# Street Level Airway Management (SLAM): If Your Patient Can't Breathe– Nothing Else Matters!

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***Learning Objectives:*** *After reading this article, the participant should be able to (1) define and state the goals of SLAM; (2) state the rationale for the SLAM Universal Emergency Airway Flowchart (SUEAF); and (3) list the five treatment pathways in the SUEAF.*

Street Level Airway Management® (SLAM®) is a system for teaching and learning emergency airway management to multidisciplinary groups of practitioners who practice from the "street level" through all areas of the hospital, especially in the nonoperating room areas. A major goal is to increase the success of tracheal intubation during nonoperating room emergency airway management and decrease the incidence of surgical airways, especially when no anesthesia provider is in attendance.

The closed malpractice claims studies on adverse respiratory events published by the American Society of Anesthesiologists[1,2] and the American Association of Nurse Anesthetists[3,4] document the need for airway education programs. Most respiratory claims in anesthesia are attributed to one of three different types of adverse respiratory events: 1) inadequate ventilation, 2) unrecognized esophageal intubation, and 3) difficult intubation.[1] SLAM focuses on preventing these and other airway pitfalls. Inadequate oxygenation and undetected esophageal intubation have decreased secondary to mandatory implementation of capnography and pulse oximetry in U.S. anesthetizing locations. However, difficult intubation continues to be a reportable source of morbidity and mortality in anesthesia.[5] SLAM seeks to address the prevention and resolution of airway pitfalls in all fields through the combined application of five elements: 1) the SLAM Airway Training Institute (SATI), 2) the SLAM Concept, 3) SLAM educational programs, 4) the SLAM Airway Provider Program, and 5) the SLAM Universal Emergency Airway Flowchart (SUEAF) (Figure 1).

## THE SLAM AIRWAY TRAINING INSTITUTE

SATI is a private corporation that produces and manages all SLAM activities. Its website (*www.airwayeducation.com*)[6] maintains information on programs,[7] and products[8] for emergency airway management, including the SATI Advisory Panel,[9] and educational sponsorship from the International Trauma Anesthesia and Critical Care Society (ITACCS [*www.itaccs.com*]).[7]

## THE SLAM CONCEPT

The SLAM Concept[10] maintains that most airway techniques used in anesthesiology can be applied to locations where emergency airway management is performed—from the street level[11,12] through all areas within the hospital.[2] Success or failure of emergency airway management in the prehospital setting,[13] nonoperating room hospital locations,[14,15] or the operating room[1,5,16,17] is often due to complex factors. Beyond the requirement for basic training and advanced skill in airway management, these factors include familiarity, availability and application of decision making strategies,[18-24] airway drugs,[14,15,17] adjunctive airway devices,[17,25-28] equipment for tracheal intubation,[23,29-32] and monitoring of lung ventilation.[23,31,33,34]

