Actionable Patient Safety Solutions (APSS) #8A:

Safer airway management

How to use this guide

This guide gives actions and resources for creating and sustaining safer airway management in patients. In it, you'll find:

Patient Safety MOVEMENT

Executive summary checklist

Major causes of patient morbidity and mortality include delays or failure to provide adequate oxygenation by means of a patent airway. Frequently, this is achieved with a secured breathing tube. Failure to recognize a malpositioned breathing tube, or to secure it in a fashion that prevents unplanned removal ("unplanned extubation"-see APSS #8B) or delays in recognizing its removal contribute to significant morbidity and mortality. These are all high priorities for airway safety efforts.

A specific APSS (#8C) addressing the pediatric and neonatal population has also been published.

Use this checklist to help you prioritize your actions and measure your organization's progress in your airway safety management efforts.

Create a Safer Airway Team and toolkit

- ☐ Assemble a core multidisciplinary leadership team to advance airway safety, including:
  - ☐ ED (emergency department), ICU (intensive care unit), hospitalist, and anesthesiology physician leaders
  - ☐ ED, ICU nursing leaders
  - ☐ Respiratory therapy leaders
  - ☐ Quality assurance (QA)/Safety leadership (VP or higher level)
  - ☐ Obstetric/neonatal/pediatric – their representation and expertise is crucial
- ☐ Under the leadership of an airway specialist physician develop a comprehensive airway toolkit method (such as the Safer Airway Bundle):
  - ☐ Start in the Operating Room (OR) or Post-anesthesia Care Unit (PACU), then ED and ICUs, and then move to pre-hospital settings, operating and recovery rooms, floor units, and other departments
  - ☐ Include these key components: Failed Airway Algorithm, Airway Cart, Airway Checklist/Time out/cognitive aids, Quality Assurance, intra-hospital and inter-hospital transport, and Team Training and dissemination of information of difficult airway management
  - ☐ Implement Safer Airway Essential Components, as described in "Actions for hospitals" in the Action Plan section

Track and analyze clinical data to find areas for improvement

- ☐ Require tracking and reporting of "near-misses" and complications of airway management
- ☐ Identify adverse outcomes that are iatrogenic (caused by medical examination or treatment) and preventable, including multiple intubation attempts, esophageal intubation, SpO_2 less than 90% or a decline of greater than 10%, and dental or soft tissue injury, front of neck (airway) access (FONA),, brain injury or death resulting from resulting from airway management.
  - ☐ Use these case data in medical staff training sessions to prevent recurrences, as a part of Continuous Quality Improvement (CQI)

- ☐ Provide regular airway management training for all care providers. This will help them:
  - ☐ IIdentify potential airway problems
  - ☐ Select and use the correct course of action
  - ☐ Understand when and how to call for expert help
- ☐ Analyze delays in care related to airway management problems, including any delays in surgery, in applying invasive (or non-invasive) mechanical ventilation, and in diagnostic studies
- ☐ Use patient stories – in written and video formats – to identify gaps and inspire change in your staff

What we know about airway management

This set of Actionable Patient Safety Solutions (APSS) promotes airway safety and gives broad recommendations for urgent and emergent airway management in settings both inside and outside of the OR, including: pre-hospital emergency medical services (EMS), EDs, ICUs, general medical/surgical units, procedural areas, and outpatient settings.

The Centers for Medicare and Medicaid Services (CMS) has identified airway safety as a priority area for Round 2 of the Hospital Engagement Networks (HENs) due to the high risk and significant impact of airway-related injuries and deaths.

Several U.S. and European organizations have provided focused evidence-based clinical recommendations to their specialty membership and general audiences. However, there have been few calls for specific standards outside of the OR. We strongly promote that this needs to change.

This Airway Safety APSS serves to:

- Highlight key need areas for best practice development and implementation
- Promote evolving programs that introduce a new level of practice and comprehensive airway safety engagement
- Launch the call for a multi-disciplinary airway safety collaborative – the collaborative will support further development, assessment, implementation, and promotion of clear actionable solutions to strengthen airway safety awareness, education, management, research, and policy

The problems with airway management

Delay or failure to secure a patient's airway or to have an unrecognized airway malposition (such as intubation of the esophagus) can result in preventable death or catastrophic injuries. Time delays are especially critical in pregnant women, infants, and children because the time to desaturation is markedly decreased due to various anatomical and physiological factors.

