For emergency medicine and trauma professionals

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Prehospital Airway Management

by Francis Guyette, MD, MS, MPH, FACEP

A 36-year-old woman, weighing 60 kg, was driving her SUV without wearing her seatbelt and was thrown from her vehicle. You and your EMT partner are the first unit on scene. After determining that the scene is safe, you perform a primary survey by opening the patient's airway and observe that she is not breathing adequately. The patient's rating on the Glasgow Coma Scale (GCS) is 3; her blood pressure is 104/50 mm Hg; her pulse measures 128 beats per minute; she has a respiratory rate of 6 breaths per minute; and her oxygen saturations are 90% on room air.

You assess the patient's airway using the LEMON method (see Figure 1). Your EMT partner begins to assist the patient with a bag valve mask (BVM), delivering 100% oxygen. You

(Continued on Page 2)

Figure 1: The LEMON Airway Assessment Method

Follow the steps outlined in the LEMON method to evaluate patients with a potentially difficult airway.

- **L**ook externally. If a patient may require intubation, look for characteristics that generally predict a potentially difficult airway.
- **E**valuate, using the 3-3-2 rule. The patient should be able to fit three fingers into the mouth, three fingers from the angle of the jaw to the chin, and two fingers between the Adam's apple and the bottom of the jaw.
- **M**allampati score. Perform a Mallampati evaluation by opening the patient's mouth. The more of the uvula that can be seen, the easier the airway.
- **O**bstruction. Look for anything that might obstruct the oropharynx, including soft tissue swelling or foreign bodies in the airway.
- **N**eck mobility. Be aware that patients with limited neck mobility may not be able to be moved into the optimal position for intubation.

Prehospital Airway Management *(Continued from Page 1)*

prepare your equipment for intubation, ensuring that you have adequate suction and that the patient is on the monitor. When your partner is ready to remove the BVM, you ask her to place the patient on a nasal cannula at 6 liters per minute (LPM). Both a 7.5 mm and a 7.0 mm endotracheal tube (ETT) are placed next to the patient. You check the balloon and insert a stylet into the ETT, ensuring that the stylet does not go past the "Murphy eye" of the tube. A waveform capnography is connected, as is a commercial tube holder. From your airway bag, you take out a size 4 King LTS-D device, which is an airway management tool that can be used as a rescue device if needed. Your partner has been assisting the patient, who now has a blood oxygen saturation level of 99%. You suction blood from the patient's mouth and place the ETT through the vocal cords. You inflate the balloon, listen to the patient's breath sounds, and connect the End-Tidal CO_2 ($EtCO_2$). The tube is secured while your EMT partner reassesses the patient's vitals. You perform a secondary survey and prepare your patient for transport to the closest trauma center.

Prehospital airway management should always be considered difficult airway management. Prehospital providers must contend with limited equipment and resources, as well as a host of unpredictable factors, including suboptimal lighting, position, and weather. Successful prehospital airway management requires good judgment, training, and a plan, known as an airway algorithm (see Figure 2).

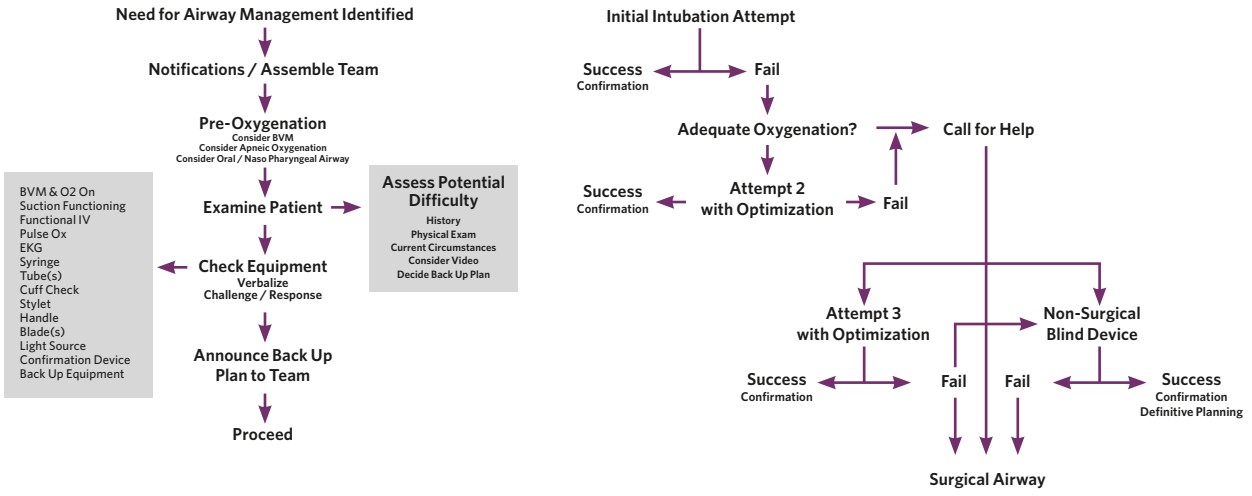
A prehospital airway management algorithm should begin with the provider performing an initial assessment, including the compressions, airway, breathing (CAB) sequence and initiation of basic life support (BLS) airway management. If a trauma patient is not perfusing, then hemorrhage and other life threats may need to be addressed first. For patients in extremis, ideally one provider will administer BLS airway management while the other performs life-saving interventions.

