The literature contains noncomparative observational studies with descriptive statistics (e.g., frequencies, percentages).
- **Level 4:** The literature contains case reports.

**Insufficient Literature.** 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 because a clear interpretation of findings is not obtained due to methodological concerns (e.g., confounding of study design or implementation) or the study does not meet the criteria for content as defined in the “Focus” of the guidelines.

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513 A minimum of five independent RCTs (i.e., sufficient for fitting a random-effects model) is required for meta-analysis.
Literature addressing risk prediction reported sensitivity, specificity, positive and negative predictive and other common values for age, sex, body mass index, weight, height, and history of snoring; values for airway assessment were reported for facial and jaw features, anatomical landmarks and measurements. A summary table for these values are available as Supplemental Digital Content 5, http://links.lww.com/ALN/XXXXXX.

Literature relating to videolaryngoscopes contained enough studies with well-defined experimental designs and statistical information to conduct formal meta-analyses (table 4). Outcomes assessed were (1) laryngoscopic view, (2) intubation success, (3) first-attempt intubation success, (4) assist maneuvers used for intubation, and (5) time to intubation. For meta-analyses of studies reporting frequency of events, event rates and odds ratios were pooled. Because not all studies of reported event rates, relative risks or hazard ratios (recognizing they approximate relative risks) were pooled. Time to intubation was pooled using risk or mean differences (continuous outcomes) for clinical relevance. Fixed-effects models were fitted using Mantel-Haenszel or inverse variance weighting as appropriate. Random-effects models were fitted with inverse variance weighting using the DerSimonian and Laird estimate of between-study variance. Small study effects (including potential publication bias) were explored by examining forest and funnel plots, regression tests, trim-and-fill results, and limit meta-analysis. Sensitivity to effect measure was also examined. Heterogeneity was quantified with $I^2$ and prediction intervals estimated. A significance level of $P < 0.01$ was applied for analyses.

Interobserver agreement among task force members and two methodologists was assessed for this update, with agreement levels using a $\kappa$ statistic for two-rater agreement pairs as follows: (1) research design, $\kappa = 0.55$ to 0.61; (2) type of analysis, $\kappa = 0.55$ to 0.83; (3) evidence linkage assignment, $\kappa = 0.67$ to 0.79; and (4) literature inclusion for database, $\kappa = 0.08$ to 0.79. Three-rater $\kappa$ values between two methodologists and task force reviewers were: (1) research design, $\kappa = 0.61$; (2) type of analysis, $\kappa = 0.65$; (3) linkage assignment, $\kappa = 0.67$; and (4) literature database inclusion, $\kappa = 0.15$. These values represented low to moderate levels of agreement.

Consensus-based evidence.

Validation of the concepts addressed by these Guidelines and subsequent recommendations proposed was obtained by consensus from multiple sources, including: (1) survey opinion from expert consultants who were selected based on their knowledge or expertise in difficult airway management; (2) survey opinions from randomly selected samples
of active members of the ASA and participating organizations (3) testimony from viewers of publicly held virtual open forums; and (4) internet commentary. All opinion-based evidence relevant to each topic was considered in the development of these guidelines. However, only findings obtained from formal surveys are reported in the document. Opinion surveys were developed by the task force to address each clinical intervention identified in the document. Identical surveys were distributed to expert consultants and a random sample of members of the participating organizations.

Survey responses were recorded using a 5-point scale and summarized based on median values.†††††††††††††††††††

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)

For consultant respondents the rate of return for the survey addressing guideline recommendations was 82% (n = 174 of 212), and results are presented in table 5. For membership respondents, the survey totals were as follows: American Society of Anesthesiologists = 220; All India Difficult Airway Association (AIDAA) = 74; European Airway Management Society (EAMS) = 79; Italian Society of Anesthesiology, Analgesia, Resuscitation and Intensive Care Society (SIAARTI) = 177; Learning, Teaching and Investigation Difficult Airway Group (FIDIVA) = 24; Society for Ambulatory Anesthesia (SAMBA) = 47; Society for Airway Management (SAM) = 70; Society for Head and Neck Anesthesia (SHANA) = 27; Society for Pediatric Anesthesia (SPA) = 268; Society of Critical Care Anesthesiologists (SOCCA) = 85; Swiss Society for Anaesthesiology and Resuscitation (SGAR) = 203; Trauma Anesthesiology Society (TAS) = 21. Survey results for each organization are presented as supplemental digital content 6, http://links.lww.com/ALN/XXXXXX.