Using direct laryngoscopy for endotracheal intubation requires skill and training. It is a physically challenging, single-operator technique which has an unacceptable rate of failure, especially in the hands of non-airway specialists. Harm and death from any of these events can be preventable:

- Unrecognized esophageal intubation
- Many failed (repeated) attempts to secure the airway
- Failure to correctly secure the endotracheal tube (with tape or an alternative securing

method), which delays recognition of airway malpositioning

- Patient aspiration of gastric contents, airway injury, trauma to teeth, hypoxemia (low blood oxygen), and brain injury

The incidence of failed airways can be as high as 1 in 50-100 in ED and ICU settings and the occurrence of death or brain damage have been reported to be 38-fold (ED) to 58-fold (ICU) higher compared to the operating room setting (Cook and MacDougall-Davis, 2012). Even when airway management is ultimately successful, delays and multiple unsuccessful attempts may cause serious harm and death (Mort, 2004; Sakles et al., 2013; Natt et al., 2016).

Causes of preventable patient harm and death include:

- **The wide variation of airway management techniques and technology**

  The goals of airway management are essentially uniform, but clinical best practices are not standardized and depend heavily on provider specialty and physical locale in healthcare settings.

  In the most recent meta-analysis looking at prehospital intubation success rates (Crewdson, Lockey, Roislien, Lossius, & Rehn (2017). , the overall intubation success rate was 0.969 (0.616-1.000). The median overall intubation success rate for physicians was 0.988 (0.781-1.000) compared to the median overall intubation success rate of non-physicians being 0.917 (0.616-1.000) Thus failed intubations occur in as high as 38% of patients in non-physician intubator field cases and as high as 22% of patients in physician intubator field cases.

- Lack of video laryngoscopy (VL) equipment in all areas

  A wealth of scientific evidence shows VL's advantage over direct laryngoscopy in a variety of clinical settings, but the high cost of VL equipment has kept it from being widely adopted.

  VL allows the approach to airway management in the EMS setting to undergo a dramatic transformation (Chemsian et al., 2014). VL:

  - Improves the laryngeal view and results in higher success rates of endotracheal intubation (ETI), both during first pass attempts and after difficult or failed direct laryngoscopy in the hospital setting (Silverberg, Li, Acquah, and Kory,2015; Aziz et al., 2011)
  - May also enable remote viewing and coaching, while recording may facilitate documentation and quality improvement

- **Unrecognized esophageal intubation (intubation of the esophagus instead of the trachea)**

  Studies show that unrecognized esophageal intubation in prehospital settings is as high as 25% (Katz and Falk, 2001) and leads to a high likelihood of death.

  Waveform capnography can identify an endotracheal tube that has not been placed correctly in the trachea and incorrectly placed in the esophagus and therefore should be readily available to avoid preventable deaths. Yet some EMS agencies and some emergency departments have not yet adopted waveform capnography. The use of waveform capnography in the intubated patient is considered standard of care by the American Society of Anesthesiologists (ASA). It should be adopted as standard of care by all organizations whose providers are responsible for airway management.

- **Unplanned extubation (See APSS 8B)**

  Unplanned extubation, both in the field and in the hospital, is generally avoidable and potentially very costly. It happens in over 7% of patients who undergo mechanical ventilation in the ICU and complications of unplanned extubations result in over $4 billion in healthcare costs (da Silva and Fonseca, 2012).

  Although unplanned extubations are more likely in EMS settings due to the difficulties of transporting critically ill patients in a chaotic environment, incidents are not tracked in most EMS data systems. Similarly, most hospitals do not track unplanned extubations and therefore the 7% incidence may be an underestimate.

