JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE

Airway Management in Trauma

To optimize the airway management for patients with traumatic injuries in the operational environment.

Note: This CPG incorporates the Airway Management of Traumatic Injuries and Airway Management in Prolonged Field Care into one guideline

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Original publication date: 18 Dec 2004	Publication Date: 28 Jan 2026	Supersedes: 17 Jun 2017

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SUMMARY OF CHANGES

1. The Airway Management of Traumatic Injuries CPG and the Airway Management in Prolonged Field Care Clinical Practice Guidelines (CPGs) were combined into a joint CPG to reduce redundancy. The new consolidated CPG is Airway Management in Trauma.
2. Significant changes were made to the Purpose/Background and main body sections.
3. The CPG was reorganized utilizing the SOAP ME (**S**uction, **O**xygen, **A**irway, **P**harmacy, **M**onitors/**M**achine, **E**TCO_2 and other **E**quipment) acronym. SOAP ME is a reasonable approach to "cleaning up" airway management for patients with traumatic injuries. It follows a more logical flow for the deployed provider. The sequence is better aligned with the steps necessary to manage trauma airways in austere environments.
4. Subsequent CPG sections were reordered, heavily edited, and updated.
5. The discussion of resuscitation before intubation and the use of advanced airway adjuncts like supraglottic airways and video laryngoscopy were added.

Airway Management in Trauma

Airway compromise is 2nd leading cause of combat casualty death after hemorrhage

Indications for Airway Management

Disrupted Face/Neck Anatomy

(MAY only require patient positioning if not sedated)

- Massive facial trauma
- Burns/hoarseness/stridor
- Massive neck trauma
- Expanding neck mass/hematoma
- Foreign body aspiration
- Anaphylaxis

Insufficient O2 or Ventilation

- Chest wall/pulmonary trauma (blunt or penetrating)
- Burns > 40% BSA
- TBI (GCS <8)/impending herniation (ETCO2 30-35)
- Procedural sedation/surgical procedure
- Respiratory failure from disease/infection /injury
  - Toxic inhalation
  - ARDS from Infection/resuscitation/drugs
  - Primary lung infection
  - Massive PE
  - TRALI/TACO due to massive transfusion

Airway Management Adjuncts

- Head tilt-chin lift
- Recovery position
- Sit up/lean forward
  - NPA if no basilar skull fracture
  - OPA if unconscious patient
- Supraglottic airway—Medic/meds/unconscious patient (Appendix D)
- Endotracheal tube—continuous meds required
- Cricothyroidotomy—invasive/high failure (Appendix E)
- Airway Management Summary (Appendix I)

METRICS

- Secure definitive Airway established and documented
- SpO2 documented
- EtCO2 documented at same Role of Care where airway established

This information is pulled from the evidence-based Joint Trauma System (JTS) Airway Management in Trauma Clinical Practice Guideline (CPG). JTS CPGs can be found at the JTS CPG website or the JTS Deployed Medicine site.

Airway Management in Trauma

Rescue techniques to secure an airway can conserve time and resources for other resuscitative priorities.

Treat Using the SOAP ME Method

S SUCTION

Min: Improvised (syringe + NPA)
Better: Manual suction bulb w/ adapter
Best: Powered commercial suction w/oral tip

O OXYGEN

Min: NC at 15L/min HOB elevated
Better: **Non-rebreather face mas**k at highest flow rate
Best: (Appendix C: BVM technique)
- Adequate Resp: reservoir mask + NC 15L/min
- Inadequate Resp: BVM with PEEP

A AIRWAY

Basic: NPA/OPA/BVM w/PEEP (patient positioning)
Intermediate: Supraglottic Airway
Advanced: Cuffed tube below the vocal cords (ETT/Cric/Trach) *Less is more - ETT/cric if indicated*

P PHARMACY: Beware rapidly falling BP

IV/IO Access:
Min: IM/IN for immediate sedation for Cric
Better: 2 patent IV/IO (16g or larger)
Best: 2 IV/IO + large bore CV access (7Fr or larger)

AIRWAY PLACEMENT
Min: Local for Cric w/o meds if conscious
Better: Any IV/IO sedation (Benzodiazepine/Opioid)
Best: Procedure dose Ketamine (1-2mg/kg IV push)

POST-AIRWAY PLACEMENT
Min: (no IV) ketamine 3-4mg/kg IM
Better: IV/IO push Ketamine, opioid, +/- midazolam
Best: Ketamine IV/IO drip w/Opioid push for BTP

M MONITORS/MACHINE

MONITORS:
Min: Pulse Ox (SpO2)
Better: Portable ETCO2 + SpO2
Best: Automatic VS monitor w/SpO2, ETCO2, EKG

MACHINE:
Min: BVM
Better: Auto portable Vent w/PEEP, O2 concentrator
Best: Full feature portable Vent w/ modes/PEEP/O2

E ETCO2 & OTHER EQUIPMENT

ETCO2:
Min: Visualize tube through cords/ausc bilat BS
Better: Colorimetric capnography
Best: Continuous ETCO2

ADVANCED AIRWAY EQUIPMENT:
Min: Supraglottic Airway, NG/OG tube
Better: Direct Laryngoscope, bougie, NG/OG tube
Best: Video Laryngoscopy, bougie, NG/OG tube

METRICS

- Secure definitive Airway established and documented
- SpO2 documented
- EtCO2 documented at same Role of Care where airway established

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PURPOSE

The intent of this Clinical Practice Guideline (CPG) is to provide evidence and experience-based solutions to those who manage airways in an austere environment. An emphasis is placed on utilizing the tools and adjuncts most often available in a resource-constrained environment. The JTS Mechanical Ventilation Basics CPG will address the specifics of mechanical ventilation. This CPG also introduces an acronym to assist providers and their teams in airway management for trauma and non-trauma patients in the operational environment.

BACKGROUND

Airway compromise is the second leading cause of potentially survivable death on the battlefield after hemorrhage.[1] Complete airway occlusion can cause death from suffocation within minutes. Austere environments present significant challenges with airway management. Considerations include variable provider experience, limitations of available equipment and finite supplies such as supplemental oxygen, medications for induction and paralysis, as well as post-intubation management. Another current reality is limited exposure and sustainment training, especially for advanced airway techniques. Airway management algorithms may change based on caregiver skillset, indications and resources. An important principle of airway management is that definitive airways (e.g., endotracheal tube and cricothyroidotomy) should only be placed if indicated. Every attempt should be made to manage patients with airway adjuncts first. **Remember, if an injured or critically ill patient is managing their airway on their own or with other adjuncts, placing a definitive airway is not a priority and other treatments should be performed first. If a definitive airway is not indicated, giving induction and paralytic medications can make a bad problem much worse , especially in hemodynamically unstable patients. If a patient does require a definitive airway and is in hemorrhagic shock, ensure adequate volume resuscitation prior to induction/intubation in order to prevent cardiovascular collapse. The ability to rapidly and consistently manage an airway when indicated and prioritize other resuscitative needs may contribute to improved outcomes.[2,3]**

INDICATIONS FOR AIRWAY MANAGEMENT

DISRUPTED FACE OR NECK ANATOMY

If managing an isolated injury that disrupts face or neck anatomy, healthy adults may only need treatment of the physical airway obstruction. Examples of conditions requiring early airway management include:

- Massive facial trauma
- Burns to the face or inhalation injury with hoarseness or stridor
- Massive neck trauma
- Expanding neck mass/hematoma
- Acute pharyngeal infection (Retropharyngeal abscess, peritonsillar abscess, epiglottitis)
- Foreign body aspiration
- Anaphylaxis (airway swelling)

INSUFFICIENT OXYGENATION OR VENTILATION

These indications may be apparent on initial evaluation or may emerge during the course of patient care. If the need to establish an airway develops more gradually, additional elective airway techniques can be employed. Interventions such as

prolonged manual bag or mechanical ventilation require an airway intervention to ensure best overall management. Examples include:

- Chest wall and pulmonary trauma (blunt or penetrating) such as flail segments, pulmonary contusions (from blast, blunt or crush mechanism)
- Burns with greater than 40% body surface area
- Traumatic brain injury with decreased level of consciousness and inability to protect their airway (GCS ≤ 8)
- Procedural sedation or surgical procedure
- Respiratory failure (inability to oxygenate or ventilate) from disease, infection, or injury

SUCTION, OXYGEN, AIRWAY, PHARMACY, MONITORS/MACHINE, END-TIDAL CARBON DIOXIDE ($ETCO_2$) & OTHER EQUIPMENT

Checklists and acronyms are used to support quality care and as an aide to providers who do not perform these procedures in their daily practice. In preparation for an advanced procedure (including securing an airway) using an acronym or other checklist can prove invaluable. One such acronym is presented: the SOAP ME acronym (**S**uction, **O**xygen, **A**irway, **P**harmacy, **M**onitors/**M**achine, **E**TCO_2 and other **E**quipment) which has been adopted to "clean up" and organize the preparation for airway management.

The patient's condition dictates the available time for a provider to consider all items on this checklist.

A rapidly deteriorating patient with airway compromise may need the airway procedure first and follow-on considerations later. If a patient can be more appropriately classified as semi-urgent (e.g., gradually worsening respiratory status) the provider will have more time to consider the algorithm and prepare. Recommendations follow the "minimum, better, best" format.

