Actionable Patient Safety Solutions (APSS) #8C:

Safer airway management in neonates and children

How to use this guide

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

Patient Safety MOVEMENT

Executive summary checklist

Major causes of patient morbidity and mortality include delays or failure to secure a patient's airway, recognize a malpositioned airway device, and maintain an airway device (Unplanned extubation See APSS 8D). These are all high priorities for airway safety efforts.

This checklist is to be used to help prioritize actions and measure an organization's progress in your airway safety management efforts.

Create a Safer Airway Team and toolkit

- ☐ Assemble a core multidisciplinary leadership team (Steering Committee) to advance airway safety, including:
  - ☐ Emergency, critical care, and anesthesia physician leadership
  - ☐ ED and ICU nursing leadership
  - ☐ Respiratory therapy leadership
  - ☐ Quality assurance (QA)/Safety leadership (VP or higher level)
  - ☐ Obstetric/neonatal/pediatric – representation and expertise are crucial for this population
- ☐ Develop a comprehensive airway toolkit (such as the Safer Airway Bundle) under the leadership of a physician airway expert,
  - ☐ Include these key components: Failed Airway Algorithm, Airway Cart, Airway Checklist/Time out, Quality Assurance, intra-hospital and inter-hospital transport, and Team Training and dissemination of information on 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, including multiple intubation attempts, unrecognized esophageal intubation, endobronchial intubation, SpO2 below target levels or a decline of > 20%, need for CPR during the procedure, and dental or soft tissue injury
  - ☐ Utilize 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:
  - ☐ Identify 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 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 hospital, including: pre-hospital emergency medical services (EMS), emergency departments (EDs), delivery rooms (DRs), intensive care units (ICUs), general medical/surgical units, procedural areas, and operating rooms.

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 operating room (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 and provide the platform for a multi-disciplinary Global Airway Safety (GAS) 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 recognize a malpositioned airway (such as intubation of the esophagus) can result in preventable death or catastrophic injuries. Similarly, failure to prevent an unplanned dislodgement of an endotracheal tube can also result in catastrophic injuries or death. Time delays are especially critical in pregnant women, infants, and children because the time to desaturation is markedly faster 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
- Multiple failed attempts to secure the airway
- Failure to correctly position and secure the endotracheal tube leading to unplanned extubation
- Patient aspiration of gastric contents, airway injury, trauma to teeth, skin, and mucosal pressure injuries, hypoxemia (low blood oxygen), and brain injury

Failed Intubations in Children

The incidence of failed intubations in children in out-of-hospital settings, defined by 3 or more unsuccessful attempts, is as high as 58%, and these or other major intubation difficulties are associated with higher odds of cardiac arrest (Hansen et al., 2016). Even for intubations

performed by hospital-based transport teams, 70% of neonates required multiple attempts, compared to 30% of the pediatric population (Smith et al., 2015).

In the hospital setting, first attempt intubation success in neonates is <50% (Sauer et al., 2016; Leone, Rich, and Finer, 2005; Foglia et al., 2019). Furthermore, endobronchial intubations occur up to 25% of intubated children (Hansen et al., 2016), and 7% to 58% of neonates (Pinheiro and Munshi, 2015) (Mainie, Carmichael, McCullough, and Kempley, 2006); they further contribute to ventilatory failure and other complications of tracheal intubation.

Thus, even for ultimately successful intubations, the combination of delays, multiple failed attempts, and ineffective ventilation due to ETT malposition may cause serious harm or death. Although no prospective studies provide data on the direct impact of difficult intubation on mortality rates in newborns (Sawyer et al., 2019), repeated intubation attempts in the highest risk newborns (those of extremely low birthweight) are associated with an increased risk of intraventricular hemorrhage (Sauer et al., 2016), as well as neurodevelopmental impairment or death (Wallenstein et al., 2016). Meanwhile, intubation success rates have shown a decreasing trend, possibly related to decreased experience during training (Hubble et al., 2010; Leone, Rich, & Finer, 2005).

Causes of preventable patient harm and death include:

1. 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.

   For example, the incidence of failed intubations in children in out-of-hospital settings, defined by 3 or more unsuccessful attempts, is as high as 58%, and these or other major intubation difficulties are associated with higher odds of cardiac arrest.(Hansen et al., 2016). Even for intubations performed by hospital-based transport teams, 70% of neonates required multiple attempts, compared to 30% of the pediatric population (Smith et al., 2015). For both pre-hospital and in-hospital locations including the delivery suite, neonatal and pediatric intubation success rates have shown a decreasing trend, possibly related to decreased experience during training (Hubble et al., 2010; Leone, Rich, and Finer, 2005).