Inconsistent outcome definitions lead to underreporting and the true frequency of airway management-related injuries is unknown. It is clear, however, that the healthcare industry must transition away from viewing airway management-related injuries as the inevitable "cost of doing business", and redefine these complications as preventable iatrogenic harm.

Leadership plan

Show leadership's commitment to safe airway management

Hospital governance and senior administrative leadership must:

- Commit to reducing the incidence of preventable airway safety events, especially failed intubations, unrecognized malpositioned esophageal intubations, and unplanned extubations
- Promote correct documentation to minimize the risk of recurrent adverse airway events
- Strive to achieve a goal of zero preventable deaths
- Drive awareness regarding the seriousness of preventable airway-related safety events
- Determine the facility's rates of preventable airway safety events through reporting and tracking within a formal QI program
- Engage your QI/Patient safety leaders to implement the Institute for Healthcare Improvement's (IHI) Model for Improvement to reduce the incidence of preventable airway safety events
- Once you know your incidence rates, develop an organizational story and use the skill set of storytelling to drive organizational awareness, action, and focus on why there is a need for change
- Create a core multidisciplinary Safer Airway Team that includes:
  - VP of Quality/Safety
  - Physician, nursing, and respiratory care team leaders from Anesthesiology, ED, OR/PACU, and ICU
  - Clinical expertise from obstetrics, neonatal, and pediatrics

Hospital governance, senior administrative leadership, clinical leadership and safety/risk management leadership must:

- Commit to taking inventory and defining the performance gaps that exist within their own hospital/healthcare system
- Commit the financial support needed to implement this Actionable Airway Safety Solution (APSS)
- Work collaboratively and champion efforts that raise awareness about the seriousness of

preventable deaths from complications of airway management

- Shape a vision of the future, clearly define safety goals, and support staff as they work through improvement initiatives, measure results, and communicate progress towards these goals
- Commit to defining performance gaps within the organization (system-wide, hospital-wide, and by department)

Create the infrastructure needed to make changes:

- Support a comprehensive approach to standardized data tracking, quality management, and process improvement efforts
- Support the implementation of practice and technology plans necessary to stop preventable deaths from complications of airway management
- Support the IHI Model for Improvement
- Set clear aims
- Identify changes that are likely to lead to improvement
- Establish measures that will clearly define if changes are leading to improvement
- Conduct small-scale tests of change using the Plan-Do-Study-Act (PDSA) cycle
- Hospital governance, senior administrative leadership, clinical leadership and safety/risk management leadership must commit to sharing airway safety best practices and lessons learned throughout your hospital and your hospital's healthcare system, and with other organizations outside your hospital's healthcare system
- Use patient stories – in written and video formats – to identify gaps and inspire change in your staff.
    - The story of Dave Bunoski, told by his wife Mimi Toomey, is an example of an unrecognized esophageal placement that can be viewed freely here: **https://youtu.be/3F7WDS00acY**
    - The story of Drew Hughes, told by his father David Hughes, is an example of an unplanned extubation, followed by a failed reintubation and unrecognized esophageal intubation, that led to the preventable death of Drew. You can view the story for free here: https://youtu.be/v8PV4mDWVWc

Action plan

This plan focuses on actions EMS and hospitals can take to improve airway safety. Actions for other stakeholder groups (such as outpatient procedure centers using moderate or deep sedation, professional healthcare stakeholder groups, industry, accrediting agencies, government, safety organizations, risk management and insurance companies, and consumer groups), are listed in **Appendix A:** Recommended actions for stakeholders.

Actions for EMS Basic Life Support (BLS) Units

- Use a Supraglottic Airway (SGA) device for cardiac arrests
- Schedule regular training courses and competency assessments for specific airway safety scenarios
- Enroll in regional and national systems for reporting adverse events and near-miss events, such as the EMS-based Emergency Medical Error Reduction Group at **www.emerg.org**