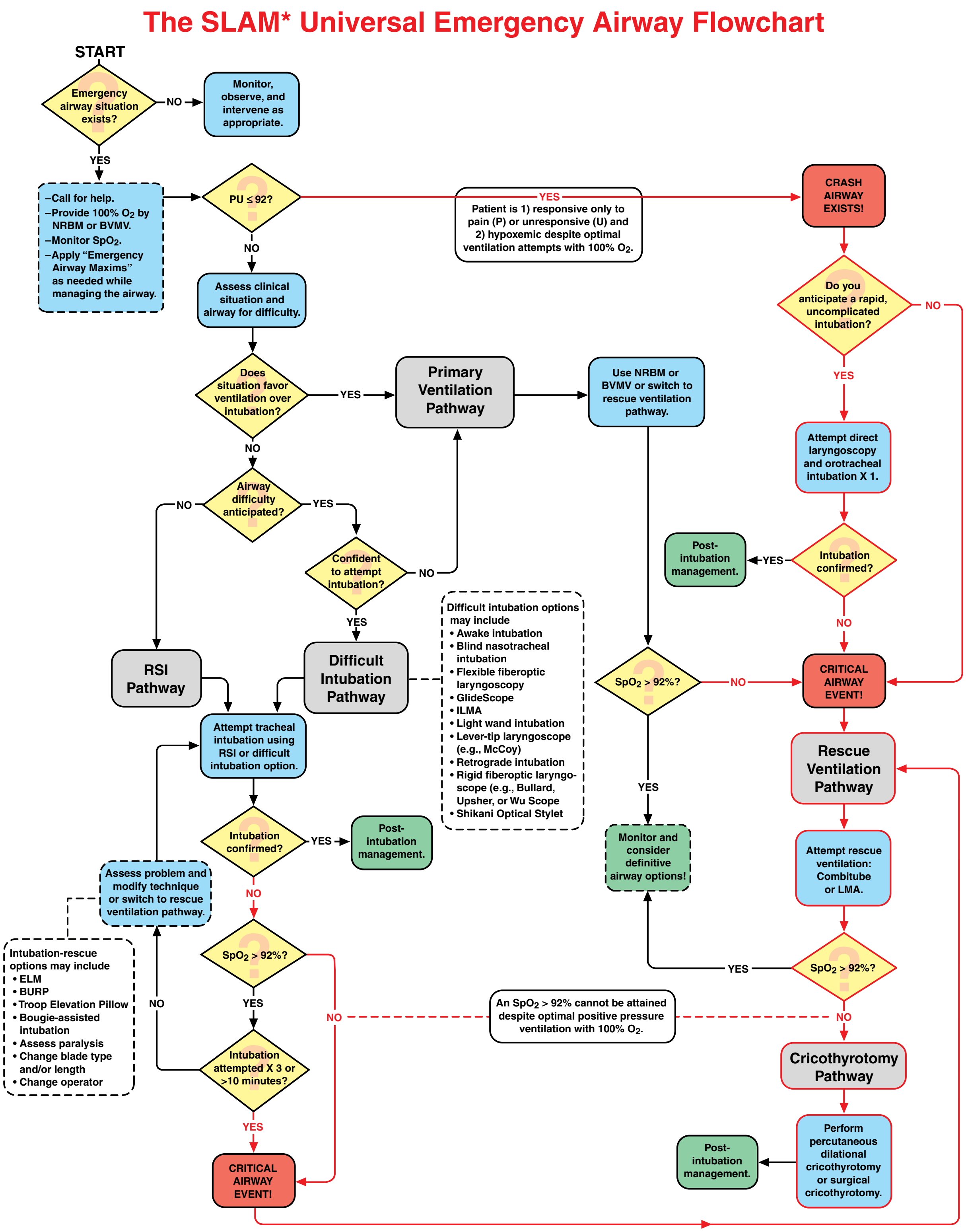
The emergency airway occurs ubiquitously across the spectrum of healthcare.[2,11-13,27,28,35] Additionally, practitioners

**Most airway techniques used in anesthesiology can be generally applied to locations where emergency airway management is performed from the street level.**

responsible for managing the emergency airway come from dissimilar groups with different levels of training and experience. However, each must provide a patent airway along with effective oxygenation and ventilation. Therefore, SLAM does not differentiate between practitioners in its approach to airway management training because providers at any level are exposed to similar airway difficulties and pitfalls. Actually, those having the most basic of training (eg, paramedics) are often presented with the most complex airway emergencies.[27]

The use of intubation rescue techniques (Table 1),[36-38] difficult intubation techniques (Table 2), and rescue ventilation techniques[27,39-44] (eg, administration of 100% oxygen and positive pressure ventilation, preferably via a Class IIa alternative airway device [ie, Combitube or LMA™])[23,45,46] to treat a critical

**Figure 1.**




*SLAM—Street Level Airway Management.

Flowchart developed by James M. Rich, CRNA, MA (www.AirwayEducation.com), Baylor University Medical Center, Dallas, TX.

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# Figure 1. (continued)

## Color and Line Key

- Pathway headings are gray.
- Decision points are yellow with a question mark.
- Action blocks are aqua.
- Explanatory blocks are white.
- Critical blocks, borders, and lines are red: Treatment delays can lead to serious morbidity or mortality.
- Safe blocks are green: Definitive airway is established or oxygenation is attained and maintained using a ventilation technique.
- Consideration borders are dashed: Factors to consider include airway difficulty, clinical setting, clinical situation, provider skill, equipment/device availability, provider privileges, medical direction, and protocols/standing orders.