If the providers are not able to ventilate or oxygenate, they should immediately call for help. Calling for help in the field might mean asking for an additional unit or a supervisor, or driving to the closest hospital. If they are able to ventilate and oxygenate using BLS skills, then they should reassess the patient to determine if invasive airway management will be necessary. If endotracheal intubation (ETI) fails, adequately ventilated patients might warrant a second attempt with actions designed to improve intubating conditions (better positioning, different blade, or different operator).

Those who cannot be ventilated need additional resources, such as a supraglottic airway (SGA) device or surgical airway. Airway attempts should be limited to two per operator, as the probability of success drops dramatically after the second attempt.

Basic airway interventions provide supplemental oxygen and/or ventilation without an ETT or supraglottic device. Basic airway interventions should be mastered by providers of all skill levels. Patients who are breathing spontaneously should be placed on the lowest level of oxygen to maintain saturations > 94%. Patients in need of an advanced airway should be placed on a high-flow mask in order to allow the lungs to denitrogenate and provide a reservoir of oxygen for intubation. Patients who are not spontaneously breathing should be immediately supplemented by BVM ventilation. Because BVM ventilation can be difficult, this skill should be practiced using both one-handed and two-handed techniques with and without adjuncts, such as nasal trumpets and oropharyngeal airways. A two-handed technique that utilizes a jaw thrust into the mask is especially useful in a trauma patient. Continuous positive airway pressure (CPAP) may be used to reduce the work of breathing and to improve oxygenation in a spontaneously breathing patient. While CPAP use is limited in trauma patients, it may help to preoxygenate select patients prior to intubation.

Figure 2: Emergency Airway Management Algorithm



ETI is the most widely recognized method of invasive airway management performed by prehospital providers. ETI places a cuffed ETT below the vocal cords, providing for a stable airway with reduced risk of aspiration. However, ETI may result in failed intubation, unrecognized esophageal intubation, hypoxia, hypotension, bradycardia, aspiration, or airway trauma. The risks of ETI are compounded when performed by a provider who lacks experience; the average paramedic in Pennsylvania intubates only 1.5 times per year. This risk can be mitigated through improved training with the proper equipment, including practice in the operating room, simulation, and the use of adjuncts such as the gum elastic bougie or video laryngoscopy.

Prior to the first intubation attempt, all equipment necessary for ETI should be prepared using a checklist (see Figure 3), and the patient should be preoxygenated as described above. The patient should then be placed on a nasal cannula providing 6 to 15 LPM of flow for passive oxygenation during the intubation attempt. If drug-assisted intubation is available, rapid or delayed sequence induction should be provided with a sedative hypnotic agent. Current practice would suggest that etomidate or ketamine are the preferred agents for trauma, as they are least likely to negatively impact blood pressure. Ideally, sedation would be followed by use of a paralytic agent to eliminate airway reflexes and maximize the opportunity for successful ETI. Trauma patients should be held in cervical motion restriction from below while the collar is removed, allowing for jaw thrust and better visualization during ETI. Video laryngoscopy may have added benefits, including improved visualization of the vocal cords and decreased cervical motion, but this method requires additional cost and training. ETI attempts should be limited to two (blade past the teeth), at which point the provider should move to the next step in the difficult airway algorithm. ETI must be confirmed by $EtCO_2$ and monitored for vital sign abnormalities, including hypoxia, hypotension, and bradycardia.