Actions for EMS Advanced Cardiac Life Support (ACLS) Units

- Ensure adequate training and promote the use of a SGA devicefor initial treatment of cardiac arrest and as a rescue device for failed or difficult intubation
- Ensure adequate training and promote the use of VL as your main device for endotracheal intubation
- Encourage the routine recording of VL attempts and where possible, time-stamped events such as heart rate and SpO2
- Use continuous waveform capnography on:
  - All SGA or intubated patients
  - Certain conditions known for creating problems with airway safety or adequate ventilation, such as overdose, respiratory distress, severe congestive heart failure, morbid obesity, and obstructive sleep apnea
- Schedule regular training courses and competency assessments for specific airway safety scenarios
- Enroll in regional and national systems for reporting adverse events and near-miss events, such as the EMS-based Emergency Medical Error Reduction Group at **www.emerg.org**

Actions for hospitals

- Establish high-reliability as the driving principle for airway safety, and as part of the overall culture of safety in all clinical areas
- Proactively embrace airway safety best practices before they are adopted by regulatory or accrediting organizations
- Form a standing leadership group for airway management safety including key stakeholders in C-suite Safety/Quality Administration, Emergency Medicine, Critical Care, Anesthesiology, Hospital Medicine, Respiratory Care, and Nursing
- Implement a system that quickly allows an anesthesiologist to assist with difficult airways in non-OR settings
- Develop standardized, site-specific systems for airway management in areas including ED, ICU, general units, and procedural areas.

The Safer Airway Program is a comprehensive, team-based system solution that hardwires evidence-based best practices in clinical settings and safety science. It provides broad recommendations and customizable tools for multiple healthcare settings including emergency departments, intensive care units, general medical/surgical units, and procedural areas. It calls for implementation of proven solutions such as Failed Airway Protocols (FAP), comprehensive equipment cart/systems, essential clinical practices, checklist utilization and team training. You can access more information here: http://www.saferairway.org/

The Safer Airway Program has been developed via a collaboration of Emergency Medicine Associates, (Germantown, MD), the Emergency Medicine Patient Safety Foundation (EMPSF), Society for Airway Management (SAM), and national advisors.

The American College of Emergency Physicians' Quality Improvement and Patient Safety Section (QIPS), the Patient Safety Movement Foundation, and other medical specialty organizations are leading the advancement of the Safer Airway Program.

Hospital-wide Failed Airway Protocol/Pathway (FAP)

	Solution and key features		Level of recommendation	Safety rationale	Reference source
1	**Failed Airway Protocol/ Pathway (FAP)** Alternative term is "Difficult Airway Pathway" (DAP)		Mandate	FAP should be operational, standardized, and actionable. Creates a team approach.	American Society of Anesthesiologists (ASA) and Difficult Airway Society (DAS),
	A	Choose a simple format (3-4 key steps) that can be known & used by all team members	Mandate	Aligns teams to focus on major vulnerabilities and key actions	NAP4
	B	Integrate "awake" non-paralyzed intubation into difficult airway pathway for ED/ICU	Highly recommend	Essential practice not commonly performed in EM	ASA DAS
	C	Include VL intubation for ED/ICU			
	D	Standardize throughout hospital	Highly recommend	Validated safety practice	

	Solution and key features		Level of recommendation	Safety rationale	Reference source
2	**Airway Equipment**				
	A	**Choose a consolidated Airway Cart** (standardized) that includes equipment for basic and difficult airway management. Use for all intubations and airway emergencies in the ED, ICU, OR, Post anesthesia Care Unit (PACU) and general unit settings.	Mandate	Avoids critical delays, assures equipment availability, and prompt access. Workspace with references.	ASA

	B	**Cart components** Organize the cart to support FAP progression of need.	Highly Recommend	Reinforces FAP and increases reliability	Mark L et al
	1	Oral (mouth) and nasal (nose) airways			
	2	Full face masks			
	3	Nasal CPAP mask			Smith, 2015
	4	VL – in room and ready for all intubations	Mandate	Gives higher 1st pass success and is an essential airway tool	ASA, NAP4, Cochran database
	5	Bougie type introducer catheters and stylets	Mandate	Critical adjunct	ASA, Emergency Medicine Australia, 2017
	6	SGA devices – appropriately sized to meet the needs of the patient population	Mandate		ASA
		a. SGA device	Mandate	Essential Rescue Device	ASA
		– SGA device with intubation capability	Highly recommend	Allows conversion to ETT	ASA
		– SGA devices with gastric access capability	Recommend	Lowers aspiration risk	DAS; Piegelir et al., 2016 Hansel et al., 2016
			Highly Recommend	Key rescue device option	
	7	Cricothyrtomy kits (simple surgical)	Mandate	High reliability kits	ASA
	8	Needle jet ventilation kits/sets – for pediatric patients under age 10, ONLY Use in ED/ ICU after failure of VL, DL, SGA and BVM. for adults Front of neck Access (EFONA)	Mandate		NAP4, ASA