## Abbreviations/Definitions

- **BAAM:** Beck Airway-Airflow Monitor (a.k.a. Beck whistle)
- **BURP:** Backward upward rightward pressure on the thyroid cartilage to improve the laryngoscopic view
- **BVMV:** Bag-valve-mask ventilation
- **Class IIa device:** A therapeutic option for which the weight of evidence is in favor of its usefulness and efficacy
- **Crash airway** patients have severe acute respiratory failure and typically 1) exhibit reduced responsiveness or are unresponsive; 2) have a respiratory rate of <10 or >30 breaths per minute; and 3) have severely depleted oxygen levels. Such patients are usually close to death and require either rapid tracheal intubation or immediate rescue ventilation.
- **Critical airway event:** Indicated by 1) any CVCI situation; 2) three or more failed intubation attempts or attempting intubation for >10 minutes (by the most experienced laryngoscopist); or 3) sustained hypoxemia that is refractory to positive pressure ventilation with 100% $O_2$
- **CVCI:** Cannot ventilate–cannot intubate
- **Definitive airway:** Orotracheal tube, nasotracheal tube, or surgical airway
- **Difficult intubation:** When multiple laryngoscopies, maneuvers, and/or blades are needed by the most experienced practitioner
- **Difficult/inadequate mask ventilation:** Inability of the most experienced practitioner to prevent or reverse signs of inadequate ventilation with one- or two-person positive pressure BVMV, using an oropharyngeal or nasopharyngeal airway (or both) and 100% $O_2$
- **ELM:** External laryngeal manipulation to improve the laryngoscopic view
- **Failed intubation:** Failure to intubate the trachea after multiple attempts, with or without hypoxemia
- **ILMA:** Intubating laryngeal mask airway or LMA-Fastrach
- **Lehane & Cormack laryngoscopic views of the airway:** Grade I—full view of the glottis from anterior to posterior commissure; Grade II—partial view of the glottis; Grade III—epiglottis only; Grade IV—soft tissue only—no visible laryngeal anatomy
- **LMA:** Laryngeal mask airway (LMA-Classic, LMA-Unique, LMA-Flexible, LMA-ProSeal)
- **MIAS:** Manual in-line axial stabilization
- **NRBM:** Nonrebreathing mask
- **PU ≤ 92:** (From Mason's PU-92 Concept.) With the AVPU system (A = alert; V = responds to voice; P = responds only to pain; U = unresponsive), patients with "P" or "U" assessments have Glasgow Coma Scale (GCS) scores of 9 or less. Hypoxemia exists with $SpO_2$ levels of 92% or less (allowing for ±2% accuracy of pulse oximeters). If a "P" or "U" assessment and hypoxemia occur simultaneously (i.e., PU ≤ 92) despite optimal attempts at oxygenation using positive pressure BVMV and 100% $O_2$, then a crash airway exists.
- **Rescue ventilation:** Administration of 100% $O_2$ and positive pressure ventilation (preferably via a Class IIa alternative airway device (i.e., Combitube or LMA) to treat a critical airway event
- **RSI:** Rapid sequence intubation. Relative indications are 1) head trauma with need for airway control and ventilation (e.g., Glasgow Coma Scale ≤ 9); 2) uncooperative or combative patient with compromised airway; 3) uncontrolled seizure activity requiring airway control; 4) depressed level of consciousness in trauma patient; 5) risk of pulmonary aspiration (e.g., full stomach).
- **SLAM:** Street Level Airway Management is an instructional system for teaching emergency airway management (www.AirwayEducation.com).
- **$SpO_2$:** Oxygen saturation as measured by a pulse oximeter
- **Tracheal intubation:** Indications include 1) airway protection and risk of aspiration; 2) definitive maintenance of airway patency; 3) head injury and Glasgow Coma Scale ≤ 9; 4) mechanical ventilation and respiratory failure; 5) emergency surgery and requirement for general anesthesia; 6) application of advanced cardiac life support and drug administration; 7) maintenance of oxygenation or positive end-expiratory pressure; 8) pulmonary toilet.
- **Troop Elevation Pillow:** Airway management pillow that positions the patient in the head-elevated laryngoscopy position