An additional survey was sent to the consultants accompanied by a draft of the Guidelines asking them to indicate which, if any, of the recommendations would change their clinical practices if the Guidelines were instituted. The rate of return was ___% (n = ___ of ___). The

††††††††††††††††††† 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.
percentage of responding consultants expecting no change associated with each linkage were as follows: (1) airway history = ___%, (2) airway physical exam = ___%, (3) preparation of patient and equipment = ___%, (4) difficult airway strategy = ___%, extubation strategy = ___% and follow-up care = ___%. ___ percent of the respondents indicated that the Guidelines would have no effect on the amount of time spent on a typical case, and ___% indicated that there would be an increase of the amount of time spent on a typical case with the implementation of these Guidelines. ___ percent indicated that new equipment, supplies or training would not be needed in order to implement the guidelines, and ___% indicated that implementation of the Guidelines would not require changes in practice that would affect costs.

___ percent of the respondents indicated that the Guidelines would have no effect on the amount of time spent on a typical case, and ___% indicated that there would be an increase of the amount of time spent on a typical case with the implementation of these Guidelines. No respondents indicated that new equipment, supplies, or training would not be needed to implement the Guidelines, and ___% indicated that implementation of the Guidelines would not require changes in practice that would affect costs.

Research Support
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Address correspondence to the American Society of Anesthesiologists: 1061 American Lane, Schaumburg, Illinois 60173, jeffa@dacc.uchicago.edu. These updated Practice Guidelines, and all ASA Practice Parameters, may be obtained at no cost through the Journal Web site, https://pubs.asahq.org/anesthesiology.
### Table 1: Airway Management Items for Anesthetizing Locations

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-inflating resuscitation bag</td>
</tr>
<tr>
<td>Suction tubing, Yankauers, suction catheters, and appropriate connectors</td>
</tr>
<tr>
<td>Various sizes of face masks</td>
</tr>
<tr>
<td>Various sizes of oral and nasal airways</td>
</tr>
<tr>
<td>Various sizes and types of laryngoscope blades and handles</td>
</tr>
<tr>
<td>Various sizes and types of tracheal tubes</td>
</tr>
<tr>
<td>Tracheal tube introducer (Bougie) for adult patients</td>
</tr>
<tr>
<td>Tracheal tube stylets (malleable and rigid)</td>
</tr>
<tr>
<td>Equipment for emergency invasive airway management</td>
</tr>
<tr>
<td>Various sizes of supraglottic airways</td>
</tr>
<tr>
<td>Water soluble medical lubricant</td>
</tr>
<tr>
<td>Nasal cannula and oxygen face masks</td>
</tr>
<tr>
<td>Video laryngoscope with appropriate stylets</td>
</tr>
<tr>
<td>Standard ASA monitors</td>
</tr>
<tr>
<td>Anesthetic induction, maintenance, and rescue medications</td>
</tr>
</tbody>
</table>

The examples listed in this table represent basic minimum contents for an anesthetizing location cart or trolley. The cart may be customized to meet the specific needs, preferences, and skills of the practitioner and healthcare facility.
Table 2: Portable Storage Unit Items for Difficult Airway Management

<table>
<thead>
<tr>
<th>Category</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative/rescue ventilation</td>
<td>Oral and nasal airways of assorted sizes</td>
</tr>
<tr>
<td></td>
<td>Supraglottic airways of assorted sizes/ Cuffed pharyngeal sealer</td>
</tr>
<tr>
<td></td>
<td>Nasal cannula</td>
</tr>
<tr>
<td>Intubation equipment</td>
<td>Tracheal tubes of assorted sizes (Including microlaryngeal tubes)</td>
</tr>
<tr>
<td></td>
<td>Rigid blades of alternate design and size for intubation</td>
</tr>
<tr>
<td></td>
<td>Tracheal tube guides. Examples include (but are not limited to)</td>
</tr>
<tr>
<td></td>
<td>semirigid stylets, light wands, forceps designed to manipulate the</td>
</tr>
<tr>
<td></td>
<td>distal portion of the tracheal tube</td>
</tr>
<tr>
<td></td>
<td>Intubating supraglottic Airway</td>
</tr>
<tr>
<td></td>
<td>Videolaryngoscope with appropriate stylet</td>
</tr>
<tr>
<td></td>
<td>Intubating Video Stylet</td>
</tr>
<tr>
<td></td>
<td>Flexible intubating bronchoscope along with</td>
</tr>
<tr>
<td></td>
<td>topical anesthetic and equipment, and airway/bite block</td>
</tr>
<tr>
<td></td>
<td>Aintree catheter</td>
</tr>
<tr>
<td>Emergency airway equipment</td>
<td>Equipment for emergency invasive airway management</td>
</tr>
<tr>
<td></td>
<td>Jet ventilation equipment</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Airway exchange catheters of assorted size</td>
</tr>
<tr>
<td></td>
<td>Multiple exhaled carbon dioxide detectors.</td>
</tr>
<tr>
<td></td>
<td>A laminated version of a local accepted difficult airway algorithm</td>
</tr>
<tr>
<td></td>
<td>cognitive aid/checklist</td>
</tr>
<tr>
<td></td>
<td>Defogger</td>
</tr>
</tbody>
</table>