	9	Continuous Waveform Capnography – maintained on all intubated patients including ED/ICU/ Transports and with central monitoring enabled	Mandate	Monitoring ventilation effectiveness and continued placement with ETT and SGA. Standard of care in UK/Europe and U.S. EMS but have significant gaps in U.S. EDs and ICUs.	ASA, AHA 2010 AARC (2003), ACEP, NAP4, AAGBI, ICS, EBA
	10	Endoscope (flexible fiberoptic scope or video scope) and/or optical stylets – in ED/ ICU at all times	Mandate	Essential for awake intubation, SGA conversion. Video scope preferred.	ASA
	11	LED blades/handles for direct laryngoscopy – replace bulb models with single-use models, which may be better	Highly recommend	10x brighter, higher reliability, and better visibility	Anes-thesia
	12	Devices or systems for securing airway in patient – to avoid unplanned extubation	Highly recommend	High rates of unplanned extubation (UE) in ED, ICU, and Transport settings	

	Solution and key features		Level of recommendation	Safety rationale	Reference source
3	**Critical practices** Use these recommended clinical and safety practices for preparing, performing, and maintaining artificial airways				
	A	Use a Checklist Quality Assurance (QA) tool for hardwiring and assessing critical practices	Mandate	Tool for practical preparation and critical practice assurance and QA monitoring	
	B	Use assessment, planning, and team communication for airway management – as appropriate in the various clinical settings	Mandate	Basic clinical and safety practices are known and accepted but often not utilized or hardwired into practice	ASA, NAP 4
	C	Use optimized patient positioning – such as tragus to sternal notch, head elevated laryngoscopy position (HELP), and ramped position in obese patients (Levitan et al., 2003)	Mandate	Critical but commonly overlooked	ASA, DAS
	D	Follow apneic oxygenation protocols – such as "no desat" or heated, humidified high-flow nasal oxygen or nasal CPAP	Mandate	Significant potential to prevent or delay desaturation in patients	Ann Emer Med, Wong, et al., (2017)
	E	Use 1- and 2-person BVM techniques – appropriate seal, jaw thrust, and prn Nasopharyngeal\ airway (NPA) and oropharyngeal airway (OPA)	Mandate	Key basic airway skill for all healthcare personnel in all settings. Often not effectively performed.	

	F	Use BIPAP/CPAP/ High Flow nasal oxygen (HFNO) pre-oxygenation in patients with persistent hypoxia	Highly recommend	Useful with persistent hypoxia in obesity, CHF, other	Ann Emer Med, Wong, et al., 2017; Smith, 2015
	G	Use delayed sequence intubation with ketamine – use for agitated patients with hypoxia	Recommend	Important for allowing pre-oxygenation	Ann Emer Med
	H	Quickly use SGA if DL/ VL failed	Highly recommend	Important airway rescue device when intubation fails	.ASA,DAS
	I	Place SGA and high flow nasal oxygen or nasal CPAP during odes (cardiac/ respiratory arrest)	Highly recommend	Assures open airway, prompt easy placement, and avoids resuscitation delay	
	J	Quickly use surgical cricothyrotomy when VL/DL, SGA, and BVM ventilation have failed (a cannot intubate cannot oxygenate situation). Only qualified personnel should perform this procedure.			NAP4, ASA
	K	Use flexible bronchoscope to convert SGA to ETT	Highly recommend	Blind techniques with only 65% 1st pass success rate	NAP4, DAS
	L	Use AFOI or other non-paralyzed intubation techniques. Use for intubations that may be difficult or highly difficult.	Highly recommend	Essential practice that is not commonly performed in EM	ASA , DAS, NAP4
	M	Immediately use and maintain Continuous Waveform Capnography – on all intubated patients	Mandate	See equipment above	See references above