## SLAM (Street Level Airway Management) Emergency Airway Maxims

1. **Call for help early. Maintain a portable emergency airway kit** with adjuncts that help to remedy difficult intubation, provide rescue ventilation, facilitate cricothyrotomy, and confirm tracheal intubation. **Patients suffer death and disability from failure to oxygenate and failure to ventilate,** not failure to intubate.
2. **Emergency airway situation (e.g., acute respiratory failure, airway obstruction, CO poisoning, CPR, critical airway event, drug-induced coma, respiratory arrest, tension pneumothorax, traumatic airway disruption): The simple recognition that a patient needs a definitive airway** does not mean that the patient should receive a definitive airway if the provider is not skilled in establishing one. **Never exceed your ability,** experience, or scope of practice. **Consider naloxone or dextrose** to treat drug-induced coma. **Patients with a clenched jaw** will require paralysis and/or sedation in order to facilitate access to the oropharynx. In the absence of RSI drugs, insert one or two soft nasopharyngeal airways to optimize oxygenation.
3. **Primary Ventilation: Provide 100% $O_2$** by NRBM or BVMV (± chin lift/head tilt or jaw thrust with oral/nasal airway as tolerated). **If tension pneumothorax exists,** decompress immediately. **Monitor $SpO_2$** (carbon monoxide toxicity will falsely elevate $SpO_2$). When a standard pulse oximeter probe fails to register a reading due to low perfusion, apply a probe to a different site or use Masimo SET technology. Hypoxemia is difficult to diagnose clinically, so make every attempt to use pulse oximetry or obtain a blood gas reading.
4. **Assessment: Assess the clinical situation and airway** for potential signs of difficulty (e.g., disproportion, distortion, decreased range of motion, and dental overbite). When no airway difficulty is predicted, unexpected difficulty managing the airway may still arise.
5. **C-Spine Protection: Protect the c-spine** in suspected or evident c-spine injury by using MIAS during all airway maneuvers and when c-spine collar is not in place. Any intubation technique is acceptable as long as MIAS is employed.
6. **Aspiration Prophylaxis: Provide available aspiration prophylaxis** to help prevent silent aspiration or passive regurgitation, e.g., cricoid pressure, particulate-free antacid, and metoclopramide. The aspiration prophylaxis afforded by the Combitube is comparable to that of a tracheal tube. The LMA protects against aspiration substantially better than BVMV. Direct laryngoscopy and tracheal intubation without neuromuscular blockers (NMBs) has a higher documented incidence of aspiration than RSI with neuromuscular blockers.
7. **Tracheal Intubation:** Use only methods with which you are trained and skilled. **Intubation attempts should generally be limited** to <10 minutes or ≤3 times by the most experienced practitioner. Employ intubation-rescue techniques between attempts (to decrease the occurrence of trauma, bleeding, and edema in the airway, which can impair mask ventilation or subsequent intubation attempts and possibly cause a CVCI situation). **Intubation-rescue techniques include** bougie-assisted intubation (e.g., gum elastic bougie, Eschman Introducer, SunMed Bougie Introducer, etc); ELM or BURP; head-elevated laryngoscopy position; assessing and/or improving neuro--muscular blockade; changing blade type (straight vs. curved) or blade length. **Along with the previously mentioned intubation-rescue techniques, difficult intubation options include but are not limited to** use of the McCoy laryngoscope, blind naso--tracheal intubation (± BAAM [+ Endotrol tube where mouth opening is inadequate]), and ILMA (± spontaneous ventilation; ± BAAM). Combined use of the Troop Elevation Pillow, ELM or McCoy lever-tip laryngoscope, and bougie introducer can synergistically facilitate intubation in patients with c-spine precautions (MIAS), morbid obesity, and other causes of Lehane & Cormack grade III or IV laryngoscopic views. **A definitive airway is always best;** however, rescue ventilation can provide interim improvement in oxygenation and ventilation until a definitive airway is established.
8. **Confirmation of Tracheal Intubation: Always confirm and document intubation** using an evidence-based device ($CO_2$ detector or self-inflating bulb) in conjunction with auscultation over the mid-axillary lines and abdomen. Use a quantitative or qualitative $CO_2$ detector in patients with a perfusing heart rhythm. Use a self-inflating bulb in patients with a nonperfusing heart rhythm.
9. **Rescue Ventilation: Provide rescue ventilation using a Combitube or LMA** in the presence of a critical airway event. The Combitube and LMA are supraglottic airway devices and thus can only assist with a supraglottic obstruction. If rescue ventilation fails, the final option is cricothyrotomy. Glottic or subglottic obstructions require intervention using either a tracheal tube or cricothyrotomy.
10. **Traumatized or Burn Airway: Avoid blind intubation techniques** in the presence of laryngotracheal trauma. Avoid neuromuscular blockers in blunt neck trauma to prevent potential airway collapse. Up to 6% of patients with blunt airway trauma may have coexisting c-spine injuries. Use only a tracheal tube to maintain patency of a surgical airway for acute burn and inhalation injuries and thus prevent subsequent edema of the anterior neck tissues from engulfing the surgical airway.

**SLAM (Street Level Airway Management) Universal Emergency Airway Flowchart**

- **The advice featured in this flowchart should be overridden when medical direction, clinical experience, the clinical situation, and/or local protocols dictate.**
- **This flowchart is intended for use in adult patients and should only be used by advanced airway practitioners who at a minimum are competent in the use of airway management drugs, direct laryngoscopy, tracheal intubation, rescue ventilation techniques, and cricothyrotomy.**
- **A thorough understanding of the flowchart is necessary prior to its use.**

**Table 1.** Rescuing intubation[17,23,33,36-38] (Used by permission from JM Rich, CRNA – SLAM Airway Training Institute– *www.airwayeducation.com*)

| Reason for Failed Intubation Attempt | Intubation Rescue Techniques |
|---|---|
| *Poor laryngeal grade* or *Poor laryngeal access* | ELM – External Laryngeal Manipulation<br>BURP – Backward Upward Rightward Pressure<br>Lever-tip laryngoscope<br>Head-Elevated Laryngoscopy Position (HELP) (eg, Troop Elevation Pillow)<br>Changing the blade length (eg, Δ 2-Miller to 3-Miller)<br>Changing the blade type (eg, Δ curved to straight)<br>Changing the operator (one with more experience or better access)<br><br>Bougie-assisted intubation (eg, Eschmann or Sunmed)<br>Assessing the degree of muscle paralysis<br>Combined use of a lever-tip laryngoscope and bougie for cervical spine–injured patients or morbidly obese patients |

Intubation rescue techniques may assist with an anticipated or unanticipated difficult intubation. "Intubation Rescue" is accomplished by first assessing the reason for the failed intubation attempt and modifying the subsequent attempt by using one or more "intubation rescue techniques" to produce an optimal laryngoscopic exposure of the glottic inlet.