2. 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. . Also, videolaryngoscope blades for the smallest neonates (size 00) are not yet available, and the design of existing blades may be suboptimal for ETT insertion in preterm newborns (Pouppirt, Foglia, and Ades, 2018). VL accelerates acquisition of intubation skills by trainees and it is useful for difficult airway management, although its advantages are less clear for expert intubators and outcomes were not improved by VL in a randomized trial in adult ICU patients.(Lascarrou et al., 2017; Pouppirt et al., 2018)

   VL allows the approach to airway management in the EMS setting to undergo a dramatic transformation (Chemsian, Bhananker, and Ramaiah, 2014).

   VL also:

   - 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

3. Unrecognized esophageal intubation (intubation of the esophagus instead of the trachea)

   Studies show that even in adults, unrecognized esophageal intubation in prehospital settings is as high as 25% (Katz and Falk, 2001). It leads to a high likelihood of death. In newly born infants, who normally start with oxygen saturations in the 60% range from birth, rapid detection of esophageal intubation is crucial, and this may occur in more than 50% of intubation attempts. (Repetto et al.,2001)

   Waveform capnography can rapidly help identify an endotracheal tube that has not been placed correctly in the trachea (Repettoet al.,2001) and should be readily available to avoid preventable deaths. Yet some EMS agencies have not yet adopted waveform capnography and technical limitations have delayed their routine use in newborns. However, colorimetric CO2 detection is widely available, inexpensive and easy to use, and it has been recommended by the internationally used Neonatal Resuscitation Program (NRP) to verify tracheal tube placement in newborns.(Textbook of Neonatal Resuscitation, 2016)

4. Endobronchial Intubation

   Successful insertion of a breathing tube in the trachea is not sufficient to provide a functional airway since a tube that is placed too deep and lies in a mainstem bronchus may restrict ventilation to one lung, resulting in severe hypoventilation, particularly in patients with pre-existing lung dysfunction. Endobronchial intubations were noted in 25% of children successfully intubated by EMS staff (Hansen et al., 2016), and also reported in 7% to 58% of neonates intubated in the hospital (Pinheiro and Munshi, 2015; Mainie, Carmichael, McCullough, and Kempley, 2006) , thereby contributing to ventilatory failure and other complications of tracheal intubation. Thus, even for ultimately successful intubations, the combination of delays, multiple failed attempts, and ineffective ventilation due to ETT malposition may cause serious harm or death. Other complications of endobronchial intubation include physical trauma to the airway by the tube tip, and accidental dislodgement of the tube during subsequent attempts to correct the tube position.

5. Unplanned Extubation

   Unplanned extubation, both in the field and in the hospital, is a common and costly problem. On average, it happens in 8% (0.8 - 18.5%) of patients who undergo mechanical ventilation in the PICU (Lucas da Silva and de Carvalho, 2010) and 18.2% (1.0% - 80.8%) of patients who undergo mechanical ventilation in the NICU (Lucas da Silva, Reis, Aguiar, and Fonseca, 2013). Although the literature does not address the rate of UE in EMS, it is expected that it is likely as high or higher than in the hospital, due to the uncontrolled environment and need for emergent transport of these patients. The complications of unplanned extubations result in the PICU and NICU result in over $500 million in healthcare costs (Roddy et al., 2015; Dominguez and Thiruchelvam, 2015).

The true frequency of airway management-related injuries is unknown. Recently, the National Emergency Airway Registry for Children (NEAR4KIDS) (Li et al., 2016) reported a 20% rate of

adverse tracheal intubation-associated events, whereas the National Emergency Airway Registry for Neonates (NEAR4NEOS; Foglia et al., 2019) reported similar adverse event rates, in addition to severe desaturation rates up to 69%. These data are from selected Children's Hospitals, and are underreported elsewhere. 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:

- Develop a culture of safety
- Commit to reducing the incidence of preventable airway safety events, especially failed intubations, unrecognized esophageal intubations, endobronchial intubations and unplanned extubations
- 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 Quality Improvement Methodologies such as 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 Anesthesia, ED, OR/PACU, o 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 Airway Safety 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 those 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,or other formalized QI approach.
- Set clear aims,including timelines
- 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 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**
    - The story of how St. Louis Children's Hospital has championed efforts to reduce preventable harm and death is told in this video: **https://www.stlouischildrens.org/health-resources/pulse/newborn-icu-patient-safety**

Action plan

This plan focuses on actions EMS and hospitals can take to improve airway safety. Actionsfor 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 supraglottic airway device (SGA) device for initial treatment of cardiac arrest and as a rescue device for failed or difficult intubation
- Ensure adequate training and promote the use ofVideo Laryngoscopy (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 subspecialties, 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, delivery suite, ICUs, 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.

  The Safer Airway Program is being 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.	
	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 Video Laryngoscopic (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 for the appropriate age range) 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), DR and general unit settings.	Mandate	Avoids critical delays, assures equipment availability, and prompt access. Workspace with references.	ASA NRP

	B	**Cart components** Organize the cart to support FAP progression of need.	Highly Recommend	Reinforces FAP and increases reliability	
	1	Oral (mouth) and nasal (nose) airways			
	2	Full face masks			
	3	Nasal CPAP mask			Smith, 2015
	4	Video laryngoscope (VL) – in room and ready for all intubations	Mandate	Gives higher 1st pass success and is an essential airway tool	ASA, NAP4
	5	Bougie type introducer catheters and stylets	Mandate	Critical adjunct	ASA
	6	Supraglottic airway devices (SGAs) – appropriately sized to meet the needs of this patient population	Mandate	Essential Rescue Device	ASA
		a. Laryngeal mask airways (LMAs)	Mandate	Essential Rescue Device	ASA, NRP
		– LMAs with intubation capability	Highly recommend	Allows conversion to ETT	ASA
		– LMAs with gastric access capability	Recommend	Lowers aspiration risk	
		b. King airway/ combitube – alternative to LMA or rescue for LMA	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 10and adults, Use in ED/ICU after failure of VL, DL, SGA and BVM.	Mandate		NAP4, ASA

	9	Continuous Waveform Capnography – maintained on all intubated patients including ED/ICU/ Transports and with central monitoring enabled; at a minimum, colorimetric capnometry for neonatal intubations	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.	AAHA 2010 AARC (2003), ACEP, NAP4, AAGBI, ICS, EBA, NRP
	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	Anesthesia
	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	
	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; however, hyperoxia should be avoided in newborns	Ann Emer Med, NRP
	E	Use 1- and 2-person bag-mask ventilation (BVM) techniques – appropriate seal, jaw thrust, and prn bilateral NPA and 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
	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; In neonatal resuscitation, LMA is functionally equivalent to ETT			NRP
	I	Place SGA during codes (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.			
	K	Use flexible bronchoscope to convert SGA to ETT	Highly recommend	Blind techniques with only 65% 1st pass success rate	NAP4
	L	Use awake fiberoptic intubation (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 unplanned extubations (UEs); in newborns, use developmental positioning, selective sedation	Highly recommend	Patients who are under sedation or agitated are at risk for airway loss (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 electronic health records (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		
	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	Considerations
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. 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 light pathway 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
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). Low cost single-use fiberscopes with reusable video monitoring, such as the Ambu aScope, are now available as an alternative to high-priced reusable fiberscope systems.

Supraglottic Airways	Supraglottic airways devices are inserted through the mouth or the nares, but 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 supraglottic airway (SGA) devices 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. These technological advances have furthered the importance of having the latest generation of SGA devices (and their advanced technology) available when needed as rescue or primary airway devices.
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, devices may differ in their ability to resist extubation forces. Standardization of the use of endotracheal tube stabilization systems by care teams has decreased unplanned extubation rates. The most current cited unplanned extubation rate of 7.3% (with a range of 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 et al., 2012).

*Company has signed some form of the Open Data Pledge. Find more information on the Patient Safety Movement Foundation website: **patientsafetymovement.org/partners/open-data-pledges/view-all-open-data-pledges/**

Technology Plan

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 improvement and helps hospitals and evaluate your progress 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.

Quality and safety metrics for intubations

Refer to NEAR4NEOS(Foglia et al., 2019) and NEAR4KIDS(Li et al., 2016) for detailed definitions on airway management encounters.