SUCTION

- **Minimum:** Improvised suction (i.e., syringe + nasopharyngeal airway [NPA]) and patient positioning if not contraindicated
- **Better:** Manual suction bulb with adapter
- **Best:** Powered commercial suction with oral tip and in-line endotracheal tube suction adapter

Suction should be available when establishing and maintaining an airway to remove excessive secretions or blood. It is particularly important to utilize suction to facilitate view of the vocal cords during endotracheal intubation. In addition, suction should be available for routine and emergency follow-up care for any intubated patient. Suction may need to be utilized as needed to remove secretions, mucous or blood from the airway. In the event of high airway pressures, suction may be used to remove mucus/mucus plugs or to clear obstructions. In the case of thick secretions, a saline flush of 1-2 mL followed by in-line suctioning of the endotracheal tube may be useful.

NOTE: *During in-line suctioning of tubes, the suction should only be applied when withdrawing the catheter and not upon initial insertion.*

OXYGEN

- **Minimum:** Standard nasal canula at 15L/min. Head of the bed elevated if not contraindicated.
- **Better:** Standard reservoir face mask with flow rate as high as possible.
- **Best:** If adequate respirations, standard reservoir face mask set with flow rate as high as possible augmented with nasal cannula at 15L/min oxygen in preparation for apneic oxygenation, leave in situ throughout procedure.

If inadequate respirations Bag-Valve-Mask (BVM) with positive end-expiratory pressure (PEEP) valve and flow rate as high as possible.

Preoxygenation prolongs tolerance of the apneic period. The goal is 3 minutes of tidal volume breathing at 90% Fraction of Inspired Oxygen (FiO2). For those with inadequate respirations BVM ventilation may be necessary. Though it appears to be relatively simple, the procedure requires preparation, training and skill to perform correctly. Care should be taken to ensure proper volume and rate of bag-delivered breath. One hand should provide moderate pressure to the bag for no more than 50% of the volume of an adult bag or just enough to see the chest begin to rise at a rate of 12-16 breaths per minute (one breath every 4-5 seconds) initially. The resuscitation bag should be no larger than 1000ml (For reference, the pocket BVM is 1600ml, 50% is 800 ml TV). It is important to avoid hyperventilation through large or rapid breaths. If able, use a two-handed technique to ensure a proper mask seal, with assistant squeezing the bag along with use of oropharyngeal or nasopharyngeal airway. See Appendix C: Bag-Valve-Mask Technique for a detailed description.

AIRWAY

Airway management

Airway management should follow a stepwise assessment, followed by:

- **Basic** interventions are recommended if it addresses the airway obstruction/respiratory insufficiency: Nasopharyngeal airway, oropharyngeal airway, BVM with PEEP valve (if available), patient positioning if not contraindicated.
- If the patient continues to decompensate, perform **intermediate** interventions: Supraglottic airway.
- If the patient requires emergent surgical intervention due to severe obstruction/respiratory insufficiency despite interventions above, obtain an **advanced airway**: oral endotracheal tube or via a surgical airway.

Positioning of the patient to help clear airway obstruction should be considered first, when possible. The simple option of placing the patient in a sitting position, placing the patient in the lateral "recovery" position, or head tilt-chin lift/jaw thrust maneuver may be enough to ensure adequate respirations. While beneficial, a jaw thrust or chin lift maneuver is difficult to maintain as it dedicates one individual solely to opening the airway. Likely more practical is placing a patient with their chin away from chest (whether its supine or recovery), when possible and not contraindicated. Simple adjuncts such as a nasal or oropharyngeal airway (NPA/OPA) may be utilized in addition to proper positioning to help ensure a clear airway.[4] Of note, there are multiple sizing challenges with an NPA that can actually cause further obstruction if not measured precisely, therefore, remain vigilant. Oropharyngeal airway insertion can present a considerable noxious stimulus and may not be tolerated by conscious or even some semiconscious patients. BVM ventilation is the next step.

For those patients requiring prolonged active respiratory support or airway protection, a definitive airway is preferred. A definitive airway requires control of the patient's airway with an inflated cuff in the trachea. Definitive airway placement requires considerable skill and sustainment training. If not current and practiced, or if encountering difficulty securing a definitive airway consider other airway adjuncts such as supraglottic airways.

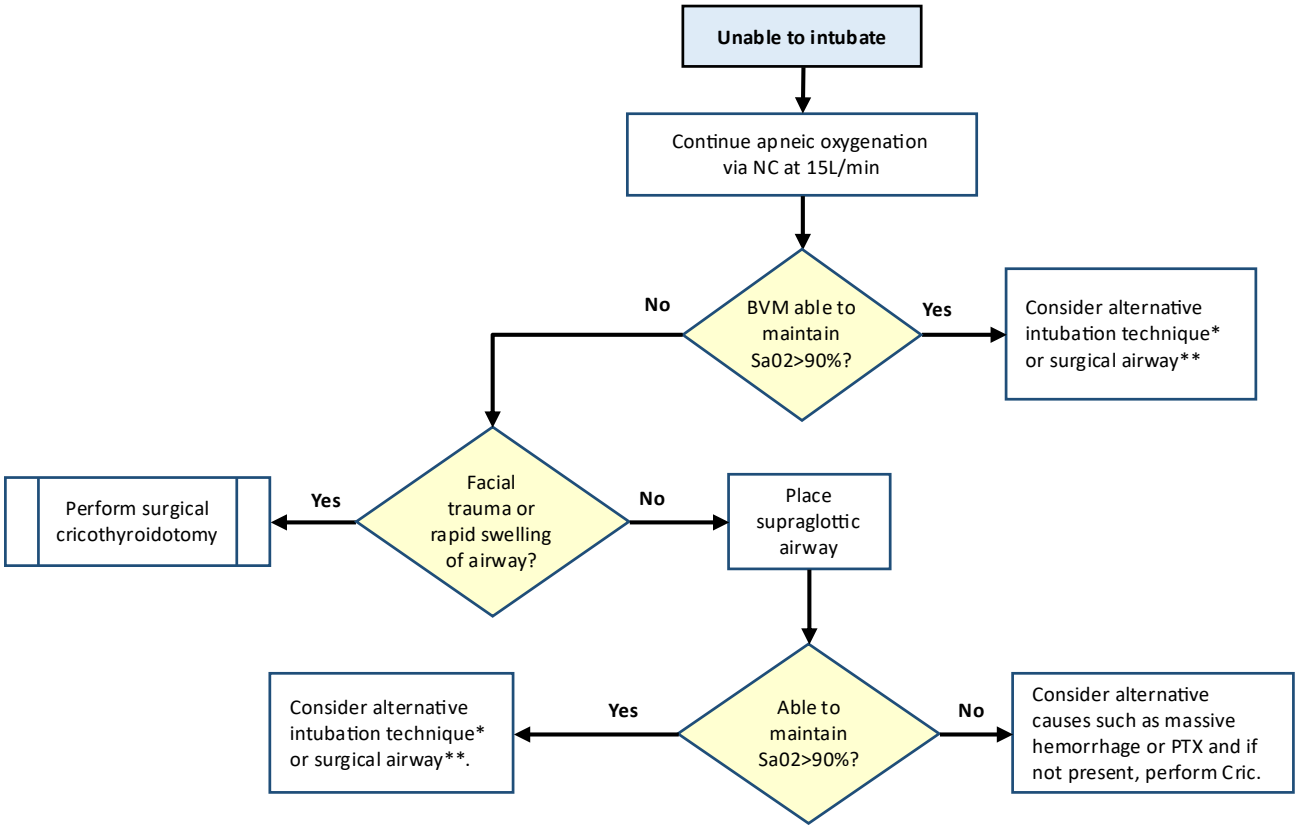
Furthermore, intubation and providing mechanical ventilation are not without risk. The benefits should outweigh the attributable cost and risk of managing the mechanically ventilated patient, especially within the austere/battlefield setting. Pathology associated with failure to oxygenate and failure to ventilate will most often require definitive airway interventions and appropriate mechanical ventilator support. At times, it may only serve as a temporizing measure while seeking definitive critical care. Initiation of mechanical ventilation must be guided by clinical suspicion of underlying pathophysiology and clear criteria. A definitive airway is required for effective mechanical ventilation and these patients require sedation – both mechanical ventilation and sedation may make a hypotensive patient more hypotensive and could result in hemodynamic instability. Thoughtful consideration for whether the patient requires mechanical ventilation must occur. In patients with hemorrhagic shock requiring intubation and mechanical ventilation, remember the general principle of "resuscitation before intubation." Utilize airway adjuncts if the patient's airway can be maintained adequately during initial resuscitation efforts with blood products. In an under-resuscitated patient, cardiac arrest can occur when induction and paralytic medications are given during rapid sequence intubation.