An SGA device is typically used as a rescue tool when ETI fails, but may also be used as a primary airway for presumed difficult intubation if the patient has no protective reflexes. Following SGA placement, the airway must be confirmed and secured, similar to ETI. If possible, the stomach should be decompressed and the trauma team should be advised that an SGA device was used. As part of the failed airway algorithm, the provider must consider the option of surgical airway management. In rare circumstances, when the patient cannot be intubated or ventilated, surgical airway management may be the only viable option.

A comprehensive strategy for trauma airway management is necessary for all prehospital providers. For BLS providers, this should include skills with oxygen delivery, BVMs, and airway adjuncts. For advanced life support (ALS) providers, training in ETI, SGAs, and surgical airways provides the tools necessary to treat patients with difficult airways.

Figure 3: Intubation Preparation Check List

- ☑ BVM and O_2 on
- ☑ Nasal cannula on for apneic oxygenation
- ☑ Functional IV (for medication-assisted intubation)
- ☑ Monitor (Electrocardiogram, Pulse Oximeter, $EtCO_2$)
- ☑ 10 ml syringe
- ☑ Tube(s)
- ☑ Cuff check
- ☑ Stylet
- ☑ Blade(s)
- ☑ Handle (video system)
- ☑ Light
- ☑ Confirmation devices
- ☑ Commercial tube holder
- ☑ Back-up plan

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References

1 Wang HE, Yealy DM. How many attempts are required to accomplish out-of-hospital endotracheal intubation? *Acad Emerg Med.* Apr 2006; 13(4):372-377.

2 Reed MJ, et al. Can an airway assessment score predict difficulty at intubation in the emergency department? *Emerg Med J* 2005 Feb; 22:99-102.

3 Guyette FX and Wang HE (2015). EMS Airway Management. In Cone D, Brice J, Delbridge T, Myers B, *Emergency Medical Services Clinical Practice and Systems Oversight.* John Wiley and Sons, Hoboken.

4 Wang HE, Mann NC, Mears G, Jacobson K, Yealy DM. Out-of-hospital airway management in the United States. *Resuscitation.* Apr 2011; 82(4):378-385.

5 Warner KJ, Sharar SR, Copass MK, Bulger EM. Prehospital management of the difficult airway: a prospective cohort study. *The Journal of emergency medicine.* Apr 2009; 36(3):257-265.

6 Wang HE, Kupas DF, Greenwood MJ, et al. An algorithmic approach to prehospital airway management. *Prehosp Emerg Care.* Apr-Jun 2005; 9(2):145-155.

Topical Hemostatics in the Prehospital Setting

by Raquel M. Forsythe, MD, FACS

Uncontrolled hemorrhage is a leading cause of potentially preventable death from traumatic injuries.[1,2] The two most important interventions utilized to control hemorrhage in the prehospital setting are tourniquets and topical hemostatic agents. Topical hemostasis is a process that acts locally on a bleeding vessel to control hemorrhage. Below is a review of currently available topical hemostatic agents, explanations of how they work, and an overview of their relative effectiveness. Pennsylvania Statewide Basic Life Support (BLS) Protocols for Bleeding Control require that a commercial tourniquet be carried on every BLS/Advanced Life Support (ALS) ambulance and Quick Response Service (QRS). Hemostatic agents are optional, and approved agents may be used by appropriately trained providers with the following requirements:

1) The agency and agency medical director must ensure that all providers who will potentially use the hemostatic agent are trained in its use.

2) Hemostatic agents that are impregnated into gauze that can be packed into a wound are preferred. Otherwise, the hemostatic agent must be contained within a packet. Free powders are not approved.[3]

During the military conflicts in Iraq and Afghanistan, the U.S. Army Institute of Surgical Research developed a standard animal model for testing hemostatic agents to be able to compare how effectively they stop bleeding. Despite numerous studies using both animal models and case series of human uses, no single hemostatic dressing has been found to be consistently the most effective. When considering the purchase of a hemostatic dressing, multiple factors will play into the decision[4] (see Figure 1). The key is to choose the agent that best meets your specific needs, as none possess all ideal properties. Some first-generation topical agents generated significant heat with application, causing pain and tissue damage. Second- and third-generation agents generate little or no heat and are useful in a variety of settings. Common indications for the use of a topical hemostatic agent include penetrating wounds that are not amenable to tourniquet placement, particularly junctional wounds in the neck, groin, or axilla. Scalp wounds can lead to significant blood loss and may not be easily wrapped in the field. Hemostatic agents are also useful in patients on anticoagulants with bleeding wounds.