A tracheal intubation "Attempt" begins with the insertion of a laryngoscope or other airway insertion accessory device into a patient's mouth or nose, and ends with the removal of the device. A "Course" of advanced airway management denotes one method for securing an airway, which may involve one or more attempts. An "Encounter" for advanced airway placement may include one or more methods (courses), each involving one or more attempts.

Key performance indicators:

- Attempts per tracheal intubation encounter (mean)
- Failed tracheal intubation courses (%)
- Esophageal intubation with delayed recognition (%)
- Endobronchial intubation (%)
- (Severe adverse tracheal intubation-associated event – composite [%])

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.

Workgroup

Chairs

Arthur Kanowitz	Airway Safety Movement, Society for Airway Management, Securisyn Medical
David Hughes	Do It For Drew Foundation
Joaquim Pinheiro	Albany Medical Center

Members

This list represents all contributors to this document since inception of the Actionable Patient Safety Solutions.

Gillian Abir	Stanford University
Paul Baker	University of Auckland, New Zealand; AirwaySkills
Kris Bysani	Medical City Children's Hospital
Anna Cleobone Ruskin	University of Chicago
Rhashedah Ekeoduru	McGovern Medical School, University of Texas Health
Mitchell Goldstein	Loma Linda University Children's Hospital
Narasimhan Jagannathan	Northwestern University
Sarah Kandil	Yale New Haven Children's Hospital
Ariana Longley	Patient Safety Movement Foundation
Olivia Lounsbury	Patient Safety Movement Foundation
Lalainya O'Connell	Albany Medical Center
Chad Pezzano	Albany Medical Center
Donna Prosser	Patient Safety Movement Founation
Kellie Quinn	Advocate
Patricia Roth	UCSF Medical Center
Larry Roy	Advocate Children's Hospital, Chicago
Lamia Soghier	Children's National

References

Aziz, M. F., Healy, D., Kheterpal, S., Fu, R. F., Dillman, D. and Brambrink, A. M. (2011). Routine Clinical Practice Effectiveness of the Glidescope in Difficult Airway Management.

Anesthesiology, 114(1), 34–41. doi:10.1097/aln.0b013e3182023eb7.

Benoit, J. L., Gerecht, R. B., Steuerwald, M. T., & McMullan, J. T. (2015). Endotracheal intubation versus supraglottic airway placement in out-of-hospital cardiac arrest: A meta-analysis. Resuscitation, 93, 20-26. doi:https://doi.org/10.1016/j.resuscitation.2015.05.007

Chemsian, R. V., Bhananker, S. and Ramaiah, R. (2014). Videolaryngoscopy. International Journal of Critical Illness and Injury Science, 4(1), 35. doi:10.4103/2229-5151.128011.

Cook, T. M. and MacDougall-Davis, S. R. (2012). Complications and Failure of Airway Management. British Journal of Anaesthesia, 109(suppl 1), i68–i85. doi:10.1093/bja/aes393.

da Silva, P. S. L. and Fonseca, M. C. M. (2012). Unplanned Endotracheal Extubations in the Intensive Care Unit. Anesthesia & Analgesia, 114(5), 1003–1014. doi:10.1213/ane.0b013e31824b0296.

Foglia, E. E., Ades, A., Sawyer, T., Glass, K. M., Singh, N., Jung, P., . . . Nishisaki, A. (2019). Neonatal intubation practice and outcomes: an international registry study. Pediatrics, 143(1), e20180902. doi:10.1542/peds.2018-0902

Hansen, M., Meckler, G., Lambert, W., Dickinson, C., Dickinson, K., Van Otterloo, J., & Guise, J. M. (2016). Patient safety events in out-of-hospital paediatric airway management: a medical record review by the CSI-EMS. BMJ Open, 6(11), e012259. doi:10.1136/bmjopen-2016-012259

Hatch, L. D., Grubb, P. H., Lea, A. S., Walsh, W. F., Markham, M. H., Maynord, P. O., . . . Ely, E. W.