Table 1. Tactical Combat Casualty Care (TCCC) Airway Management Adjuncts (Consider basic adjuncts first)

Device/ Techniques	Pros	Cons	Pharmacy Reqs to Maintain (0/+/++)
Tactical airway maneuvers (All Service Members)			
Head-Tilt/ Chin-Lift	Easy	Requires hands-on continuously	0
Recovery Position	Easy; tactically feasible (TCCC/Mass Casualty))	May limit patient assessment, ongoing management, or contraindicated with c-spine or pelvic fractures.	0
Sit Up/Lean Forward	Easy and practical (may be position of comfort)	May indicate impending airway loss and contraindicated with c-spine or pelvic fractures.	0
Non-definitive airway adjuncts (skill, training, equipment required)			
Nasopharyngeal airway (NPA)	Easy	Risk of nose bleeds with placement and sizing challenges. Should not be used if suspect basilar skull fracture.	0
Oropharyngeal airway (OPA)	Easy	Not tolerated in conscious patient	+
Supraglottic Airway (SGA)	Easy	Not tolerated in conscious patient	++
Definitive Airways (skill, training, equipment, and experience required)			
Oral Endotracheal Tube (ETT) Airway	Familiar to trained providers; Definitive; No surgical incision needed	Skill sustainment challenging, requires neuromuscular blockade (rapid-sequence intubation) for best success, may require suction to visualize vocal cords, requires sedation (potential limitation in Prolonged Field Care {PFC})	++
Cricothyroidotomy (Cric)	Definitive; Better tolerated than Oropharyngeal (OP), SGA or ETT. May require less sedation to sustain once in place	Invasive procedure, high failure rate in some studies. [5,6]	+

For Pharm Reqs: Maintain: 0 = no additional medications; + = some or intermittent dosing medications required; ++ = continuous or multiple medications required

Figure 1. Difficult Airway Management Algorithm

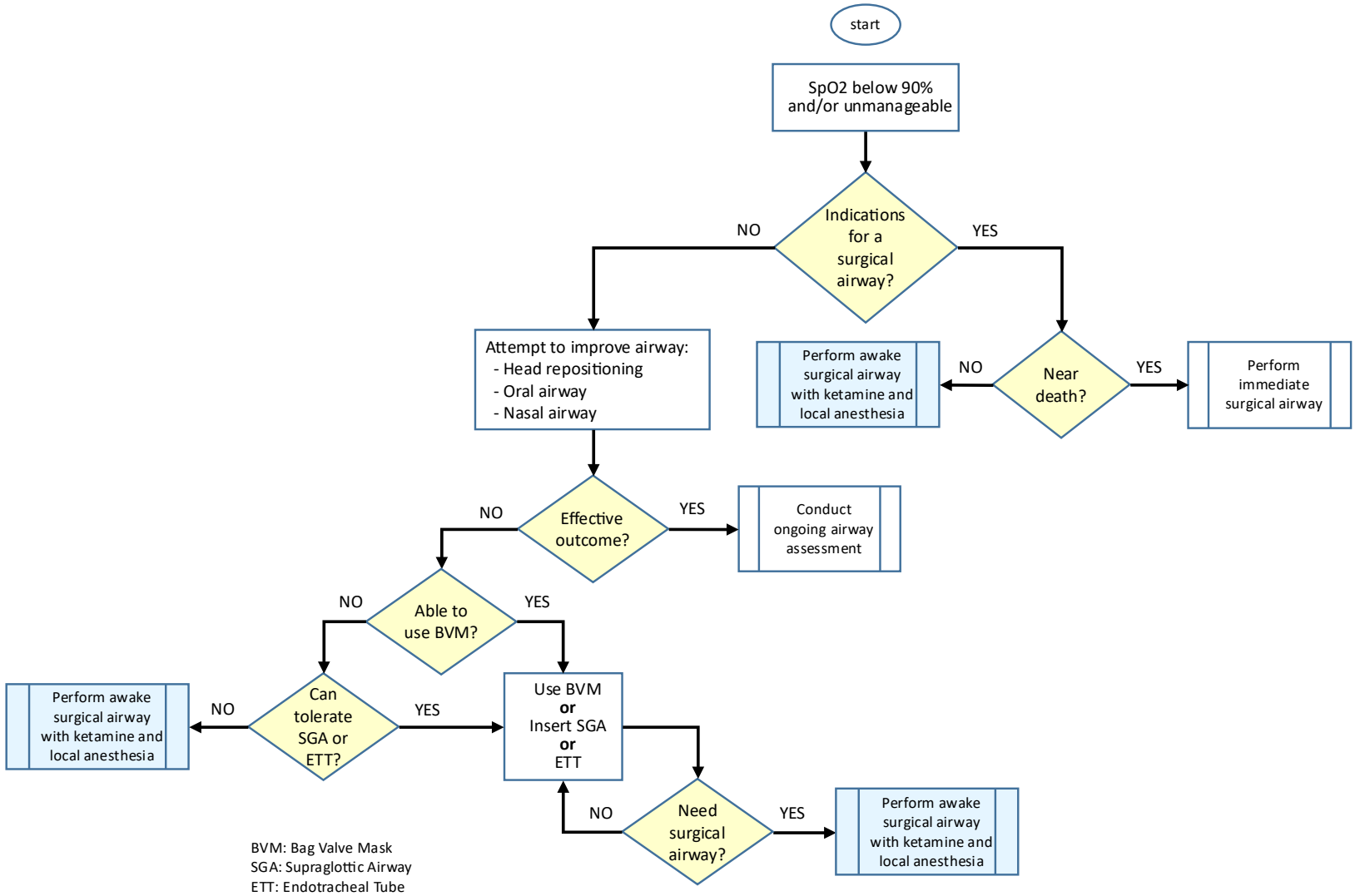


*Alternative intubation techniques include:
- Video or direct laryngoscopy (whichever not used first)
- Fiberoptic scope
- Transtracheal illumination device
- Retrograde wire with Magill forceps
- Changing providers

**Surgical airway includes both tracheostomy and surgical cricothyroidotomy.

Airway management in the tactical setting requires a different conceptual approach than airway management in the hospital, or even the civilian prehospital environment. Differences in epidemiology, injury patterns, equipment and environment must be considered if airway management is to be optimized. First, most military casualties requiring a prehospital airway have trauma to the head, face or neck. Surgical airway is often the final common pathway due to bleeding or distorted anatomy. When reliable suction and oxygen delivery are not available, personnel are not experienced in rapid sequence intubation or using neuromuscular blockade, a definitive airway will often mean a surgical airway. (see Appendix E: cricothyroidotomy procedure checklist for a detailed description).

Figure 2. An Awake Patient Surgical Airway Algorithm



Source: Mabry RL, Kharod CU, Bennett BL. Awake cricothyrotomy: a novel approach to the surgical airway in the tactical setting. Wilderness Environ Med. 2017;28(2S):S61-8. Adapted with permission from the Wilderness Medical Society. ©2017 Wilderness Medical Society.[7]

PHARMACY

A definitive airway is required for effective mechanical ventilation and these patients require sedation – both mechanical ventilation and sedation may make a hypotensive patient more hypotensive and could result in hemodynamic instability. In an under-resuscitated patient, cardiac arrest can occur when induction and paralytic medications are given during rapid sequence intubation.

Be cautious with sedation, advanced airway placement and positive pressure ventilation in patients who are hypotensive or under-resuscitated. Blood pressure can fall rapidly during airway management due to a variety of mechanisms.

Be cautious with sedation, advanced airway placement and positive pressure ventilation in patients who are hypotensive or under-resuscitated. Blood pressure can fall rapidly during airway management due to a variety of mechanisms.

Active resuscitation with blood products especially in the hypotensive patient is recommended. Be prepared to support blood pressure with additional fluids and vasopressors (e.g., norepinephrine/epinephrine bolus or drip) if trained or under direct telemedicine guidance.

In all cases, monitor blood pressure (BP) closely (every 1-2 minutes during the procedure, every 3 minutes post-procedure). A BP drop may be brief (if due to vagal effects of epiglottis stimulation during ETT placement) or sustained (if due to loss of sympathetic drive secondary to pain and sedation medications, and/or positive pressure ventilation).

IV/IO Access

- **Minimum**: If (IV) / intraosseous (IO) attempts fail or when unavailable: medication may be given intramuscularly or intranasally for immediate sedation to facilitate surgical cricothyroidotomy. Continue attempts at IV/IO access after airway has been controlled
- **Better:** 2 patent IV/IO
- **Best:** 2 patent IV/IO and if appropriately trained large bore central venous access

Flow is directly proportional to the fourth power of the catheter radius and inversely proportion to the length of a catheter (R4 /Length). Prior to administering medications and providing positive pressure ventilation two 16 gauge or larger angiocatheters should be placed. If continued massive transfusion is required, consideration should be given to placement of a 9 French central venous line so that rapid transfusion can be maintained. Ultrasound may be used to help identify deep veins.

Airway Placement

- **Minimum:** Local anesthetic for cricothyroidotomy (superficial skin anesthesia plus 1-2 mL injected through the cricothyroid membrane); or placement without medications in unconscious patient. **Note: most sedating agents can be given an intramuscular (IM) if IV/IO has not been established
- **Better:** Any IV/IO sedating agent (opioid, benzodiazepine: reference the JTS Analgesia and Sedation Management During Prolonged Field Care CPG. for procedural doses of such agents).[8]
- **Best:** Procedural dose ketamine (1-2 mg/kg IV push) for ETT or cricothyroidotomy placement + local anesthetic (lidocaine) for cricothyroidotomy placement.

Post-Airway Placement

- **Minimum (without IV access):** Ketamine (sedation dose), 3-4mg/kg IM
- **Better:** IV/IO pushes of ketamine, opioid, and/or midazolam (alone or in combination as per the individual's scope of practice, experience, and availability of medications)
- **Best:** Ketamine IV/IO Drip. Hydromorphone or alternate opioid IV/IO push for breakthrough pain and midazolam IV/IO push as needed for sedation

(Reference JTS Analgesia and Sedation Management During Prolonged Field Care CPG for details and drug doses).[8]

Neuromuscular blockade (succinylcholine, rocuronium, vecuronium, etc.) is only recommended for use by those trained and practiced in its use. Though these are standard medications to use in rapid sequence intubation and ventilator management, their potential lethality in inexperienced hands does not justify routine use. If trained and/or under direct supervision of telemedicine support, the use of neuromuscular blockade may be considered, subject to local medical direction and protocols.