	N	Optimize sedation and restraint protocols to minimize UE	Highly recommend	Patients who are under sedation or agitated are at risk for airway loss (e.g. UE)	AJCC
	O	Formalize system for optimally securing ETT (Tube holders for adults, C- Collar infants in transport)	Highly recommend	UE causes high death rates – reportedly as high as 7%. High risk in pediatric patients	
	P	Implement a system for flagging identified difficult airway patients in EHR system	Highly recommend	Many EHR systems are able to flag difficult airway patients, but flagging is not developed or used	
	Q	Use extubation guidelines	Highly recommend		.ASA, NAP 4
	R	Implement system for tracking and reviewing QA data from intubations or UEs – see Airway Registry	Highly recommend	Safety reporting systems have shown low yield for near-miss events from fear of punishment	DAS
	S	Use strategies for avoiding peri-intubation hypotension by having medications ready prior to intubations	Highly recommend	Use IVF, positioning, and pressers in high-risk groups	
	T	Promote routine recording of airway management when video devices are utilized. Promote use of cognitive aids for routine and failed airway management, such as the Vortex Airway Approach (**vortexapproach.org**)			

	Solution and key features		Level of recommendation	Safety rationale	Reference source
4	**Team training**		Mandate		
	A	Train all clinical staff on airway safety protocols, equipment, and critical practices – including basic and advanced practices for preparation, performance, and post-intubation management. Make sure all clinicians doing airway management are credentialed.	Mandate		
	B	Promote teamwork and clear communication – include a plan for sharing, open communication, and debriefing	Mandate		
	C	System for ensuring that practitioners are trained and credentialed in airway management			

Technology Plan

These suggested practices and technologies have shown proven benefit or, in some cases, are the only known technologies for certain tasks. If you know of other options not listed here, please complete the form for the PSMF Technology Vetting Workgroup to consider: **patientsafetymovement.org/actionable-solutions/apss-workgroups/technology-vetting/**

Test and use airway management devices that improve safety and drive better patient outcomes, including:

System or Practice	Available technology
ONC Meaningful Use Certified Electronic Health Record (EHR) System An effective EHR System should include: • Computerized Provider Order Entry (CPOE) • Drug-drug interaction check • Drug-allergy interaction check • Clinical Decision Support tools (CDS)	

Laryngoscopes

A laryngoscope is a rigid airway visualization device that allows the user direct vision of the glottis (vocal cords), through which he/she will manually pass an endotracheal tube. It generally consists of a handle, held in the user's left hand, and an attached blade, inserted through the mouth in such a way as to move the tongue and allow a direct visual path to the glottis. The use of this device requires considerable skill and training, and it may be unsuccessful in patients with difficult airway anatomy. The most commonly used laryngoscope blades include the straight blade (Miller Blade), traditional curved blade (Macintosh Blade) and acute angle blade.

Direct laryngoscopy (DL) has been used for decades to perform placement of endotracheal tubes. In 2001, video laryngoscopy (VL) was introduced. Although the literature has little to support that VL improves first pass success, some meta-analyses suggest that VL reduces the incidence of difficult or failed intubation.

Therefore, based on VLs ability to reduce failed intubations, it is highly recommended that:

- VL equipment be readily available for all intubations
- All airway providers responsible for intubation be trained and comfortable with these devices

Many providers and hospitals haven't made the transition to VL, either because the cost of VL equipment or the change in technique required for successful VL. More recently, many video laryngoscopes have developed VL equipment that allows use of a traditional DL technique. This change may help with the transition.

Video Laryngoscopes

A video laryngoscope is a rigid device similar to an ordinary laryngoscope, with the addition of a fiber-optic light pathway for both illuminating and visualizing the glottis. Properly inserted into the mouth, the video laryngoscope can show the user an image of the glottis on a screen, without the requirement to establish a direct line of sight from the glottis to the user's eye. The user can then insert the endotracheal tube through the glottis while monitoring the displayed image.