The examples listed in this table represent airway management equipment beyond what may be available in the anesthetizing location (see Table 1). In areas where these items are not available at the anesthetizing location, add them to this portable storage unit. Equipment and supplies sizes should match the intended population to be served (e.g., neonates, pediatrics, adults).

The items listed in this table represent suggestions. The contents of the portable storage unit should be customized to meet the specific needs, preferences, and skills of the practitioner and healthcare facility.

Choice of some items (e.g., videolaryngoscope, front of neck access, jet ventilation equipment) may depend on practitioner familiarity and experience with the device.
Table 3: Human Factors relevant to difficult airway management

This table lists aspects of airway management that address how the practitioner may interact with patients other clinicians, assistants, equipment, or the environment during the process of airway management. Practitioners may consider these factors before, during and/or after the course of airway management. Factors are classified as related directly to or external to the practitioner.

**Practitioner factors**

**Pre**
- Practitioner knowledge and training
- Possible alternate outcomes (Plan B)
- Preoperative assessment
- Complacency

**During**
- Internal and external stressors (fatigue, illness, production pressure)
- Decision making (perseveration, judgment, situational awareness, interpretation of data)
- Team dynamics (leadership, role assignment, empowerment, sterile cockpit)
- Calling for assistance

**Post**
- Strategic debriefing

**External factors**

**Patient factors**
- Anatomical/physiological airway difficulty risk, aspiration risk, infection risk, exposure risk, urgency, comorbidities

**Environment factors**
- Airway equipment
- Monitoring
- Personal protective equipment

**Institutional factors**
- Culture, staffing, shift duration
- Protocols, reporting
- Supervision/support, training
### Table 4: Meta-analysis Summary

#### Videolaryngoscopy versus direct laryngoscopy

<table>
<thead>
<tr>
<th></th>
<th>Studies*</th>
<th>Patients</th>
<th>Effect</th>
<th>Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fixed</td>
<td>Random</td>
</tr>
<tr>
<td>Laryngoscopic view</td>
<td>8</td>
<td>1100</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.08, 0.19)</td>
<td>(0.06, 0.28)</td>
</tr>
<tr>
<td>Successful intubation</td>
<td>10</td>
<td>1213</td>
<td>0.18</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.10, 0.34)</td>
<td>(0.06, 0.80)</td>
</tr>
<tr>
<td>First attempt success</td>
<td>9</td>
<td>624</td>
<td>0.33</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.16, 0.67)</td>
<td>(0.17, 0.75)</td>
</tr>
<tr>
<td>Additional maneuvers</td>
<td>6</td>
<td>738</td>
<td>0.38</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.25, 0.57)</td>
<td>(0.15, 0.65)</td>
</tr>
</tbody>
</table>

#### Odds Ratio (99% CI) †‡

- **Laryngoscopic view**: OR = 0.12 (0.08, 0.19), p < 0.001
- **Successful intubation**: OR = 0.18 (0.10, 0.34), p < 0.001
- **First attempt success**: OR = 0.33 (0.16, 0.67), p < 0.001
- **Additional maneuvers**: OR = 0.38 (0.25, 0.57), p < 0.001

#### Mean Difference (99% CI)

- **Intubation time**: Mean Difference = -0.29 (-0.50, -1.09), p < 0.001

---

Statistics for individual studies and forest plots are available as supplemental digital content 6, [http://links.lww.com/ALN/](http://links.lww.com/ALN/)