MONITORS/MACHINE

Monitor

- **Minimum:** Pulse oximeter (SpO2), portable Capnometry ($ETCO_2$)/capnography assistant to monitor respirations and record manual vital signs. Trending vital signs using a flow sheet is recommended. Refer to the JTS Documentation in Prolonged Field Care CPG.[9] Voice or data connections to perform telemedicine communication
- **Better:** Transmit photographs from smartphones or personal devices to augment telemedicine communications.
- **Best:** Automatic vital signs monitor with SpO2, $ETCO_2$/waveform capnography, +/- electrocardiogram (EKG); Synchronous (real-time continuous) telemedicine using video or remote patient monitoring systems

Monitoring is the active process of assessing the patient throughout a procedure. It involves the gathering, documenting and interpretation of vital signs and other data, and the continuous assessment of their clinical status. Telemedicine can be an important adjunct and critical capability to employ when monitoring a patient undergoing complex procedures.

Machine

- **Minimum:** Bag-Valve-Mask (BVM) with positive end-expiratory pressure (PEEP) valve
- **Better:** Automated portable ventilator (preferably with PEEP); oxygen concentrator
- **Best:** Full-feature portable ventilator (e.g., several ventilatory modes, PEEP); supplemental oxygen if available

Managing ventilators or advanced equipment unfamiliar to a provider presents challenges. Initiate telemedicine consultation for best guidance at 833-ADVSRLN (833-238-7756)/DSN: 312-429-9089..

PEEP is important for prolonged ventilation. PEEP is the pressure in the airway at the end of the expiration which prevents the alveoli of the lung from completely collapsing. In a spontaneously breathing person, this pressure is maintained by closing the glottis, clearing the throat, coughing, sighing, etc. With an invasive airway, the glottis is bypassed with the tube and "natural" PEEP is lost. PEEP should therefore be introduced into the ventilated patient using a PEEP valve on the BVM or using the PEEP setting on a ventilator. When using BVM or ventilator, provide PEEP. (Recommended initial setting is 5cm H2O.)[10]

$ETCO_2$ & Other Equipment

Airway Confirmation Equipment ($ETCO_2$)

- **Minimum:** Visualization of the tube through the cords and auscultation of breath bilateral sounds
- **Better:** Colorimetric capnography
- **Best:** Continuous end-tidal carbon dioxide ($ETCO_2$)

Regardless of how an endotracheal tube is placed, a verification of correct tube placement must be performed every time as incorrect tube placement may be fatal. The right mainstem and hypopharynx are the most common locations of incorrect placement of ETT. Visualization of the tube passing through the vocal cords (in the case of endotracheal intubation) should be assured. Esophageal intubation is also common. Auscultate, if possible, to verify bilateral breath sounds and absence of gurgling in the epigastric region. When performing a cricothyroidotomy subcutaneous placement of the tube may occur. For both oral and surgical airways colorimetric capnography and endotracheal detection devices should be considered to

verify correct tube placement as tube misplacement can be fatal. Continuous $ETCO_2$/wave capnography is the gold standard for initial detection of and monitoring for appropriate tube placement. (See Appendix G: Waveform Capnography & Pulse Oximetry Interpretation for a detailed description)

Other Equipment

Supraglottic airways are most commonly placed blindly. They are also not considered definitive airways in that they do not provide an inflated cuff in the trachea. Without an inflated cuff in the trachea, the airway is not protected against aspiration. Nonetheless, supraglottic airways can provide a conduit for oxygenation and ventilation. If definitive airway is required, an endotracheal tube may be placed through the supraglottic airway or a bougie may be threaded to allow for endotracheal exchange. (See Appendix D: Supraglottic Airway Placement for a detailed description.)

Repeated attempts at endotracheal intubation are associated with worse outcomes. Visualization of the vocal cords is vital for endotracheal intubation. Direct laryngoscopy traditionally has been used for endotracheal intubation. Although there are shortcomings described regarding the use of video laryngoscopy, including fogging especially in airways with heavy secretions, video laryngoscopy is associated with a higher first attempt intubation rate and should be considered the best option especially in those with limited experience**.** Nonetheless, given its limitations, airway providers must maintain competency with both techniques.

An important adjunct to passing an endotracheal tube whether trans orally or through a cricothyroidotomy, is the use of a bougie (sometimes also referred to as an Eschmann Stylet). This device is simple, rugged and can be used to guide tube placement. The bougie is placed in the trachea before the endotracheal tube and may be used first to confirm proper positioning. The bougie will provide tactile feedback against the tracheal rings confirming proper placement, or by encountering a hard stop when abutted against a distal bronchus. An endotracheal tube is then introduced over the bougie into the trachea, while the laryngoscope is maintained in place to lift the laryngeal structures. Lastly, the bougie is removed. A bougie may also be used to change tubes in the case of a tube malfunction. This may be accomplished by placing a bougie in a tube or SGA that is currently positioned, remove the tube over the bougie (ensuring the bougie remains in the proper position within the airway lumen), and replacing a new tube over that bougie. Remove the bougie, leaving the new tube in place.

Placement of a nasogastric or orogastric tube should be considered following intubation of a patient in order to reduce the risk of pulmonary aspiration and prevent gastric distention. If only supraglottic airway access is available, consider using a supraglottic device that incorporates an orogastric tube port. Always measure the distance from nose to stomach and note the distance prior to insertion, then verify epigastric sounds. Always reassess tube position prior to putting anything into stomach to ensure proper gastric placement.

PERFORMANCE IMPROVEMENT (PI) MONITORING

POPULATION OF INTEREST

1. All patients who received ETT/cricothyroidotomy/supraglottic airway/NPA
2. All patients with compromised airway or (initial GCS < 8)

INTENT (EXPECTED OUTCOMES)

1. All injured patients who present with obtundation (GCS<8), apnea, respiratory distress or insufficiency, airway obstruction, or impending airway loss will have a secure and definitive airway established expeditiously upon arrival to a Role 2 or Role 3 if not done prehospital.
2. All patients in the population of interest will have no signs of hypoxia. Patients with a definitive airway (endotracheal tube, cricothyroidotomy, tracheostomy) have $ETCO_2$ monitoring to confirm airway placement.

PERFORMANCE/ADHERENCE METRICS

1. Patients who had a secure and definitive airway (endotracheal tube, cricothyroidotomy, tracheostomy) established or verified, or documentation of appropriate intervention upon arrival to a Role 2 or Role 3 if not done prehospital.
2. SpO2 is maintained ≥ 90%. Patients who had definitive airway (endotracheal tube, cricothyroidotomy, tracheostomy) with $ETCO_2$ documented to confirm placement.

DATA SOURCES

- Patient Record
- Department of Defense Trauma Registry (DoDTR)

SYSTEM REPORTING & FREQUENCY

The above constitutes the minimum criteria for PI monitoring of this CPG. System reporting will be performed annually; additional PI monitoring and system reporting may be performed as needed.

The system review and data analysis will be performed by the JTS Chief , and the JTS PI Branch.

RESPONSIBILITIES

It is the trauma team leader's responsibility to ensure familiarity, appropriate compliance and PI monitoring at the local level with this CPG.

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APPENDIX A: AIRWAY MANAGEMENT SUGGESTED PACKING LIST

	Equipment	Notes
Minimum	Nasopharyngeal airway (NPA)	
	Oropharyngeal airway (OPA)	
	Cricothyroidotomy kit: a standardized kit should include at a minimum a #10 scalpel, a tracheal hook (or small, curved hemostat), an airway tube, a 10mL syringe, and a securing strap. The airway tube may be a prefabricated cricothyroidotomy tube such as that included in the Cric-Key (Control Cric), a Shiley tracheostomy tube, or a 6.0-sized endotracheal tube.	
	Bag valve mask (BVM)	
	PEEP valve: either separate device, or affixed to the BVM device	
	Capnography/capnometry device	
	Bougie	
Better	All suggested minimum equipment	
	Additional endotracheal tubes	
	Portable suction device	
Best	All suggested minimum and better equipment	
	Supraglottic airway: options include I-Gel (Size 4 if only one; size 5 for >90kg patient) or King-LT.	
	Waveform capnography	
	Commercial power suction device	
	Automatic (electronic) patient monitor	
	Direct laryngoscope: Macintosh blade size 3 or 4 for adults; Miller 1 or 2 for infants and small children as needed.	For those trained in endotracheal tube placement and opt to include equipment in their aid bag
	Endotracheal tubes: for cricothyroidotomies (6.0 mm tubes). Personnel trained in endotracheal intubation should also carry a 7.5 or 8.0mm tube for primary intubation. A 7.0 mm tube should be carried as a secondary ET tube in case of difficult intubation. (If pediatric trauma is common, consider adding smaller sizes, but these should be limited to the most common ages expected to encounter, and calculated on the classic rule of tube size = 4 + (age/4). Examples of what to carry include 4.0 mm uncuffed for infants, and 6.0 cuffed for older children).	For those trained in endotracheal tube placement and opt to include equipment in their aid bag
	Video laryngoscope: hand-held devices should utilize a blade with an angle that allows for direct laryngoscopy function should the video screen/battery fail during intubation.	For those trained in endotracheal tube placement and opt to include equipment in their aid bag
	Mechanical ventilator	
	Pediatric-sized equipment	
	Other equipment listed above but not carried due to cube/weight restrictions	