**Table 2.** Difficult intubation options[17,23] (Used by permission from JM Rich, CRNA–SLAM Airway Training Institute– *www.airwayeducation.com*)

| Technique | Considerations/Requirements |
|---|---|
| Awake Laryngoscopic Intubation | ± Judicious sedation; ± topical anesthesia |
| Blind Nasotracheal Intubation | Spontaneous Ventilation; ± judicious sedation; ± topical anesthesia; ± vasoconstrictor; ± BAAM. |
| Intubating LMA in spontaneously breathing patient | Use of Chandy's maneuver;[48] Spontaneous Ventilation; ± sedation; ± topical anesthesia; ± BAAM. |
| Intubating LMA in an apneic patient | Use of Chandy's maneuver;[48] positive pressure ventilation |
| Retrograde Intubation | Can Ventilate – Can't Intubate situation; ± PET; ± DL |
| Rigid Fiberoptic Laryngoscope | ± Upsher Laryngoscope or ± Wu Scope or ± Bullard Scope |
| Flexible Fiberoptic Bronchoscope | Nasal vs. Oral; Awake vs. GA; ± Spontaneous Ventilation; ± judicious sedation; ± topical anesthesia; ± topical vasoconstrictor |
| Videographic Laryngoscopic Devices | Glide Scope |
| Fiberoptic stylet | Shikani Optical Stylet; ± DL |
| Intubation Rescue Techniques[36-38] | May assist with either an anticipated or unanticipated difficult intubation |

Intubation requires prior preparation of equipment, airway drugs; the patient (eg, aspiration prophylaxis; position; preoxygenation). Possible use of intubation rescue techniques – see Figure 1 and Table 1. DL = direct laryngoscopy; GA = general anesthesia; LMA = laryngeal mask airway; PET = Parker Endotracheal Tube.

**Table 3.** Methods for confirmation of tracheal intubation[23,51,54] (Used by permission from JM Rich, CRNA–SLAM Airway Training Institute–*www.airwayeducation.com*)