Mechanisms and Active Agents

The process of coagulation is a complex mechanism that involves vasoconstriction, formation of a platelet plug, and clotting of blood. Topical hemostatics work through one of three mechanisms.

Factor concentrators absorb water from the blood and concentrate the clotting factors in the blood at the site of hemorrhage. QuikClot® Granular and QuikClot Advanced Clotting Sponge, both made by Z-Medica, are examples of factor concentrators. Factor concentrators frequently contain zeolite, which is a naturally occurring crystalline aluminosilicate mineral. It is a porous material with cage-like cavities that attract water as well as sodium and calcium ions. They trap large amounts of water in the blood, which causes concentration of the clotting factors. The original QuikClot Granular preparation is a zeolite powder. However, because it generated heat upon application, it was removed from Tactical Combat Casualty Care (TCCC) recommendations in 2008 when improved second-generation agents became available.[5] The QuikClot Advanced Clotting Sponge contains zeolite beads enclosed in a mesh bag, which generate less heat than the earlier granular version.

Procoagulants activate the blood coagulation cascade. QuikClot Combat Gauze, also made by Z-Medica, is a procoagulant. The most common procoagulant agent is kaolin, which is a clay-based material. It is a naturally occurring aluminum silicate mineral that activates the coagulation cascade, accelerating clot formation in the wound. This is the active agent in Combat Gauze, which is the first-line agent in the Committee for TCCC guidelines for the U.S. military. Combat Gauze comes as a Z-fold to facilitate wound packing. Proper application of Combat Gauze requires packing into the wound and direct manual pressure to be held for three minutes, or until active bleeding stops.

Mucoadhesives form a strong adherent seal over bleeding vessels independent of the coagulation cascade.[6] Mucoadhesive agents are generally chitosan-based. Chitosan includes a series of polymers that are derived from the shells of shrimp and other shellfish. Chitosan does not have any actual clotting properties; instead, it has a positive charge that attracts negatively charged blood cells and platelets to form a gel that physically seals bleeding tissues. There is no heat generated

Figure 1: Properties of the Ideal Hemostatic Agent

- Approved by appropriate regulatory agency
- Quickly stops severe bleeding from arterial or venous source
- Lightweight and easy to carry
- No systemic or local toxicity or reaction
- No pain or injury with application
- Long shelf life
- Easy to apply to a variety of wound types
- Can be used in austere environments
- Cost-effective

during this reaction. Celox, made by Medtrade Products Ltd, and ChitoGauze®, made by Tricol Biomedical Inc., are both chitosan-based hemostatic agents.

Safe Use

Hemostatic agents are most likely to be indicated for wounds involving the scalp, face, neck, axilla, groin, or buttocks. Hemostatic agents are not appropriate for minor bleeding, bleeding that can be controlled by direct pressure, bleeding that can be controlled by application of a tourniquet, or bleeding from open abdominal or chest wounds. The spring 2016 edition of *Trauma Rounds* detailed the U.S. Department of Homeland Security's "Stop the Bleed" campaign, which is intended to empower everyone in the community to save a life by learning hemorrhage control techniques. Training, sponsored by UPMC, will be offered throughout western Pennsylvania. As the Stop the Bleed initiative rolls out and hemorrhage-control equipment becomes more commonly available in the community, injured patients may have topical hemostatics applied by law enforcement officers or the lay public prior to the arrival of emergency medical professionals. If bleeding is controlled, any applied hemostatics should be left in place until the patient's arrival in the emergency department. If ongoing bleeding is noted, removal and reapplication is warranted.

What's Next for Hemostatic Agents

Until all potentially preventable deaths from exsanguination are eliminated, research on improving methods to control hemorrhage in the field will continue. In December 2015, the U.S. Food and Drug Administration approved the use of the XSTAT 30™ wound dressing, which is an expandable, multi-sponge dressing for junctional wounds for both military and civilian trauma settings.[7] The first field use occurred in a military setting in May 2016 and was successful.[8] After further testing, this and other new types of topical hemostatic agents may be available in the near future.