APPENDIX B: AIRWAY MANAGEMENT NURSING / CONTINUED CARE

Long-Term Airway Management, Nursing and Prolonged Field Care

Below is the recommended Prolonged Field Care Nursing Flowsheet to use as a guide.[1]

Patient ID:			Time	1hr	2hr	3hr	4hr	5hr	6hr	7hr	8hr	9hr	10hr	11hr	12hr	13hr	14hr	15hr	16hr	17hr	18hr	19hr	20hr	21hr	22hr	23hr	24hr
	Action (suggested interval)	Interval																									
Vitals	Check BP/HR/RR/T/SPO2/ETCO$_2$ (Q1H)																										
	Check Peripheral Pulses (Q1H)																										
	Check Skin Temp and Color (Q1H)																										
	Check Lactate (Q4H)																										
	Check Blood Glucose (Q8H)																										
Ins/Outs	Check Drip Rates/Fluids In (Q1H)																										
	Check Urine Output (Q1H)																										
	Check Urine Dipstick (Q1H)																										
	Perform NG/OG Tube Care (Q2H)																										
	Perform Foley Care (Q24H)																										
	Flush PRN Locks (Q8H)																										
Pain/Sedation	Check GCS/RASS/PAIN (Q1H)																										
	Give Pain Rx (per Rx)																										

Patient ID:			Time	1hr	2hr	3hr	4hr	5hr	6hr	7hr	8hr	9hr	10hr	11hr	12hr	13hr	14hr	15hr	16hr	17hr	18hr	19hr	20hr	21hr	22hr	23hr	24hr
	Give Sedation Rx (per Rx)																										
HEENT	Perform Tube Suctioning (PRN)																										
	Perform Oral Suctioning (PRN)																										
	Perform Nasal Care/Moisten (Q4H)																										
	Perform Oral Care/Moisten (Q4H)																										
	Apply Lip Balm (Q1H)																										
	Apply Eye Ointment/Drops (per Rx)																										
	Brush Teeth (Q12H)																										
	Change All Tape (Q24H)																										
Respiratory	Check Ventilator Settings (Q1H)																										
	Auscultate Lungs (Q1H)																										
	Turn, Cough, Deep Breathe (Q1H)																										
	Check Chest Drainage (Q1H)																										
Integumentary	Check S/S Compartment Syndrome (Q2H)																										
	Reposition (Q2H)																										
	Check Padding (Q2H)																										
	Perform LE Massage (Q2H)																										
	Check Dressings (Q4H)																										

Patient ID:			Time	1hr	2hr	3hr	4hr	5hr	6hr	7hr	8hr	9hr	10hr	11hr	12hr	13hr	14hr	15hr	16hr	17hr	18hr	19hr	20hr	21hr	22hr	23hr	24hr
	Do A/P Limb ROM (Q8H)																										
	Wash and Dry Skin (Q24H)																										
	Perform Burn Skin Care (Q24H)																										
	Irrigate Wounds (Q24H)																										
	Debride Wounds (Q24H)																										
	Change Dressings (Q24H)																										
	Give Antibiotics Rx (Q24H)																										
Gastrointestinal	Give PPI Rx if Indicated (per Rx)																										
	Give Antiemetic Rx (per Rx)																										
	Auscultate Abdomen (Q2H)																										
	Palpate Abdomen (Q2H)																										
	Give Food/Nutrition (Q8H)																										
Extra Stuff	Check O2 Supply																										
	Check/change batteries																										
	Compression Socks/Stockings																										

AIRWAY-SPECIFIC PROLONGED FIELD CARE NURSING GUIDELINES / ASSESSMENT / TASKS

- Oral suction (or in-line/tube suctioning, if placed) as indicated during routine patient assessments
- Nose and mouth moistened every 4 hours
- Lip balm applied every hour
- Teeth brushed every 12 hours - Prevents pneumonia and other infections.
- Auscultate lungs every hour. If available, get a second medic to double check and verify if sounds are questionable or cannot otherwise auscultate. Extra diligence should be given to check for diminished breath sounds for suspected pneumothorax, as well as for pulmonary edema, especially if giving aggressive fluids in the case of a massive resuscitation, or replacement fluids. Consider ultrasound evaluation if available.[2]

Naso/Orogastric Tube (NGT/OGT) and Abdominal Care

(as applicable)

- Consider placing an NG/OG tube for prolonged care of intubated/cricothyrotomy patient or those with an Supraglottic Airway (SGA) device in place (if a compatible port is available on the SGA)
- Abdominal palpation AND auscultation every 2 hours.
- Appropriate placement must be confirmed before feeding or hydration is begun through NG/OG tube. If volume instilled is too large or rate too fast, there is a risk for vomiting.

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APPENDIX C: BAG-VALVE-MASK TECHNIQUE

Proper technique is essential to perform successful bag-valve-mask (BVM) airway management. Patients should be in the supine position, neck in a neutral position and the occiput slightly elevated (on a folded blanket, sheet, small pillow, etc.) to achieve a "sniffing position," with the opening of the ears at the same level as the sternal notch. A folded sheet or blanket may need to be placed under the shoulders to assist with achieving a sniffing position. Masks should be of the proper size and should be fitted to the face to obtain a seal. Resuscitation bulb should be no larger than 1000ml. This is best achieved by first placing the tapered portion of the opening of the mask over the bridge of the nose, then covering the patient's mouth. If using the one-person method, the non-dominant had should use the "C & E" method with the thumb and index finger forming a C to cover the mask, and the middle, ring and small fingers forming an E on the bone of the mandible effectively lifting the jaw into the mask (rather than pressing the mask onto the face).

The other hand should gently squeeze the bag delivering a breath at a rate of one squeeze every 5-6 seconds. There should not be a leak around the mask, and you should be able to observe the rise and fall of the patient's chest. An $ETCO_2$ monitor may be placed in-line with the bag and mask. PEEP should be used with the BVM and initially set to 5mmHg. Every attempt should be made to maintain a seal to ensure continued PEEP. If the patient is breathing spontaneously, careful observation and delivery of an assisted synchronous breath should be a priority.

Some additional considerations are below:

1. If unable to perform adequate single hand C & E clamp, use two handed technique with a second person to bag.
2. Don't press mask down on to face when performing C & E clamp, visualize you are lifting face into mask.
3. Be aware fingertips on "E-clamp" should be positioned on the bones of the mandible and not on soft tissue, which could possibly occlude the airway.
4. Use "BOOTS" to predict difficult face-mask seals: **B**earded, **O**bese, **O**ld, **T**oothless, **S**noring. In addition, maxillofacial trauma and edema from burns may prevent effective ventilation by BVM.
5. NPA should be used to assist with face mask ventilations (unless obvious contraindications such as mid-face trauma). OPA are also effective in obtunded patients or those who have received chemical sedation or neuromuscular blockade.
6. For bearded patients, lubrication of mask may assist seal. Tegaderm occlusive dressings over beard may also help if available. (If Tegaderm is used in sedated patient, consider pulling off before medication wears off, to lessen pain).
7. Consider mask straps to make face-mask seal more "hands free", especially if a non-medic is assisting you with BVM.

APPENDIX D: SUPRAGLOTTIC AIRWAY PLACEMENT

SUPRAGLOTTIC AIRWAY (SGA) PLACEMENT CHECKLIST

- ☐ Open airway manually, measure and insert simple airway adjunct (Nasopharyngeal Airway [NPA] or Oropharyngeal Airway [OPA]). NPA should be measured from the Nares to the Tragus. OPA should be measured from the corner of the mouth to the angle of the mandible.
- ☐ Ventilate patient with bag-valve-mask (BVM) (attach supplemental oxygen, if available).
- ☐ If ventilations insufficient, or the patient is clearly unconscious and not breathing adequately, prepare for supraglottic airway insertion. Assure appropriate resuscitation has begun. Inspect SGA to ensure appropriate size. Lubricate airway to facilitate passage. Cricothyroidotomy kit should be prepared for use if SGA fails.
- ☐ Follow SOAP ME (Suction, Oxygen, Airway Assessment, Pharmacy, Plan, Monitor, and Equipment) and for induction, use ketamine (1-2 mg/kg IV/IO or 3-4mg/kg IM) if time permits and the recommended medications are available.

INSERTING THE AIRWAY:

- ☐ Properly position head in a neutral or "sniffing" position (neck extended, as on a pillow or small blanket while lying flat) and open airway.
- ☐ Remove OPA if previously placed.
- ☐ Insert device to proper depth (may adjust later if needed for improved ventilation).
- ☐ Inflate , if applicable; inflate as per device-specific volume instructions and immediately remove syringe.
- ☐ Confirm placement with ventilation and auscultation over epigastrium, then bilaterally over chest, left lung then right lung. Get a second practitioner to double check and verify in sounds are questionable or cannot otherwise auscultate.
- ☐ Verify proper SGA placement by secondary confirmation such as capnography/capnometry or colorimetric device.
- ☐ Place orogastric tube and decompress stomach if available, and compatible with SGA device (has a port specifically for orogastric tube placement).