| **Non-Failsafe Methods** | **Non-Failsafe: Recommendations–Benefits - Hazards** |
|---|---|
| • Auscultated breath sounds over chest<br>• No breath sounds auscultated over abdomen<br>• No gastric distention<br>• Chest rise and fall<br>• Intercostal spaces flare out with inspiration<br>• Large spontaneous exhaled tidal volume<br>• Tracheal tube fogging ( - with inspiration and + with expiration)<br>• Air heard exiting the tracheal tube when chest is compressed<br>• Reservoir bag has appropriate compliance<br>• Reciprocating pulsed pressures between endotracheal tube (ETT) pilot balloon and suprasternal notch when suprasternal notch is compressed | • Non-failsafe methods should only be used in conjunction with other evidence-based methods–near failsafe or failsafe.<br>• Use of only non-failsafe methods has resulted in death and brain death secondary to the occurrence of undetected esophageal intubation.[1,13,49-51] |
| **Near-Failsafe Methods** | **Near-Failsafe: Recommendations–Benefits - Hazards** |
| • Carbon dioxide ($CO_2$ ) detectors and esophageal detector devices (EDD)<br>• The choice of portable $CO_2$ detectors includes:<br>  • disposable qualitative colorimetric $CO_2$ detectors (eg, Easy Cap II $CO_2$ Detector or Capnoflo - Tyco-Healthcare-Nellcor);<br>  • portable qualitative nonwaveform electronic carbon dioxide detectors (eg, Nonin Medical, Inc, Plymouth, Minn); and<br>  • portable quantitative electronic $CO_2$ devices (eg, Tidal Wave Sp,<br>  • Novametrix Medical Systems, Inc, Wallingford, Conn).<br>• The EDD and $CO_2$ detector are considered to be *near–failsafe* because either occasionally can produce false-positive or false-negative readings.[51-53] | • Near-failsafe devices are evidence-based and are recommended for confirmation of tracheal intubation.[51]<br>• Use of a near-failsafe device should also include auscultation over the mid-axillary lines and epigastrium to help ensure the presence of bilateral lung ventilation.<br>• Choice of $CO_2$ detector vs. EDD is based on the patient's cardiac perfusion status[54]<br>• Perfusing cardiac rhythm–$CO_2$ detector[54]<br>• Nonperfusing cardiac rhythm–EDD[54]<br>• Use $CO_2$ detectors also permits monitoring of lung ventilation.[27] |
| • Disposable qualitative colorimetric $CO_2$ detectors<br>• Easy Cap II $CO_2$ Detector (Tyco-Healthcare-Nellcor, Pleasanton, CA) or<br>• CapnoFlo–(Tyco-Healthcare-Nellcor, Pleasanton, CA) | • Colorimetric $CO_2$ is adequate for both confirming tracheal intubation and monitoring lung ventilation during post-intubation management. However, they are not durable and can stop working after an indeterminate period of time.[27]<br>• Use $CO_2$ detection in patients with a perfusing cardiac rhythm.[54] |
| • Portable Electronic Qualitative Nonwaveform $CO_2$ detector<br>• Provides a qualitative range of $CO_2$ (eg, 30-50 mm Hg) via a lighted LED readout rather than an actual $CO_2$ reading<br>• Inclues apnea alarm | • Adequate for both confirming tracheal intubation and monitoring lung ventilation during post-intubation management.[27,28,51,54]<br>• No capnographic waveform is displayed which does not allow for the use of other capnographic-waveform benefits (eg, lower air way obstruction) |
| • Portable Electronic Quantitative Waveform $CO_2$ Detector<br>• Provides a quantitative reading of $CO_2$ in mm Hg<br>• Provides a capnographic $CO_2$ waveform<br>• Includes apnea alarm | • Best for confirmation of tracheal intubation and monitoring of lung ventilation in the presence of a perfusing cardiac rhythm because:<br>• It gives $CO_2$ reading in mm Hg and<br>• Has the benefit of a capnographic waveform |
| • Esophageal Detector Device (EDD)<br>• Self-inflating bulb (SIB) (eg, Tubecheck-B)<br>• Syringe type EDD | • EDD is adequate for detecting esophageal intubation but occurrence false positives and false negatives must be understood.[27,51-53,55,56]<br>• Use an EDD (eg, SIB) in patient's with a nonperfusing cardiac rhythm (eg, CPR; severe traumatic hemorrhage. EDD may also be used in patients with a tension pneumothorax.[27,28,51,54]<br>• The SIB primarily assesses ETC location within the esophagus or the trachea |
| **Failsafe Methods** | **Failsafe: Recommendations–Benefits - Hazards** |
| • Recognition of supraglottic anatomy around the endotracheal tube during a second laryngoscopic look (eg, epiglottis, arytenoids, vocal cords). | • Recommended in the absence of $CO_2$ or if EDD is indeterminate or not available.[51] |
| • Recognition of subglottic anatomy using flexible fiberoptic bronchoscope within the endotracheal tube (eg, tracheal rings, carina, right and left mainstem bronchi). | • Recommended during flexible fiberoptic intubation and can confirm any intubation if it is immediately available.[51] |

airway event (Figure 1) are central to the SLAM concept. Also important is evidence-based confirmation of tracheal intubation and monitoring of lung ventilation (Table 3). It is imperative that rescue ventilation devices are understood and available wherever airway management is practiced due to the temporizing benefits they offer when failed intubation occurs (Figure 1).[23,27,28,47]

## SLAM AIRWAY EDUCATION PROGRAMS

Airway education programs have been documented to produce a positive outcome with regard to improving the success of intubation and decreasing the need for cricothyrotomy.[57] SLAM educational programs include both lectures and hands-on training. Several iterations are offered, including 1-day advanced airway workshops and 2- and 3-day conferences (with human airway cadaver labs). Since 2001 the SLAM 1-day workshop[58] has been presented at the request of organizations at more than 40 different locations.[59] More than 2500 practitioners have attended SLAM meetings since the SATI's inaugural SLAM conference[7] in March 2000 in Dallas, Texas.

Lectures and hands-on instruction are provided by experts in paramedicine, anesthesiology, nurse anesthesia, emergency medicine, surgery, and nursing.[60] Hands-on training consists of clinical stations that use computerized airway simulators, airway management trainers, regimented scenarios, and human cadavers, as well as porcine laryngeal-tracheal segments. Topics include rescue intubation, overcoming difficult intubation, rescue ventilation, cricothyrotomy, and evidence-based techniques for confirmation of tracheal intubation and monitoring of lung ventilation. Upon successful completion of a written and hands-on test, participants receive a SLAM Airway Provider Card, which is valid for 2 years,[61] which documents successful completion of cognitive and skills evaluation for emergency airway management in accordance with SATI's standards for quality assurance and risk management purposes for emergency airway management training.

## SLAM AIRWAY PROVIDER PROGRAM

The SLAM Airway Provider Program is offered with the SLAM Express 1-Day Workshops. Upon successful completion of a written and hands-on test, participants receive a SLAM Airway Provider Card good for 2 years. This documents successful completion of cognitive and skills evaluation for emergency airway management in accordance with SATI's standards for quality assurance and risk management purposes for emergency airway management training.