An effective VL system should:

- Be portable and easy to use
- Have clear and reliable airway visualization without fogging
- Permit ETT delivery with minimal operator fine motor skills
- Have a large video screen that allows multiple operators to act as a team. Devices with small video screens may be better when space is limited, such as in helicopters
- Have large image storage capability
- Have low risk for cross-contamination
- Have capablilities fpr recording events for clinical documentation, review and teaching

Fiberscopes A "fiberscope" or fiber-optic bronchoscope is a highly flexible, guided tubular device that can be passed through the lumen of an endotracheal tube. The scope provides both light illumination and indirect visualization through its tip. The user can control the exact shape of the fiberscope tip to guide it through the patient's glottis. Once the tip of the scope has passed through the glottis, the endotracheal tube is advanced over the scope and into the trachea. Although video laryngoscopes have reduced the need for fiberoptic intubation, fiberscopes remain the device of choice in certain critical airway conditions, such as (angioedema, oropharyngeal neoplasm, head and neck radiation, and congenital deformity). A combined use of fiberoberoptic and Video Laryngoscope would be recommended as placing ETT through cords over just fiberoptic is still a blind intubation Low cost single-use fiberscopes with reusable video monitoring are now available asan alternative to high-priced reusable fiberscope systems. The availaility of single-use flexible scopes requires little capital investment and may be particularly suited in areas where they will be infrequently used.	Delete such as AMBU aScope. There are now multiple companies supplying single use

Supraglottic Airways Supraglottic airway devices are inserted through the mouth and do not pass through the vocal cords. They displace the tongue using a variety of technologies, thus creating an open airway between the mouth or nares and the glottis. Second-generation SGAs are now available and provide safety advantages over first-generation devices by allowing for easier placement, higher ventilation pressures, gastric decompression, and intubation through the device. It is recommended not to do a blind intubation through an intubating LMA as success rates arre low, thus use a fiberoptic bronchoscope. These technological advances have furthered the importance of having the latest generation of SGA devices available when needed as rescue or primary airway devices.	Supraglottic devices permitting gastric decompression include: • LMA ProSeal or Supreme (LMA) • AuraGain (Ambu) • (MedtronicCovidien)* • King LT-D (King) • iGel (Intersurgical) • AirQ (Cookgas) The Aintree Intubation Catheter (Cook Medical) allows for exchange of supraglottic airway to endotracheal tube using a flexible fiberscope
Waveform Capnography Capnography is the measurement of carbon dioxide tension (in mmHg) in the respired gas during both inspiration and expiration, and the display of that quantity versus time. This important technology has become the standard of care for intubated patients in the UK and parts of Europe. North American Intensive Care Units, Emergency Departments, and Emergency Medical Services are beginning to adopt this technology, but significant gaps exist. Continuous Waveform Capnography: • Should become a mandated safety practice for all SGA or intubated patients • Should have the capability to integrate into your facility's monitoring systems	

Endotracheal Tube Stabilizers The current systems for stabilizing endotracheal tubes include adhesive tape, cotton twill ties, and multiple commercial devices. Although the current literature does not clearly identify any particular device or technique that is superior, numerous devices on the market are clearly inferior in their ability to restrain against extubation forces. The most current cited unplanned extubation rate of 7.3% (with a rangeof studies showing rates as high as 35.8%) suggests that current stabilization techniques and devices are inadequate. Further research into developing a better stabilization system should be supported (da Silva and Fonseca, 2012).	

Measuring outcomes

Tracking will help your organizations improve and helps hospitals evaluate their progress on how they are doing. At this time, this workgroup has not developed metrics to track failed intubations or unrecognized esophageal placements. Please refer to APSS #8B for metrics on unplanned extubations.