SGA Size Chart

Estimated patient size	LMA/i-gel
Neonates/Infants (up to 5kg)	1
Infants 5-10 kg	1.5
Infants/Children 10-20kg	2
Children 20-30kg	2.5
Children 30-50kg	3
Adults 50-70kg	4
Adults 70-100kg	5
Adults over 100kg	6

APPENDIX E: CRICOTHYROIDOTOMY PROCEDURE CHECKLIST

PREPARE PATIENT

1. Pre-oxygenate patient if possible.
2. Inspect/assemble/test equipment for cricothyroidotomy.
3. Prepare site with alcohol and betadine -or- Chlorhexadine (Chlora-prep).
4. Follow SOAP ME and for induction, use ketamine (1mg/kg IV/IO or 3-4mg/kg IM) if time permits and the medication is available. SOAP ME: Suction, Oxygen, Airway Assessment, Pharmacy, Plan, Monitor, and Equipment

For awake cricothyrotomy: Explain procedure to patient; *Use local anesthesia: lidocaine (1% or 2%), bupivacaine (0.25%, 0.5% or 1%); local through planned incision area AND approx. 1-2mL through cricothyroid membrane

PERFORM PROCEDURE

1. Stabilize thyroid cartilage with nondominant hand. Maintain control with hand until the membrane incision is secured (step 8 below).
2. Locate cricothyroid membrane with index finger (commonly located approximately three to four finger widths above the sternal notch in adults).
3. Make vertical incision through the skin over cricothyroid membrane.
4. Make horizontal incision through cricothyroid membrane, then immediately:
5. Open and maintain membrane incision with tracheal hook (or curved hemostat, bougie or blunt end of scalpel).
6. Insert endotracheal/tracheostomy tube into opening and direct tube caudad into trachea until the balloon is just inside the airway.
7. Inflate cuff and detach syringe (palpate bulb to ensure it's not under-inflated or over-inflated).
8. Maintain control of tube at all times to prevent dislodgement.
9. Attach waveform capnography, or capnometry, or colorimetric device to confirm proper placement of tube.
10. Being careful not to dislodge the tube, attach BVM with positive end-expiratory pressure and further check placement (epigastric and bilateral chest) and adequacy of bilateral insufflation of lungs.
11. Remove BVM (if sufficient respiratory effort), assess respirations for adequacy (rate, rhythm, and quality), assist ventilations if needed.
12. Secure with sutures and tie with girth hitch passed around the neck if time permits. As a stopgap, may use chest seal or secure around the neck with tie, ensuring inflation bulb does not get caught.
13. Consider placing a nasogastric/orogastric tube if available.

APPENDIX F: POST CRICOTHYROTOMY / ENDOTRACHEAL INTUBATION CHECKLIST

POST CRICOTHYROTOMY / ENDOTRACHEAL INTUBATION CHECKLIST

- ☐ Double check placement with waveform capnography or capnometry, placed directly on ET tube adapter.
- ☐ Check proper tube depth (not main stem) by auscultating bilateral lung sounds.
- ☐ Check that tube is secured (suture to skin + tie with girth hitch around neck, should be able to fit 2 fingers under the tube tie).
- ☐ Bag-valve-mask (BVM) with positive end-expiratory pressure (PEEP) valve @ 5 of PEEP at proper volume (one hand moderate squeeze) and proper rate (one squeeze every 5-6 seconds).
- ☐ Provide adequate analgesia and sedation. (Follow the JTS Analgesia and Sedation Management During Prolonged Field Care CPG.) [1]
- ☐ Calculate remaining medication and establish analgesia and sedation plan. A patient with a cricothyroidotomy may not require heavy continuous sedation.
- ☐ Raise the head and torso to 30 - 45°.
- ☐ Filter and humidify the air with a heat moisture exchanger. Place HME in-line distal to $EtCO_2$ device.
- ☐ As needed, place in-line suction for the tube, and suction the mouth for any excess secretions.
- ☐ Check cuff pressure (palpate bulb – should be moderately firm but still compressible).
- ☐ Place orogastric tube, if available.
- ☐ Put a BVM +PEEP valve at the bedside if using a mechanical ventilator.
- ☐ Decontaminate the mouth with chlorhexidine swab or toothbrush without paste as per the nursing care plan.

Reference

1. Joint Trauma System. Analgesia and Sedation Management During Prolonged Field Care, 11 May 2017 Clinical Practice Guideline.

APPENDIX G: WAVEFORM CAPNOGRAPHY & PULSE OXIMETRY INTERPRETATION

WAVEFORM CAPNOGRAPHY (END TIDAL CO2 (ETCO2)) AND PULSE OXIMETRY (SPO2) INTERPRETATION

Detection of $ETCO_2$ is the most reliable way to continuously monitor ventilation and therefore confirm placement of an advanced airway (the only exception is during CPR when $ETCO_2$ may be undetectable). Waveform capnography is the preferred method to detect $ETCO_2$, and with the development of small, portable devices, is the recommended technique even in austere field environments. Inexpensive colorimetric CO_2 detectors are available; however the color change method may be very difficult to visualize with poor lighting or night vision devices. Waveform capnography measures the end-tidal carbon dioxide that passes through the device as the patient exhales in real time since it is placed directly in-line with the endotracheal tube. $ETCO_2$ may also be attached to a face mask to verify normal and spontaneous breaths, if an advanced airway has not been placed. With most portable field capnographs, a number in mmHg will appear on the display, which indicates the value of the CO_2 in the exhaled breath and can be an immediate confirmation of correct tube placement. If the airway was placed correctly, and the patient is ventilating normally, the capnograph should read between

35-45 mmHg. Some other examples include:

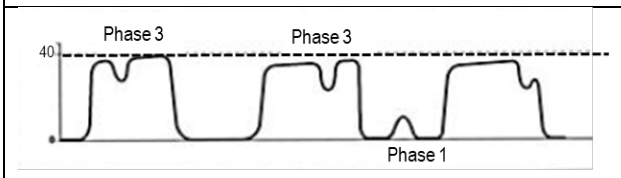
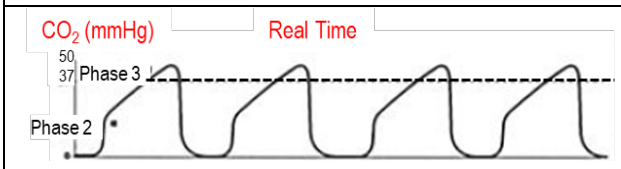
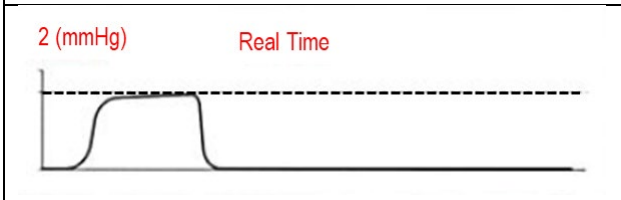
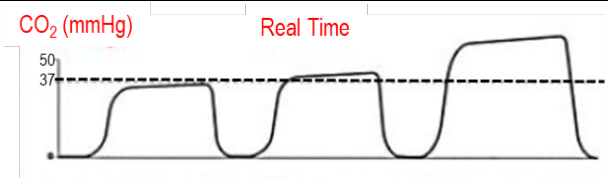
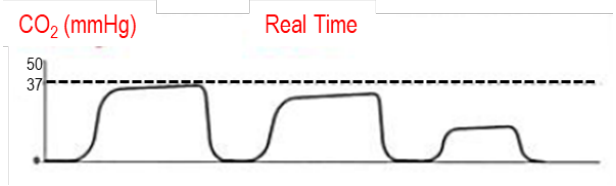
- $ETCO_2$ = 0: the tube does not transmit any CO_2: disconnected, tube placed in wrong position or has become dislodged. This may also occur if the patient is dead and there is no gas exchange.
- $ETCO_2$ <35: Hyperventilation. The most common cause is over-bagging the patient but may also indicate pain or anxiety. The only indication for "induced" hyperventilation is severe traumatic brain injury with signs of acute herniation, GOAL = 30-35 (no less than 30)
- $ETCO_2$ >45: Retaining CO_2, ineffective ventilation may indicate oversedation, primary lung problem, brain injury, worsening obstructive disease (asthma). If the trend is rising, this is an indicator of need for active ventilation assistance (BVM or mechanical ventilator)

During CPR (as an indicator of effectiveness of chest compressions and return of circulation):

- $ETCO_2$ < 10: there is no return of CO_2 to the lungs (no effective circulation). If CPR is initiated, it is ineffective
- $ETCO_2$ = 10-20: EFFECTIVE CPR
- $ETCO_2$ = 40 OR GREATER: You may see an abnormally high CO_2 reading immediately after return of spontaneous circulation (ROSC), for instance after a successful defibrillation or return of effective cardiac activity.

Monitors that can provide waveform capnography can provide much more insight into a patient's ventilation and oxygenation status. A quick reference to the most common waveforms is helpful to understanding the status of a patient.

Pulse oximetry is also of use in monitoring the oxygenation status of a patient. It can be an indirect measure of oxygen delivery to the tissues, and overall pulmonary function. Pulse oximetry monitors oxygenation by measuring absorbance differences between oxyhemoglobin and deoxyhemoglobin through the use of an infrared light. Pulse oximetry, however, has some important key limitations. A pulse oximetry reading indirectly reflects the patient's central (pulmonary) oxygenation status by measuring the peripheral oxygenation. This means that any intervention that addresses oxygenation in the lungs may not be detected by the pulse oximeter until 30-90 seconds after the intervention. Additionally, if the patient is suffering from carbon monoxide or some other forms of poisoning, the pulse oximetry may read inaccurate. Also, a strong peripheral pulse and warm extremity are required to perfuse the capillary beds of the extremities and allow the pulse oximeter to obtain a valid measurement, therefore it may be difficult to measure in cold or hypotensive patients.