## THE SLAM UNIVERSAL EMERGENCY AIRWAY FLOWCHART (SUEAF)

While other algorithms target a particular group of practitioners (eg, anesthesiology or emergency medicine),[19,22,24,62] the SUEAF was developed for a wide variety of airway practitioners (Figure 1). During development, the SUEAF was presented in various formats at several educational conferences,[47,63-68] and culminated by receiving the award for *best scientific exhibit for clinical application* at the 57th Postgraduate Assembly of the New York State Society of Anesthesiologists in December 2003.[69] A short flash movie highlighting the SUEAF is available on the Internet.[70]

Initially, the flowchart was introduced and reviewed as The SLAM Emergency Airway Flowchart[23], which has been changed to SUEAF to reflect its universal application with regard to the site of airway injury (eg prehospital or hospital) or type of advanced airway practitioner (physician vs. non-physician).

The flowchart assists in teaching emergency airway management, the acquisition of critical decision-making skills, and the improvement of patient care in regard to airway management. It fills a dual role in that it helps prevent and manage difficult airway situations through practical methods to modify failed intubation attempts, while providing the emergency airway practitioners with clinical guidance on 1) when tracheal intubation is appropriate, 2) when to stop attempting tracheal intubation, or 3) when to undertake rescue ventilation. Additionally, the SUEAF brings a new term to airway management, *critical airway event*, which summarizes dangerous airway conditions that are generally reversible using rescue ventilation, but may lead to death or disability if allowed to continue without intervention.[1,2,27] A critical airway event is indicated by 1) any cannot ventilate-cannot intubate (CVCI) situation, 2) three or more failed intubation attempts or attempting intubation for longer than 10 minutes (by the most experienced practitioner), and 3) sustained hypoxemia that is refractory to positive pressure ventilation with 100% oxygen (Figure 1).[23]

The SUEAF provides comprehensive and clear strategies for treating emergency airway situations, especially those occurring in the prehospital[11-13,21,35,71] and nonoperating room[2] hospital environments. It assists in teaching prevention, rapid recognition, and treatment of critical airway events, while assisting practitioners in developing decision-making skills in emergency airway management. The SUEAF also contributes to improved patient safety with regard to emergency airway management.[27,28] It is intended for use by advanced airway practitioners trained in direct laryngoscopy, tracheal intubation, the administration of drugs for airway management,[72,73] rescue ventilation techniques,[27] and cricothyrotomy.[74,75] Yet, it recognizes that airway management is performed in various locations by different types of practitioners who have different levels of training and experience.[11-13,15,27,28,72,76,77] The location of care can affect the clinical situation by creating difficulty in what might otherwise be an uncomplicated airway management encounter as is seen in prehospital confined-space rescue.[11,12,78] New evidence shows the timing and location of airway management in the hospital can directly affect patient outcome (ie, severity of injury increases and survivability decreases the further the distance of the occurrence of the injury from the operating room and PACU).[2]

The SUEAF has five treatment pathways: 1) primary ventilation, 2) rapid sequence intubation, 3) difficult intubation, 4) rescue ventilation, and 5) cricothyrotomy. Each pathway poses “YES” or “NO” questions that lead to a definitive airway or rescue ventilation. Tracheal intubation is not always achievable and airway difficulty is not always predictable.[17] Additionally, difficult laryngoscopy is reported to occur in approximately 6% of laryngoscopies in anesthesia.[17] However, difficult laryngoscopy created by the need for the neutral head position (eg, cervical spine precautions) has been reported to occur with an incidence as high as 42%.[79] Regardless of why laryngoscopy is difficult or failed intubation occurs, the situation can often be temporized using rescue ventilation.[27,43,44] A difficult airway situation can occur without warning and regardless of the experience or scope of practice of the practitioner;[1,5,11-13,77,80-82] therefore, the SUEAF does not differentiate between physician and nonphysician.

Death or brain damage occurred in more than 85% of 522 airway closed claims that were analyzed through 1985.[1] Inadequate ventilation, unrecognized esophageal intubation, and difficult intubation accounted for approximately 75% of the adverse respiratory events.[1] Improvements in monitoring within the operating room have greatly decreased the first two mechanisms of injury in anesthesiology.[27] However, reports of airway injury, inadequate ventilation, unrecognized esophageal intubation, and other complications of airway management continue to be reported.[5,13,15] The SUEAF is intended, at a minimum, to assist in preventing these types of airway complications.