- * Number of studies included in the meta-analysis.
- ** Statistical significance values for heterogeneity of effect size; a p value of < 0.01 indicates that the studies are significantly heterogeneous.
- † CI = Confidence interval.
- ‡ Continuity correction of 0.5 for zero cell frequencies.
### Table 5. Expert Consultant Survey Results (Response Rate = 82%)

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>N</th>
<th>Strongly Agree (%)</th>
<th>Agree (%)</th>
<th>Neutral (%)</th>
<th>Disagree (%)</th>
<th>Strongly Disagree (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluation of the Airway</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a. Before the initiation of anesthetic care or airway management, assure that an airway risk assessment is performed by the person(s) responsible for airway management whenever feasible to identify patient, medical, surgical, environmental, and anesthetic factors (e.g., risk of aspiration) that may indicate the potential for a difficult airway.</td>
<td>174</td>
<td>92&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1b. Before the initiation of anesthetic care or airway management, conduct an airway physical examination.</td>
<td>174</td>
<td>84&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Preparation for Difficult Airway Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2a. If a difficult airway is known or suspected, assure that a skilled individual is present or immediately available to assist with airway management.</td>
<td>174</td>
<td>94&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2b. If a difficult airway is known or suspected, inform the patient or responsible person of the special risks and procedures pertaining to management of the difficult airway.</td>
<td>174</td>
<td>74&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>21</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2c. If a difficult airway is known or suspected, administer oxygen before initiating management of the difficult airway and deliver supplemental oxygen throughout the process of difficult airway management, including extubation.</td>
<td>173</td>
<td>83&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>10</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Anticipated Difficult Airway Management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Identify a strategy for (1) awake intubation, (2) the patient who can be adequately ventilated but is difficult to intubate, (3) the patient who cannot be ventilated or intubated, and (4) alternative approaches to airway management failure.</td>
<td>164</td>
<td>84&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>12</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4a. When appropriate, perform awake intubation if the patient is suspected to be a difficult intubation and- Difficult ventilation (face mask/SGA) is anticipated.</td>
<td>165</td>
<td>68&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>22</td>
<td>7</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4b. When appropriate, perform awake intubation if the patient is suspected to be a difficult intubation and- Increased risk of aspiration is anticipated.</td>
<td>165</td>
<td>42</td>
<td>30&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>15</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>4c. When appropriate, perform awake intubation if the patient is suspected to</td>
<td>166</td>
<td>44</td>
<td>34&lt;sup&gt;‘&lt;/sup&gt;</td>
<td>14</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>
The patient is likely incapable of tolerating a brief apneic episode is anticipated.  
4d. When appropriate, perform awake intubation if the patient is suspected to be a difficult intubation and- Difficulty with emergency invasive airway rescue is anticipated.  
5. If a noninvasive approach is selected, identify a preferred sequence of noninvasive devices to use for airway management.  
5a. If difficulty is encountered with individual techniques, combination techniques may be performed.  
5b. Be aware of the passage of time, number of attempts, and oxygen saturation.  
5c. Provide and test mask ventilation between attempts.  
5d. Limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications.  
6. If an elective invasive approach to the airway (e.g., surgical cricothyroidotomy, tracheostomy, or large bore cannula cricothyroidotomy) is selected, identify a preferred intervention.  
6a. Assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.  
6b. If the selected invasive approach fails or is not feasible, identify an alternative invasive intervention.  
Unanticipated and Emergency Difficult Airway Management  
7a. Upon encountering an unanticipated difficult airway determine the benefit of waking and/or restoring spontaneous breathing.  
7b. Upon encountering an unanticipated difficult airway determine the benefit of a noninvasive versus invasive approach to airway management.  
8. If a noninvasive approach is selected, identify a preferred sequence of noninvasive devices to use for airway management.  
8a. If difficulty is encountered with individual techniques, combination techniques may be performed.  
8b. Be aware of the passage of time, number of attempts, and oxygen saturation.
8c. Provide and test mask ventilation between attempts.
8d. Limit the number of attempts at tracheal intubation or SGA placement to avoid potential injury and complications.
9. If an invasive approach to the airway (e.g., surgical cricothyroidotomy, tracheostomy, or large bore cannula cricothyroidotomy) is necessary (i.e., cannot intubate, cannot ventilate), identify a preferred intervention.
9a. Assure that an invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.
9b. Assure that an invasive airway is performed as rapidly as possible.
9c. If the selected invasive approach fails or is not feasible, identify an alternative invasive intervention.