CAPNOGRAPHY ($ETCO_2$) WAVEFORM	CHARACTERISTICS	CONSIDERATIONS
	**Cuff Leak** Waveform degrades sharply	• Check ET Tube for leak and replace as necessary (recommend exchange over a bougie)
	**Curare Cleft** Cleft or notch in waveform	• Represents asynchronous ventilation • Reassess patients level of sedation and augment as needed
	**Obstruction** Classic shark fin pattern	• Represents bronchospasm or airway obstruction • Assess for Hx of asthma, kinked ET tube, foreign body in airway or other anatomical airway obstruction.
	**Loss of Waveform** Normal waveform and then no waveform	• Assess for total airway obstruction, apnea, or cardiac arrest. • Assess ET tube for dislodgement and/or the need for suction • Check equipment for failure
	**Increasing $ETCO^2$** Waveform increases in amplitude and width	• Assess for insufficient respirations, if breathing spontaneously, and treat underlying cause • Assess for respiratory failure • Assess for temperature increase • Consider increasing minute ventilation • Note: TQ release and sodium bicarbonate may cause a temporary increase in $ETCO_2$
	**Decreasing $ETCO_2$** Waveform decreases in amplitude and width	• Assess for tachypnea and treat underlying cause, if patient breathing spontaneously, • Assess for pulmonary embolism (If possible)

APPENDIX H: PEDIATRIC CONSIDERATIONS

PEDIATRIC CONSIDERATIONS FOR SOAP ME & AIRWAY MANAGEMENT

SOAP ME:

Similar to adult patients, the same preparatory steps should be followed prior to pediatric airway intervention. There are, however, significant differences with respect to equipment requirements and provider skill level. The core principles of SOAP ME remain the same, with the following considerations:

- **S**uction – Similar to adults, ideally you can provide in-line suction, but you also will at a minimum need the correct size tubes to be able to provide suction
- **O**xygen –Multiple sized nasal cannulas, face masks and BVMs may be required for infants and children.
- **A**irway – Multiple sizes of tubes are essential and proper pre-mission logistic planning includes pediatric supplies. Avoid surgical airway in <12 years old - use needle cricothyroidotomy (12-14 gauge).
- **P**harmacy – Ensure you have a drug estimation guide, but always double check pediatric weight-based doses and measurements.
- **M**onitor/**M**achine – Continuous ventilation requires specific rate and volume based on the patient's age/size. Ensure your ventilator can provide the required rate and volume prior to intubating or performing advanced procedures.[1,2]
- **E**quipment – Having pediatric sized equipment is essential as well as being able to adapt to pediatric sizes using adult monitors. Ensure you have pediatric sized needles with 24, 22, 20 and 18g as the primary access based on age of the patient. Pediatric intraosseous needles may be required.

ADDITIONAL EQUIPMENT

1. Broselow Tape or similar height-based treatment aids.[3]
2. Video Laryngoscopy (VL) – While this is frequently an adjunctive (better/best) consideration for adult airway management, in the case of pediatric airways, VL has been shown in studies to out-perform direct laryngoscopy.[4-7]
3. Pediatric Kit – Pediatric airway equipment should be pre-packaged and set apart to allow for a rapid inclusion or addition to baseline airway kits.

ESSENTIAL MEASUREMENTS AND FORMULAS

Unlike adult airways that are narrowest at the level of the vocal cords (and therefore visible during DL or VL) pediatric tracheas are narrowest at the infraglottic level (19). In consideration of this, the following formulas and treatment aids are presented to best estimate tube sizes and measurements:

1. ETT size: age/4 +3.5. [8]
2. ETT insertion depth (for children over 1 year of age) in centimeters: age/2 + 13
3. ETT insertion depth (for children under 1 year of age) in centimeters: weight/2 + 8
4. Tidal volume: 5-8 cc/kg, rate concordant with pre-arrest breathing or rate prior to intervention. PALS recommends initial rate of at least 10-12 breaths/minute.[1,2]
5. Use caution with BVM, especially if improvising with adult BVM. Inflate gently only until the chest begins to rise.

SURGICAL AIRWAY MANAGEMENT

Surgical airways should NOT be attempted on children younger than 12 years of age given the maturity of the thyroid cartilage and the cricothyroid membrane.

LMAs should be the first choice in all children prior to consideration of surgical intervention. Surgical airways should NOT be attempted on children younger than 12 years of age given the maturity of the thyroid cartilage and the cricothyroid membrane. It should never be attempted in children where the thyroid cartilage cannot be palpated. For children needing advanced airway intervention younger than 12 years of age, a combination of bag-valve-mask ventilation or placement of a supraglottic airway is recommended.[1,9]

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APPENDIX I: AIRWAY MANAGEMENT SUMMARY

Trauma Airway Management

Airway Assessment

- All trauma airways are potentially high-risk. Anticipate a difficult airway.
- Identify critical team members and verbalize role assignments.
- Initiate pre-oxygenation ([1,2]).
- Recall that the neutral position ("C-spine stabilization") degrades the laryngoscopic view.

Rapid Sequence Induction (RSI) and Intubation Pathway

1. **Confirm equipment availability and function**
   Suction, oxygen source, self-inflating bag and mask, oral & nasal airways, ETT with stylet and/or bougie, supraglottic airway, surgical airway kit, drugs, monitors, ventilator, laryngoscope- direct and video ([3,4]), C02 detector.
2. **Pre-Oxygenate (Denitrogenate) the lungs ([1,2,5])**
   - Prolongs tolerance of apneic period
   - Goal is ≈ 3 minutes of tidal volume breathing at 90% FiO2
   - With standard reservoir facemask set flow rate of oxygen as high as possible
   - Recommend augmenting with nasal cannula at 15L/min oxygen in preparation for apneic oxygenation, leave in situ throughout procedure **([2,6])**
   - Elevate head of bed if not contraindicated
3. **Maintain cervical spine stabilization**
4. **Remove front of cervical collar**
5. **Consider cricoid pressure simultaneous w/ medication administration ([7,8])**
6. **Administer medications :** Initiate RSI

   ALWAYS SEDATE PRIOR TO PARALYZING

Sedative/hypnotic

- Ketamine (First Line): 2 mg/kg IV/IO
- Etomidate (Second Line): 0.3 mg/kg IV/IO

Unstable patients require reduced dosage of induction agent.

Neuromuscular Blockade

- Rocuronium: 1.2 mg/kg IV/IO or
- Vecuronium: 0.1 mg/kg IV/IO or
- Succinylcholine: 1.5 mg/kg IV/IO

7. **Perform laryngoscopic tracheal intubation**
   - Following onset of neuromuscular blockade
   - Recommend gum elastic bougie as primary ETT stylet
8. **If laryngoscopic view is poor:**
   - Apply external laryngeal manipulation technique(s)
   - Consider alternative visualization method or Supraglottic airway device
9. **Confirm tracheal intubation**
   - Visualize tube passing between the vocal cords
   - Easy chest rise, equal axillary breath sounds/absence of gastric insufflation, CO2 Calorimeter, and "fog" in ETT
   - Wave form or digital capnography
10. **Provide continuing care IAW JTS Anesthesia for Trauma Patients CPG**

Recommendations for Pediatric Patients

1. Train to expect pediatric patients. Have a dedicated pediatric airway cart, including Broselow tape or equivalent.
2. Pre-dose with atropine IV/IO (0.02mg/kg, minimum dose 0.1mg, maximum dose 0.5mg) in all <1 years old, those <5 who are receiving succinylcholine, and in all who receive a 2nd dose of succinylcholine
3. Induction -
   - Ketamine (first line) 2mg/kg IV/IO
   - Etomidate (second line) 0.3mg/kg IV/IO
4. Neuromuscular blockade -
   - Succinylcholine 1.5mg/kg IV/IO (2mg/kg <5 years old) or
   - Rocuronium 1mg/kg IV/IO
5. Avoid surgical airway in <12 years old - use needle cricothyroidotomy (12-14 gauge), tracheostomy preferred over surgical cricothyroidotomy

Unable to Intubate: Can You Mask Ventilate?

Mask Ventilation Pearls

- Skilled operator
- Good seal
- Jaw thrust
- Oral airway
- Nasal airway(s)
- Two operator mask ventilation

YES	• Improve position, video laryngoscope, gum elastic bougie change blade/operator. • More than ≈ 3 attempts at intubation may abolish your ability to mask ventilate due to edema caused by laryngoscopy. • Surgical airway (Cricothyroidotomy or tracheostomy)
NO	• Emergency pathway. Seconds matter. • Supraglottic airway or • Surgical cricothyroidotomy

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APPENDIX J: CLASS VIII MEDICAL MATERIEL

This itemized list of medical materiel is based on interventions outlined in the JTS Airway Management in Trauma CPG. It includes both basic and advanced airway management supplies, suitable for Role 1–3 care settings.