A unique benefit of the SUEAF is that it assists in expeditious application of rescue ventilation through the use of Mason’s PU-92 Concept.[21] Patients who are either responsive only to pain (P) or unresponsive (U) with a simultaneous pulse oximetry ($SpO_2$) $\leq$ 92% are designated as a “crash airway patient” and require immediate tracheal intubation or rescue ventilation to survive.[21,23] Mason’s concept appears in the second yellow decision diamond after the flowchart’s starting point and assists in recognition of the crash airway patient (Figure 1).[23] Upon recognition that a crash airway exists, rapid treatment is required to prevent disability and, in the worst case, death. Once the patient’s oxygenation status improves, a definitive airway can be applied. Although newer techniques (eg, Cobra™ PLA [Engineered Medical Systems, Indianapolis, IN; EasyTube®, Rusch Inc., Duluth, Georgia; King LT, King Systems, Noblesville, IN) may eventually prove effective for rescue ventilation, the Combitube® and LMA currently are the only alternative airway devices with a class IIa designation (ie, a therapeutic option for which the weight of evidence favors its usefulness and efficacy).[27] Therefore, they are recommended preferentially for treating critical airway events.[17-19,23,24,27,28,33,43,54] However, since the esophageal-tracheal Combitube and LMA are supraglottic airway devices, they offer no assistance in overcoming a glottic or subglottic obstruction.[33] For these obstructions, a tracheal tube or cricothyrotomy is required.[33]

If rescue ventilation is not required initially, the flowchart directs the operator to assess the airway to determine whether the patient should be treated using the RSI pathway, the difficult intubation pathway, or the primary ventilation pathway. The primary ventilation pathway can be chosen in lieu of either of the tracheal intubation pathways if the clinical situation favors oxygenation/ventilation over intubation.[11,12,28,78] Both tracheal intubation pathways use a common format to direct the practitioner to 1) confirm intubation using an evidence-based method, 2) generally limit intubation attempts to less than 10 minutes and $\leq$ 3 attempts (by the most experienced laryngoscopist), 3) assess the reason for unsuccessful intubation and modify the intubation technique during the subsequent attempt (Table 1),[36-38] and 4) attempt to maintain an $SpO_2 > 92\%$ between unsuccessful attempts. This does not mean the practitioner should leave an intubation pathway or proceed with rescue ventilation if the oxygen saturation drops briefly below 93% but can subsequently be regained using optimal ventilation with 100% oxygen. However, leaving an intubation pathway and proceeding to the rescue ventilation pathway is indicated for sustained hypoxemia that cannot be corrected by optimal ventilation with 100% oxygen. Additionally, the rescuer can switch early to the rescue ventilation pathway if intubation is unfeasible after one or two attempts. When a critical airway event cannot be readily corrected by other means, one should proceed with rescue ventilation.[27] If rescue ventilation fails, the final option is performance of a cricothyrotomy.[74,75]

Throughout the SUEAF, oxygenation and ventilation are emphasized over intubation, because patients die or suffer brain death from failure to ventilate and oxygenate, rather than failure to intubate.[1,13,77,83] Additionally, the SUEAF recommends ready availability of a portable airway kit for either hospital or prehospital emergency airway management (Figure 1).[23] The main limitations of the SUEAF are that it is suitable for use only with adult patients, it cannot be used by rescue personnel who are not trained in the use of anesthetic drugs and neuromuscular blocking agents to facilitate intubation, and it depends heavily on assessment of the $SpO_2$. If measurement of $SpO_2$ is not possible, rescuers must proceed using their best judgment about the status of the oxygen content (eg, respiratory rate < 10 or > 30 bpm may indicate that a crash airway exists). However, because hypoxia is difficult to diagnose clinically,[84] every effort should be made to obtain a pulse oximeter reading. Use of the SUEAF may decrease the incidence of difficult intubation and/or help prevent airway trauma, which can cause death or disability.[1,5]

## CONCLUSION

SLAM has been introduced as a system for teaching and learning emergency airway management that was implemented to improve the care of patients requiring emergency airway management. It utilizes a conceptual framework, which maintains that most airway techniques used in anesthesiology can be generally applied to locations where emergency airway management is performed from the street level[11,12] to within all areas of the hospital (eg, operating room/PACU and nonoperating room).[2] The concept holds that the emergency airway occurs ubiquitously across the spectrum of healthcare.[2,11-13,27,28,35] From this concept an algorithm was developed for management of the difficult and emergency airway (Figure 1). It facilitates instruction at SLAM airway education programs. Beyond this, SATI has a program to document successful completion of cognitive and skills evaluation for emergency airway management for purposes of quality assurance and risk management. The impact of SLAM is directly related to the contributions and encouragement of the many professionals and organizations which the author has had the good fortune of working with throughout the past several years.

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***Disclosure of Unlabeled Use and Investigational Product Discussions***

Mr. Rich has indicated that this article does not discuss unlabeled uses of commercial products, or products that have not been approved by the FDA in the United States.

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