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References

1 Eastridge BJ, Mabry RL, Seguin P, et al. Death on the Battlefield (2001-2011): Implications for the future of combat casualty care. *J Trauma Acute Care Surg* 2012; 73:S431-S437

2 Teixeira PG, Inaba K, Hadjizacharia P, et al. Preventable or potentially preventable mortality at a mature trauma center. *J Trauma* 2007; 63:1338-1346

3 Pennsylvania Department of Health, Bureau of Emergency Medical Services. Pennsylvania Statewide Basic Life Support Protocols. Accessed at http://www.health.pa.gov/My%20Health/Emergency%20Medical%20Services/EMS%20Statewide%20Protocol/Pages/default.aspx#.V3XaqLgrK01 on June 28, 2016.

4 Grissom TE, Fang R. Topical hemostatic agents and dressings in the prehospital setting. *Curr Opin Anesthesiol* 2015; 28:210-216

5 Bennett BL, Littlejohn L. Review of new topical hemostatic dressings for combat casualty care. *Mil Med* 2014: 179:497-514

6 Pourshahrestani S, Zeimaran E, Djoordjevic I, et al. Inorganic hemostats: The state of the art and recent advances. *Materials Science and Engineering C* 2016:58:1255-1268

7 FDA News Release. Accessed at http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm475810.htm on 6/30/2016.

8 RevMedX Press Release. Accessed at http://www.ireachcontent.com/news-releases/revmedx-announces-first-field-use-of--xstat-580244211.html on 6/30/2016.

Meet the UPMC Presbyterian Trauma/ Acute Care Surgery Experts

Front row (left to right): Rani Schuchert, MD; Brian Zuckerbraun, MD; Andrew Peitzman, MD; Louis Alarcon, MD; Matthew Rosengart, MD, MPH; and Deepika Mohan, MD, MPH

Back row (left to right): Timothy Billiar, MD; Matthew Neal, MD; Juan Carlos Puyana, MD; Raquel Forsythe, MD; Greg Watson, MD; Graciela Bauza, MD; and Jason Sperry, MD

"Surgical Rescue" and the System-Wide Management of Surgical Complications

by Matthew Kutcher, MD

The practices of trauma and emergency general surgery have evolved rapidly over the past 20 years, aiming to meet the demands of an aging population with increasingly complex medical and surgical issues. In 2005, as part of this evolution, the American Association for the Surgery of Trauma proposed the creation of a new surgical specialty called "acute care surgery,"[1] combining training in trauma, emergency general surgery, and surgical critical care. Including the fellowship at UPMC Presbyterian, there are now 19 accredited acute care surgery fellowships providing the newest generation of general surgeons with additional skills focused on emergent management of "time-sensitive surgical disease,"[2] often at times of the day or in clinical settings in which a specialist is not immediately available.[3] Several studies of the implementation of an acute care surgery-type model of surgical care have shown improved efficiency, reduced delay to operation, and shorter length of hospital stay for patients with acute surgical conditions such as appendicitis[4-7] and cholecystitis,[4, 8-11] while protecting the practice pattern and operative volume of general surgeons at the same institution.[12]

Practitioners of acute care surgery also possess unique skills in the management of patients with procedural complications. According to Centers for Disease Control and Prevention figures, of more than 36 million inpatient hospital discharges across the United States in 2006, more than 900,000 were related to a complication of medical or surgical care. This is a more common discharge diagnosis than bowel obstruction, appendicitis, and cholelithiasis combined.[13] In fact, 40% of in-hospital complications are related to an operative procedure, with complications 2- to 4.5-fold more common in surgical patients as compared to medical patients.[14] Several recent, large studies demonstrate that the incidence of complications across surgical specialties at high-performing hospitals (those with risk-adjusted low mortality rates) versus low-performing hospitals (those with risk-adjusted high mortality rates) is not significantly different. Instead, marked differences in mortality stem primarily from the capacity to expeditiously and appropriately "rescue" patients from the complication.[15-20] The skills of the acute care surgeon are uniquely tailored to the time-sensitive condition of such patients and are particularly critical in maintaining good patient outcomes in regional hospital systems as well as in individual hospitals with active interventional and surgical specialty services.