**Confirmation of Tracheal Intubation**
10. Confirm tracheal intubation using capnography or end-tidal carbon dioxide monitoring.
11. When uncertain about the location of the tracheal tube, determine whether to either remove it and attempt ventilation or use additional techniques to confirm positioning of tracheal tube.

**Extubation of the Difficult Airway**
12. Have a preformulated strategy for extubation and subsequent airway management.
13. Assure that a skilled individual is present to assist with extubation.
14. Select an appropriate time and location for extubation when possible.
15. Assess the relative clinical merits and feasibility of the short-term use of an airway exchange catheter and/or SGA that can serve as a guide for expedited reintubation.
16. Before attempting extubation, evaluate the risks and benefits of elective surgical tracheostomy.
17. Evaluate the risks and benefits of awake extubation versus extubation before the return to consciousness.
18. Assess the clinical factors that may produce an adverse impact on ventilation after the patient has been extubated.

**Follow-up Care**
19. Inform the patient (or responsible person) of the airway difficulty that was
encountered to provide the patient (or responsible person) with a role in guiding and facilitating the delivery of future care.

20. Document the presence and nature of the airway difficulty in the medical record to guide and facilitate the delivery of future care.

An asterisk beside a percentage score indicates the median.
Figure 1 provides three tools to aid in airway management for the patient with a planned, anticipated difficult, or unanticipated difficult airway. **Part 1** is a decision tool that incorporates relevant elements of evaluation and is intended to assist in the decision to enter the Awake Airway Management or Airway Management with the Induction of Anesthesia arms of the ASA difficult airway algorithm. **Part 2** is an awake intubation algorithm. **Part 3** is a strategy for managing patients with induction of anesthesia when an unanticipated difficulty with ventilation with a planned airway technique (as determined by capnography) is encountered.
Part 2: Awake Airway Management

Review airway strategy for awake intubation

Awake Technique

Elective invasive airway

Fail to establish Tracheal Intubation

Success confirmed by adequate ventilation

Deliver oxygen / optimize oxygenation

Consider Call for help

Call for

Awake non-emergency pathway

Postpone or consider risks and benefits of
- Alternative awake technique
- Awake elective invasive airway
- Alternative anesthetic techniques
- Induction of anesthesia (if unstable or can’t be postponed) with preparations for emergency invasive airway
a **Review airway strategy**: consider anatomical / physiological airway difficulty risk, aspiration risk, infection risk, other exposure risk, equipment and monitoring check, role assignment, A/B/C back-up and rescue plans. **Awake techniques include** FIS, VL, DL, SGA, combined, retrograde-wire aided.

b **Adequate ventilation** by any means (e.g., FM, SGA, TI) confirmed by capnography when possible.

c The intent of **limiting** attempts at TI and SGA insertion is to reduce the risk of bleeding, edema, and other types of trauma that may increase the difficulty of mask ventilation and/or subsequent attempts to secure a definitive airway. Persistent attempts at any airway intervention,
including ineffective mask ventilation, may delay obtaining an emergency invasive airway. A reasonable approach may be to limit attempts by any device to 3, with 1 additional attempt by a clinician with higher skills

d Optimized: suction, relaxants, repositioning, FM: oral/nasal airway, hand mask grip. SGA: size, design, repositioning, 1st vs 2nd gen. TT: introducer, rigid stylet, VL hyperangulated, blade size, external laryngeal manipulation. Consider other causes of inadequate ventilation (including but not limited to laryngospasm, bronchospasm)

e 1st vs 2nd generation SGA with intubation capability for initial or rescue SGA

f Video Laryngoscopy as an option for initial or rescue TI

Invasive airways include: surgical cricothyroidotomy, needle cricothyroidotomy with a pressure regulated device, large bore cannula cricothyroidotomy or surgical tracheostomy. Elective invasive airways include the above and retrograde wire guided intubation, percutaneous tracheostomy, rigid bronchoscopy, and Extracorporeal Membrane Oxygenation (ECMO)

Follow-up care includes post-extubation care (i.e., steroids, racemic epinephrine), counseling, documentation, team debriefing, encourage patient difficult airway registry

Postpone the case / intubation - Return with appropriate resources (e.g. personnel, equipment, patient preparation, awake intubation)

Invasive airway is performed by an individual trained in invasive airway techniques, whenever possible.