Basic Airway Management Supplies

Manual Airway Support

- Nasopharyngeal airways (multiple sizes)
- Oropharyngeal airways (multiple sizes)
- Bag-valve-mask (BVM) with:
  - Reservoir bag
  - Pediatric and adult masks
  - PEEP valve (optional but beneficial)

Supplemental Oxygen Delivery

- Portable oxygen cylinder with regulator
- Nasal cannulas (adult and pediatric sizes)
- Non-rebreather masks (adult and pediatric)
- Oxygen tubing and humidifiers (optional)

Airway Suction

- Suction unit (manual or battery-operated)
- Yankauer suction catheters
- Flexible suction catheters (various sizes)
- Suction tubing
- Mucus trap (for pediatric use or specimen collection)

Advanced Airway Management Supplies

Supraglottic Airway Devices (SGA)

- i-gel or King LT or LMA devices (sizes 3, 4, 5)
- Water-soluble lubricant
- Securing straps

Endotracheal Intubation Equipment

- Endotracheal tubes (ETT) (sizes 6.0 to 8.5 mm)
- ETT stylets (malleable)
- 10 mL syringes (for cuff inflation)
- Laryngoscope handles (battery-operated)
- Laryngoscope blades:
  - Macintosh (curved): sizes 3 and 4
  - Miller (straight): sizes 2 and 3
- Bougies (introducers) – standard and pediatric
- End-tidal CO_2 detection:
  - Colorimetric CO_2 detector
  - Capnography sensor (if available)
- Tube securing device or tape
- Video Laryngoscopy (if available)
  - Video laryngoscope with disposable blades
  - Monitor and power source

Surgical Airway Supplies (Cricothyrotomy)

Surgical Cricothyrotomy Kit (commercial or improvised)

- Scalpel (#10 or #11 blade)
- Tracheostomy hook or hemostat
- Cuffed tracheostomy or endotracheal tube (5.0–6.0 mm)
- Ties or securing device
- Antiseptic prep (chlorhexidine or povidone-iodine)
- Suction and oxygen source (as above)

Needle Cricothyrotomy Kit (pediatric or temporary use)

- 14–16 gauge over-the-needle catheter
- Syringe
- Tubing and connectors for jet insufflation (if available)

Monitoring & Support Supplies

- Pulse oximeter with pediatric/adult probes
- Cardiac monitor (if available)
- Capnography monitor or handheld device
- Blood pressure cuff (manual or automatic)
- Stethoscope
- Documentation tools (trauma cards, markers)

Adjunctive Medications (as per protocol)

- Lidocaine 2% (for nasal intubation or cricothyrotomy)
- Ketamine (induction agent)
- Etomidate (induction agent)
- Succinylcholine or Rocuronium (paralytics)
- Midazolam or fentanyl (sedation)
- Atropine (for pediatric intubation or bradycardia)

Note: *All medications must be secured and used per local protocol and authorized prescriber.*

Pediatric Considerations

- Pediatric BVM and masks
- Pediatric ET tubes (uncuffed and cuffed)
- Pediatric-sized LMAs or i-gel devices
- Broselow tape or pediatric reference guides

For additional information including National Stock Number (NSN), refer to dha.ncr.med-log.list.lpr-cps@health.mil

DISCLAIMER: *This is not an exhaustive list. These are items identified to be important for the care of combat casualties.*

APPENDIX K: TELEMEDICINE / TELECONSULTATION

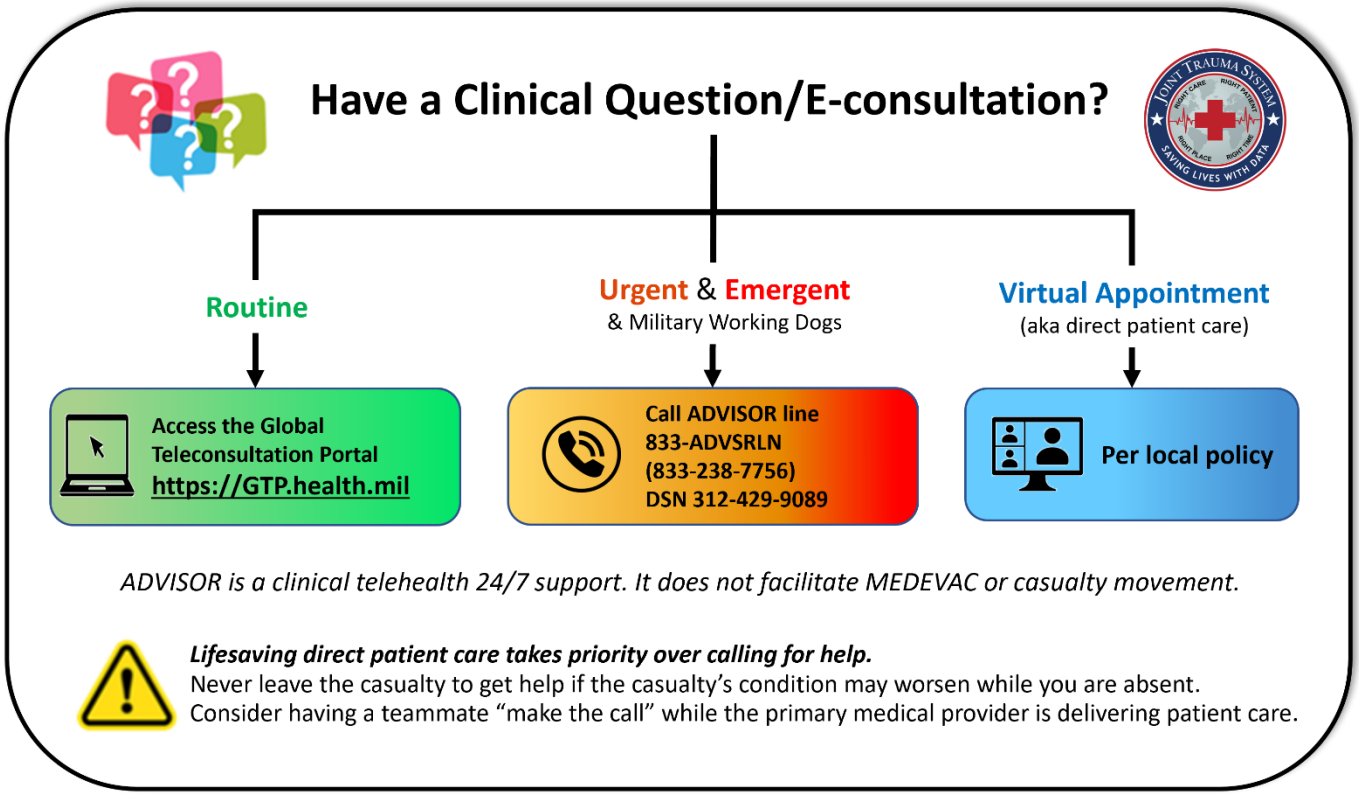

Illustration by Raymond Samonte

GTP: https://GTP.health.mil

Theater Patient Movement Requirements Center (TPMRC): to coordinate evacuation.

- TPMRC-Americas (NORTHCOM & SOUTHCOM), 618-817-4200
- TPMRC- East (EUCOM, AFRICOM, CENTCOM), DSN 314-480-8040
- TPMRC- West (INDOPACOM), DSN 315-448-1062

APPENDIX L: INFORMATION REGARDING OFF-LABEL USES IN CPGS

PURPOSE

The purpose of this Appendix is to ensure an understanding of DoD policy and practice regarding inclusion in CPGs of "off-label" uses of U.S. Food and Drug Administration (FDA)–approved products. This applies to off-label uses with patients who are armed forces members.

BACKGROUND

Unapproved (i.e. "off-label") uses of FDA-approved products are extremely common in American medicine and are usually not subject to any special regulations. However, under Federal law, in some circumstances, unapproved uses of approved drugs are subject to FDA regulations governing "investigational new drugs." These circumstances include such uses as part of clinical trials, and in the military context, command required, unapproved uses. Some command requested unapproved uses may also be subject to special regulations.

ADDITIONAL INFORMATION REGARDING OFF-LABEL USES IN CPGS

The inclusion in CPGs of off-label uses is not a clinical trial, nor is it a command request or requirement. Further, it does not imply that the Military Health System requires that use by DoD health care practitioners or considers it to be the "standard of care." Rather, the inclusion in CPGs of off-label uses is to inform the clinical judgment of the responsible health care practitioner by providing information regarding potential risks and benefits of treatment alternatives. The decision is for the clinical judgment of the responsible health care practitioner within the practitioner-patient relationship.

ADDITIONAL PROCEDURES

Balanced Discussion

Consistent with this purpose, CPG discussions of off-label uses specifically state that they are uses not approved by the FDA. Further, such discussions are balanced in the presentation of appropriate clinical study data, including any such data that suggest caution in the use of the product and specifically including any FDA-issued warnings.

Quality Assurance Monitoring

With respect to such off-label uses, DoD procedure is to maintain a regular system of quality assurance monitoring of outcomes and known potential adverse events. For this reason, the importance of accurate clinical records is underscored.

Information to Patients

Good clinical practice includes the provision of appropriate information to patients. Each CPG discussing an unusual off-label use will address the issue of information to patients. When practicable, consideration will be given to including in an appendix an appropriate information sheet for distribution to patients, whether before or after use of the product. Information to patients should address in plain language: a) that the use is not approved by the FDA; b) the reasons why a DoD health care practitioner would decide to use the product for this purpose; and c) the potential risks associated with such use.