As a nationally recognized leader in acute care surgery research, the Division of Trauma and Acute Care Surgery at UPMC Presbyterian has been at the forefront of investigating the epidemiology, logistics, and best practices for management of patients with a complication of an interventional or surgical procedure, referred to as "surgical rescue."[21] Surgical rescue is a provision of immediate care (usually operative) to save the life of a patient who has a medical or surgical care complication. These vulnerable patients require immediate access to the operating room, intensive care unit (ICU), general surgeons, blood bank, and surgical subspecialties available at our institution. Analyzing UPMC Presbyterian's electronic medical records for the years 2013-2014, we used ICD-9 codes to screen for patients who were evaluated by an acute care surgeon for management of a surgical complication.[22] We learned that 20% of the patients on our Acute Care Surgery service were admitted specifically to be rescued from a complication of previous care. Of these complications, 88% were related to a previous operative procedure, while 12% were the result of an interventional or endoscopic procedure. Patients with a complication were, on average, older; had a significantly higher incidence of anemia, renal dysfunction, and shock during the course of their treatment; and had longer ICU and hospital stays compared to patients seen for other conditions. 82% of patients required an operation, and 53% required ICU-level care in the management of their complication.

Next, we investigated the circumstances of the original complication in our "surgical rescue" population. The patients who required surgical rescue originated primarily from other hospitals in the region and from different services than patients from within UPMC Presbyterian. Compared to UPMC Presbyterian patients, these "regional" referrals were the most likely to require primary operative therapy, as opposed to interventional procedures or critical care. Importantly, the in-hospital (7%) and 30-day (10%) mortality of patients transferred for surgical rescue were statistically similar to patients whose complication occurred at UPMC Presbyterian.

These findings coincide with evidence from nationwide administrative databases suggesting that the incidence of surgical complications is associated with individual patient characteristics, while the morbidity and mortality resulting from any given complication is primarily related to hospital practices.[23] A recent study of inpatient surgery, involving more than 200,000 Medicare patients undergoing six major elective operations, ranked hospitals into "high-performing" and "low-performing" groups based on risk-adjusted mortality rates. Surprisingly, complications occurred just as often in high-performing as in low-performing hospitals; the better survival rates in high-performing hospitals were the result of successful management of complications, with low-performing hospitals "failing to rescue" the patient with a complication.[14] A systematic review further

highlighted the fact that delay in the escalation of care occurred in 20-50% of patients with a complication and was a significant driver of associated mortality.[24] As awareness of the importance of rescue to hospital performance has grown over the past decade, "failure to rescue" (defined as the mortality rate in patients with a complication) is now being tracked as a quality metric that is publicly reported at the hospital level.[25, 26]

This ongoing research highlights the importance of UPMC's regional transfer network to the optimal care of surgical patients, as it provides hospitals in the region access to immediate operating room availability; medical and surgical specialists; advanced interventional and endoscopic services; and critical care capacity, all of which are key in the surgical rescue of patients with a complication.[14] Our ongoing research aims to further characterize best practices in surgical rescue, specifically focusing on improvements in early patient identification, information-sharing, and improved transfer protocols.

***Matthew Kutcher, MD**, is a trauma/acute care surgeon at the University of Mississippi. He completed his trauma/acute care surgery fellowship at UPMC and previously completed his residency at the University of California San Francisco. Dr. Kutcher earned his medical degree from Tufts University.*

References

1 Committee to Develop the Reorganized Specialty of Trauma SCC, and Emergency Surgery. Acute care surgery: trauma, critical care, and emergency surgery. *J Trauma* 2005; 58(3):614-6.

2 Santry HP, Pringle PL, Collins CE, et al. A qualitative analysis of acute care surgery in the United States: it's more than just "a competent surgeon with a sharp knife and a willing attitude." *Surgery* 2014; 155(5):809-25.

3 Davis KA, Dente CJ, Burlew CC, et al. Refining the operative curriculum of the acute care surgery fellowship. *J Trauma Acute Care Surg* 2015; 78(1):192-6.

4 Cubas RF, Gomez NR, Rodriguez S, et al. Outcomes in the management of appendicitis and cholecystitis in the setting of a new acute care surgery service model: impact on timing and cost. *J Am Coll Surg* 2012; 215(5):715-21.