In an unstable situation, or when airway management is mandatory after a failed awake intubation, a switch to the Airway Management With Induction of Anesthesia pathway may be entered with preparations for an emergency invasive airway

Low or High Flow NE, head elevated position throughout procedure. Non-invasive ventilation during pre-ox.

Figure 2: Difficult Airway Management Infographic – Pediatric Patients

***************

Developed in collaboration with the Society for Pediatric Anesthesia: John E. Fiadjo, M.D., Thomas Engelhardt, MD, PhD, FRCA, Nicola Disma, MD, Narasimhan Jagannathan, MD, MBA, Britta S von Ungern-Stemberg, MD, PhD, DEAA, FANZCA, and Pete G. Kovatsis, MD, FAAP
PRACTICE GUIDELINES FOR DIFFICULT AIRWAY MANAGEMENT

A. **The Time Out for** identification of the airway management plan.
   A team based approach with identification of the following is preferred
   - The primary airway manager and backup manager and role assignment
   - The primary Equipment and the backup equipment
   - The person(s) available to help
   Contact ECMO Team/ENT surgeon if non-invasive airway management is likely to fail e.g., Congenital High Airway Obstruction, Airway Tumor etc.

B. **Color Scheme**
   The colors represent the ability to oxygenate/ventilate.
   - Green - Easy oxygenation/ventilation
   - Yellow - Difficult or Marginal oxygenation/ventilation
   - Red - Impossible oxygenation/ventilation
   - Reassess oxygenation/Ventilation after each attempt and move to the appropriate box based on the results of the oxygenation/ventilation check

C. **Non-emergency Pathway (Oxygenation/Ventilation Adequate for an Intubation known or Anticipated to be challenging)**
   - Deliver oxygen throughout airway management
   - Attempt Airway management with the technique/device most familiar to the primary airway manager.
   - Select from the following devices: Supraglottic Airway (SGA), Videolaryngoscopy, flexible bronchoscopy or a combination of these devices e.g (flexible bronchoscopic intubation through the SGA)
   - Other techniques (e.g. Lightwand, lighted stylets, rigid stylets may be used at the discretion of the clinician)
   - Optimize and alternate devices as needed
   - Reassess Ventilation after each attempt

**Limit direct laryngoscopy attempts (e.g., 1 attempt) with consideration of Standard Blade Video Laryngoscopy in lieu of direct laryngoscopy.**

Limit total attempts (insertion of the intubating device until its removal) by the primary airway manager (e.g., 3 attempts) and 1 additional attempt by the secondary airway manager.

- After 4 attempts consider emerging the patient and reversing anesthetic drugs if feasible. Clinicians may make further attempts if the risks and benefits to the patient favor continued attempts.

**Marginal/ Emergency Pathway (Poor or No Oxygenation/Ventilation for an Intubation known or Anticipated to be challenging)**
- Treat Functional (e.g. airway reflexes with drugs) and Anatomical (mechanical) obstruction
- Attempt to improve ventilation with Facemask, Tracheal intubation and SGA as appropriate
- If all options fail consider emerging the patient or using advanced invasive techniques
Consider a team debrief after all difficult airway encounters to identify processes that worked well and opportunities for system improvement. Provide emotional support to members of the team particularly when there is patient morbidity or mortality.
**Figure 3:** Example of a Cognitive Aid

The “Loop” is entered whenever ventilation is judged inadequate. The Loop is exited when adequate ventilation is established by any means, or is considered unachievable by non-invasive means.

- **Limit attempts**
  - Alternate techniques
  - Optimize each attempt
  - Consider muscle relaxation

- **Ventilation adequate**
  - Yes ➔ Stable, consider options
  - No ➔ Emergency Invasive Airway
    - Rigid bronchoscopy, ECMO

- **Adequate ventilation by any means (e.g., FM, SGA, TI)?**
  - As confirmed by CO2 measurement
  - No ➔ Continue to monitor for adequate ventilation
  - Yes ➔ Progress to maintenance airway device
**Pre-Intubation Decision Making Tool:** This tool can be used to choose between the awake or post-induction airway strategies. Each assessment should be made by the clinician managing the airway, using their techniques of choice.