(2016). Interventions to improve patient safety during intubation in the neonatal intensive care

unit. Pediatrics, 138(4), e20160069. doi:10.1542/peds.2016-0069

Hatch, L. D., Grubb, P. H., Lea, A. S., Walsh, W. F., Markham, M. H., Whitney, G. M., . . . Ely, E. W. (2016). Endotracheal intubation in neonates: a prospective study of adverse safety events in 162 infants. J Pediatr, 168, 62-66.e66. doi:S0022-3476(15)01151-8 [pii];10.1016/j.jpeds.2015.09.077 [doi]

Hubble, M. W., Wilfong, D. A., Brown, L. H., Hertelendy, A. and Benner, R. W. (2010). A Meta-Analysis of Prehospital Airway Control Techniques Part II: Alternative Airway Devices and Cricothyrotomy Success Rates. Prehospital Emergency Care, 14(4), 515–530. doi:10.3109/10903127.2010.497903.

Hunt, K. A., Yamada, Y., Murthy, V., Srihari Bhat, P., Campbell, M., Fox, G. F., . . . Greenough, A. (2019). Detection of exhaled carbon dioxide following intubation during resuscitation at delivery. Archives of Disease in Childhood - Fetal and Neonatal Edition, 104(2), F187-F191. doi:10.1136/archdischild-2017-313982

Katz, S. H. and Falk, J. L. (2001). Misplaced Endotracheal Tubes by Paramedics in an Urban Emergency Medical Services System. Annals of Emergency Medicine, 37(1), 32–37. doi:10.1067/mem.2001.112098.

Kugelman, A., Golan, A., Riskin, A., Shoris, I., Ronen, M., Qumqam, N., . . . Bromiker, R. (2016). Impact of Continuous Capnography in Ventilated Neonates: A Randomized, Multicenter Study. The Journal of Pediatrics, 168, 56-61.e52. doi: https://doi.org/10.1016/j.jpeds.2015.09.051

Langhan, M. L., Auerbach, M., Smith, A. N., & Chen, L. (2012). Improving detection by pediatric residents of endotracheal tube dislodgement with capnography: a randomized controlled trial. J Pediatr, 160(6), 1009-1014. doi:S0022-3476(11)01262-5 [pii];10.1016/j.jpeds.2011.12.012 [doi]

Lascarrou, J. B., Boisrame-Helms, J., Bailly, A., Le Thuaut, A., Kamel, T., Mercier, E., . . . Group, C. R. i. I. C.-S. (2017). Video laryngoscopy vs direct laryngoscopy on successful first-pass orotracheal intubation among ICU patients: A randomized clinical trial. JAMA, 317(5), 483-493. doi:10.1001/jama.2016.20603

Leone, T. A., Rich, W., & Finer, N. N. (2005). Neonatal intubation: Success of pediatric trainees. The Journal of Pediatrics, 146(5), 638-641.

Levitan, R. M., Mechem, C. C., Ochroch, E. A., Shofer, F. S. and Hollander, J. E. (2003). Head-elevated Laryngoscopy Position: Improving Laryngeal Exposure During Laryngoscopy by Increasing

Head Elevation. Annals of Emergency Medicine, 41(3), 322–330. doi:10.1067/mem.2003.87.
Li, S., Rehder, K. J., Giuliano, J. S., Apkon, M., Kamat, P., Nadkarni, V. M., . . . Investigators, S. I. N. (2016). Development of a Quality Improvement Bundle to Reduce Tracheal Intubation–Associated Events in Pediatric ICUs. American Journal of Medical Quality, 31(1), 47-55. doi:10.1177/1062860614547259

Mainie, P., Carmichael, A., McCullough, S., & Kempley, S. T. (2006). Endotracheal tube position in neonates requiring emergency interhospital transfer. Am J Perinatol, 23(2), 121-124.

McCoy, E. P., Russell, W. J., & Webb, R. K. (1997). Accidental bronchial intubation. An analysis of AIMS incident reports from 1988 to 1994 inclusive. Anaesthesia, 52(1), 24-31.

Mort, T. C. (2004). Emergency tracheal intubation: Complications Associated with Repeated Laryngoscopic Attempts. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/15271750.

Natt, B. S., Malo, J., Hypes, C. D., Sakles, J. C., & Mosier, J. M. (2016). Strategies to Improve First Attempt Success at Intubation in Critically Ill Patients. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/27221259.

Ozawa, Y., Ades, A., Foglia, E. E., DeMeo, S., Barry, J., Sawyer, T., for the NEAR4NEOS Investigators (2019). Premedication with neuromuscular blockade and sedation during neonatal intubation is associated with fewer adverse events. Journal of Perinatology, 39(6), 848-856. doi:10.1038/s41372-019-0367-0

Pinheiro, J. M. B., & Munshi, U. K. (2015). Factors contributing to endobronchial intubation in neonates. Pediatric Critical Care Medicine, 16(1), 54-58.