5 Earley AS, Pryor JP, Kim PK, et al. An acute care surgery model improves outcomes in patients with appendicitis. *Ann Surg* 2006; 244(4):498-504.

6 Fu CY, Huang HC, Chen RJ, et al. Implementation of the acute care surgery model provides benefits in the surgical treatment of the acute appendicitis. *Am J Surg* 2014; 208(5):794-9.

7 Wright GP, Ecker AM, Hobbs DJ, et al. Old dogs and new tricks: length of stay for appendicitis improves with an acute care surgery program and transition from private surgical practice to multispecialty group practice. *Am Surg* 2014; 80(12):1250-5.

8 Britt RC, Bouchard C, Weireter LJ, et al. Impact of acute care surgery on biliary disease. *J Am Coll Surg* 2010; 210(5):595-9, 599-601.

9 Lau B, Difronzo LA. An acute care surgery model improves timeliness of care and reduces hospital stay for patients with acute cholecystitis. *Am Surg* 2011; 77(10):1318-21.

10 Lim DW, Ozegovic D, Khadaroo RG, et al. Impact of an acute care surgery model with a dedicated daytime operating room on outcomes and timeliness of care in patients with biliary tract disease. *World J Surg* 2013; 37(10):2266-72.

11 Michailidou M, Kulvatunyou N, Friese RS, et al. Time and cost analysis of gallbladder surgery under the acute care surgery model. *J Trauma Acute Care Surg* 2014; 76(3):710-4.

12 Barnes SL, Cooper CJ, Coughenour JP, et al. Impact of acute care surgery to departmental productivity. *J Trauma* 2011; 71(4):1027-32; discussion 1033-4.

13 Buie VC OM, DeFrances CJ, Golosinskiy A. National Hospital Discharge Survey: 2006 Annual Summary. *Vital Health Stat* 2010(168).

14 Ghaferi AA, Birkmeyer JD, Dimick JB. Complications, failure to rescue, and mortality with major inpatient surgery in medicare patients. *Ann Surg* 2009; 250(6):1029-34.

15 Almoudaris AM, Burns EM, Mamidanna R, et al. Value of failure to rescue as a marker of the standard of care following reoperation for complications after colorectal resection. *Br J Surg* 2011; 98(12):1775-83.

16 Ferraris VA, Bolanos M, Martin JT, et al. Identification of patients with postoperative complications who are at risk for failure to rescue. *JAMA Surg* 2014; 149(11):1103-8.

17 Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and failure to rescue with high-risk surgery. *Med Care* 2011; 49(12):1076-81.

18 Taenzer AH, Pyke JB, McGrath SP. A review of current and emerging approaches to address failure-to-rescue. *Anesthesiology* 2011; 115(2):421-31.

19 Tamirisa NP, Parmar AD, Vargas GM, et al. Relative Contributions of Complications and Failure to Rescue on Mortality in Older Patients Undergoing Pancreatectomy. *Ann Surg* 2015.

20 Wong SL, Revels SL, Yin H, et al. Variation in hospital mortality rates with inpatient cancer surgery. *Ann Surg* 2015; 261(4):632-6.

21 Peitzman AB, Leppaniemi A, Kutcher ME, et al. Surgical Rescue: An Essential Component of Acute Care Surgery. *Scand J Surg* 2015; 104(3):135-6.

22 Gonzalez AA, Dimick JB, Birkmeyer JD, et al. Understanding the volume-outcome effect in cardiovascular surgery: the role of failure to rescue. *JAMA Surg* 2014; 149(2):119-23.

23 Silber JH, Williams SV, Krakauer H, et al. Hospital and patient characteristics associated with death after surgery. A study of adverse occurrence and failure to rescue. *Med Care* 1992; 30(7):615-29.

24 Johnston MJ, Arora S, King D, et al. A systematic review to identify the factors that affect failure to rescue and escalation of care in surgery. *Surgery* 2015; 157(4):752-63.

25 Ghaferi AA, Birkmeyer JD, Dimick JB. Variation in hospital mortality associated with inpatient surgery. *N Engl J Med* 2009; 361(14):1368-75.

26 Wakeam E, Hyder JA. Raising the Bar for Failure to Rescue: Critical Appraisal of Current Measurement and Strategies to Catalyze Improvement. *JAMA Surg* 2015; 150(11):1023-4.

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