Figure 4: Example of a Difficult Intubation Algorithm – Adult Patients

Preceed with Patient Awake

- Awake Intubation
  - SUCCESS
  - FAIL
- Airway electively secured by invasive access
  - Optimize Oxygenation Throughout
- Intubation Attempt after Induction of General Anesthesia
  - FAIL
  - SUCCESS
- Limit Attempts
  - Consider calling for help

Suspected difficult laryngoscopy (DL/ VL intubation)?
- Yes
  - Suspected difficult ventilation with (FM/ SGA)?
    - No
      - Significant increased risk of aspiration?
        - No
          - Increased risk of rapid desaturation?
            - No
              - Suspected difficult emergency invasive airway
                - Always evaluate for emergency invasive airway
            - Yes
        - Yes
      - Yes
  - No

Mask ventilation Adequate as confirmed by CO2
- Non-Emergency Pathway
  - Ventilation adequate/intubation unsuccessful
    - Limit Attempts and consider awakening the patient
  - Consider alternative intubation approaches, invasive access or the feasibility of other options
    - SUCCESS
    - FAIL or deteriorating ventilation
- Emergency invasive airway
  - FAIL
  - SUCCESS
*** The airway manager’s assessment and choice of techniques should be based on their prior experience, available resources, including equipment, availability and competency of help, and the context in which airway management will occur.

1. Awake intubation techniques include flexible bronchoscope, videolaryngoscopy, direct laryngoscopy, combined techniques, and retrograde-wire aided intubation

2. After considering risks and benefits, other options include postponing the case or:
   - Alternative awake technique
   - Awake elective invasive airway
   - Alternative anesthetic techniques
   - Induction of anesthesia (if unstable or can’t be postponed) with preparations for emergency invasive airway

3. Invasive airway techniques include: surgical cricothyroidotomy, needle cricothyroidotomy with a pressure regulated device, large bore cannula cricothyroidotomy or surgical tracheostomy. Elective invasive airway techniques include the above and retrograde wire guided intubation and percutaneous tracheostomy. Also consider rigid bronchoscopy and Extracorporeal Membrane Oxygenation (ECMO).

4. Consideration of size, design, positioning, and 1st vs 2nd generation SGAs may improve the ability to ventilate.

5. Alternative difficult intubation approaches include but are not limited to: video-assisted laryngoscopy, alternative laryngoscope blades, combined techniques, intubating SGA (with or without flexible bronchoscopic guidance), flexible bronchoscopy, introducer, and lighted stylet or lightwand. Adjuncts that may be employed during intubation attempts include tracheal tube introducers, rigid stylets, intubating stylets, or tube changers and external laryngeal manipulation.

6. Includes postponing the case or postponing the intubation and returning with appropriate resources (e.g. personnel, equipment, patient preparation, awake intubation)

7. Other options include but are not limited to: proceeding with procedure utilizing face mask or supraglottic airway (SGA) ventilation. Pursuit of these options usually implies that ventilation will not be problematic.

8. Low or high flow nasal cannula, head elevated position throughout procedure. Non-invasive ventilation during preoxygenation.
Figure 5: Suggested Factors to Consider During Development of an Airway Management Strategy

1. Assess the patient’s airway for the following potential risk factors:
   - Difficulty with patient cooperation or consent
   - Provider experience
   - Difficult mask ventilation
   - Difficult supraglottic airway placement
   - Difficult laryngoscopy/intubation
   - Difficult invasive airway access*
   - Significantly increased risk of aspiration
   - Increased risk of rapid desaturation

2. Actively pursue opportunities to optimize oxygenation throughout the process of difficult airway management. Techniques to consider include low or high flow nasal cannula, non-invasive ventilation and elevating the head of the bed.

3. Consider the relative merits and feasibility of basic management choices:
   - Awake intubation vs. intubation after induction of general anesthesia
   - Non-invasive technique vs. invasive techniques for the initial approach to intubation
   - Video-assisted laryngoscopy as an initial approach to intubation
   - Preservation vs. ablation of spontaneous ventilation

4. Consider calling for help early. Know who and when to call for help in advance if difficulty is encountered.

* Invasive airway access includes but is not limited to surgical or percutaneous airway, jet ventilation, retrograde intubation, and Extracorporeal Membrane Oxygenation (ECMO).