Topic 1

Rate:

Outcome Measure Formula:

Numerator:

Denominator:

Metric recommendations

Indirect Impact:

Direct Impact:

Lives Spared Harm:

Lives Saved:

Notes:

Data Collection

Mortality (will be calculated by the Patient Safety Movement Foundation):

Conflicts of interest disclosure

The Patient Safety Movement Foundation partners with as many stakeholders as possible to focus on how to address patient safety challenges. The recommendations in the APSS are developed by workgroups that may include patient safety experts, healthcare technology professionals, hospital leaders, patient advocates, and medical technology industry volunteers.

Some of the APSSs recommend technologies offered by companies involved in the Patient Safety Movement Foundation. The workgroups have concluded, based on available evidence, that these technologies work to address APSS patient safety issues. Workgroup members are required to disclose any potential conflicts of interest.

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Appendix A: Recommended actions for stakeholders

These are recommended actions for stakeholder groups, other than EMS and hospitals, to improve airway safety.

Actions for outpatient procedure centers using moderate or deep sedation

- Ensure staff who administer sedation are trained to monitor and manage airways appropriate to the setting
- Use proper monitoring equipment and tools, including pulse oximetry and waveform capnography
- Equip your facility with needed airway management equipment and skills for use, including: oxygen therapy, bag-valve mask ventilation, BLS-level use of supraglottic airway devices

Actions for professional/healthcare/stakeholder organizations

Seek national collaboration with other professional, safety, and healthcare organizations in an Airway Safety Collaborative with the aim to help the industry:

- Learn more about airway management practices in a broad representation of hospitals and other clinical environments
- Develop and promote high impact best practices to be implemented in specified clinical units, such as pre-hospital, ED, ICU, medical/surgical floor, procedural areas, and outpatient settings
- Research system solutions to improve airway safety
- Develop education programs and materials for trainees and practicing clinicians

Actions for companies in the airway industry

- Collaborate with current and future safety initiatives to develop or modify products or solutions that best address airway safety threats. To do this:
  - Optimize human factors and device usability
  - Label products to be clearly and easily identified for size and use (considering human factors in high-stress events)
  - Seek out and respond to clinical and safety requests for modification
- Establish a mechanism for industry to collaborate on:
  - Rapidly identifying and responding to vulnerabilities
  - Seeking fast dissemination and adoption of high-reliability components to products or services
  - Package products for high reliability and easy access
  - Package essential supplies to work with portable airway cart systems
- Support:
  - Airway safety research
  - The development of a national airway safety policy
  - Unbiased educational forums for airway safety
- Participate in the Global Airway Safety (GAS) Collaborative

Actions for accrediting agencies

- Work with professional clinical/safety organizations to establish airway safety process, performance, and measurement standards
- Highlight and assess airway standards during site visits as a high priority focus
- Elevate airway safety as a national patient safety goal

Actions for government (funders/regulators/service providers)

- Work with professional clinical/safety organizations to establish airway safety process, performance, and measurement standards
- Fund, and encourage other to fund, research for improving airway management safety through the entire spectrum of hospital and healthcare settings
- Use financial incentives to help drive adoption of established highly reliable airway safety practices

Actions for safety organizations (global, national, regional, state levels)

- Assist, support, and participate in the development of a Global Airway Safety Collaborative
- Elevate airway safety as a national safety goal
- Support and promote the development and implementation of actionable airway safety solutions
- Network with potential funders to help empower development and research of airway safety solutions
- Support the development of airway safety training programs and tools

Actions for the risk management/insurance industry

- Elevate airway safety as a national safety goal
- Fund and support the development and implementation actionable airway safety solutions
- Establish financial incentives for groups that demonstrate implementation, tracking, assessments, and training in airway safety practices, tools, and procedures

Actions for consumer groups

- Support and help fund the development of a Global Airway Safety (GAS) Collaborative with the aim to elevate the airway safety standard of care
- Support and help fund safety organizations and programs that will help protect constituent members with regard to airway safety, including key focus areas in patient groups for older adults, children, and people with obesity
- Demand specific, demonstrable, and highly reliable airway safety programs from healthcare organizations and institutions.
- Help establish and promote public awareness campaigns for airway safety engagement, practices, and performance