Pouppirt, N. R., Foglia, E. E., & Ades, A. (2018). A video is worth a thousand words: innovative uses of videolaryngoscopy. Arch Dis Child Fetal Neonatal Ed, 103(5), F401-F402. doi:10.1136/archdischild-2017-314288

Pouppirt, N. R., Nassar, R., Napolitano, N., Nawab, U., Nishisaki, A., Nadkarni, V., . . . Foglia, E. E. (2018). Association Between Video Laryngoscopy and Adverse Tracheal Intubation-Associated Events in the Neonatal Intensive Care Unit. The Journal of Pediatrics, 201, 281-284.e281. doi:https://doi.org/10.1016/j.jpeds.2018.05.046

Prekker, M. E., Delgado, F., Shin, J., Kwok, H., Johnson, N. J., Carlbom, D., . . . Rea, T. D. (2016). Pediatric Intubation by Paramedics in a Large Emergency Medical Services System: Process, Challenges, and Outcomes. Annals of Emergency Medicine, 67(1), 20-29.e24.
https://doi.org/10.1016/j.annemergmed.2015.07.021

Repetto, J. E., Donohue, P. K., Baker, S. F., Kelly, L., & Nogee, L. M. (2001). Use of capnography in the delivery room for assessment of endotracheal tube placement. J. Perinatol, 21(5), 284-287.

Sakles J.C., Chiu S., Mosier J., Walker C., Stolz U., Reardon R.F.: The Importance of First Pass Success When Performing Orotracheal Intubation in the Emergency Department. Acad Emerg Med 2013; 20: 71-78.

Sauer, C. W., Kong, J. Y., Vaucher, Y. E., Finer, N., Proudfoot, J. A., Boutin, M. A., & Leone, T. A. (2016). Intubation attempts increase the risk for severe intraventricular hemorrhage in preterm infants—A retrospective cohort study. The Journal of Pediatrics, 177, 108-113. doi:http://dx.doi.org/10.1016/j.jpeds.2016.06.051

Sawyer, T., Foglia, E. E., Ades, A., Moussa, A., Napolitano, N., Glass, K., . . . National Emergency Airway Registry for Neonates, i. (2019). Incidence, impact and indicators of difficult intubations in the neonatal intensive care unit: a report from the National Emergency Airway Registry for Neonates. Arch Dis Child Fetal Neonatal Ed. doi:10.1136/archdischild-2018-316336

Silverberg, M. J., Li, N., Acquah, S. O. and Kory, P. D. (2015). Comparison of Video Laryngoscopy

Versus Direct Laryngoscopy During Urgent Endotracheal Intubation. Critical Care Medicine, 43(3), 636–641. doi:10.1097/ccm.0000000000000075.

Smith, K. A., Gothard, M. D., Schwartz, H. P., Giuliano, J. S., Jr., Forbes, M., & Bigham, M. T. (2015). Risk Factors for Failed Tracheal Intubation in Pediatric and Neonatal Critical Care Specialty Transport. Prehosp Emerg Care, 19(1), 17-22. doi:10.3109/10903127.2014.964888

Team-Based Airway Safety High Reliability for Airway Management. Retrieved from https://www.saferairway.org. Textbook of Neonatal Resuscitation. (2016). (G. Weiner, J. Zaichkin, & J. Kattwinkel Eds. 7 ed.). Elk

Grove Village, IL: American Academy of Pediatrics.

Wallenstein, M. B., Birnie, K. L., Arain, Y. H., Yang, W., Yamada, N. K., Huffman, L. C., . . . Stevenson, D. K. (2016). Failed endotracheal intubation and adverse outcomes among extremely low birth weight infants. J Perinatol, 36(2), 112-115. doi:10.1038/jp.2015.158

Wagner, J. L., Shandas, R. and Lanning, C. J. (2014). Extubation Force Depends upon Angle of Force Application and Fixation Technique: a Study of 7 Methods. BMC Anesthesiology, 14(1). doi:10.1186/1471-2253-14-74.

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 administers 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, delivery suite, ICU, medical/surgical floor, procedural areas, and outpatient settings
- Research system solutions to improve airway safety
  - Adapt tools and use data from NEAR4KIDS and NEAR4NEOS registries
- 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 of 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