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JOINT EN ROUTE CARE GUIDELINES

Committee on En Route Combat Casualty Care

Joint Trauma System and Defense Committee on Trauma
The Department of Defense Center of Excellence for Trauma

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Joint En Route Care (ERC) Guidelines

The En Route Care (ERC) guidelines define the standards for providing medical treatment during casualty/patient movement from the point of injury/illness through successive roles of medical care and is a joint service responsibility in accordance with Joint Publication 4-02, *Joint Health Services* and DoD Instruction 6000.11, *Patient Movement*. ERC guideline responsibility resides with the Committee on En Route Combat Casualty Care (CoERCCC) under the Joint Trauma System's Defense Committee on Trauma (DCoT). These guidelines align with the Committee on Tactical Combat Casualty Care (CoTCCC) framework, expanding casualty care into the ERC continuum and Prolonged Casualty Care (PCC).

ERC covers the transit medical care during:

- **Medical Evacuation** (MEDEVAC) – dedicated air and ground platforms with medically trained personnel to provide all levels of ERC.
- **Casualty Evacuation** (CASEVAC) – unregulated patient movement providing ERC aboard any vehicle/ platform not designated as MEDEVAC. Although CASEVAC can technically occur without trained medical personnel, the ERC guidelines are for trained medical personnel. This platform retains its legal combatant status and is not protected under the Geneva Conventions and Law of Armed Conflict.
- **USAF Aeromedical Evacuation** (USAF AE) – Strategic level patient movement between theaters of operation (intertheather) with all levels of ERC aboard fixed wing. Although the US Army is doctrinally responsibility for intratheater AE (covered under MEDEVAC), it can be conducted by the USAF as well.
- **Multimodal Patient Movement** (MM-PM) – MMPM is the regulated or unregulated movement of casualties using non-designated platforms of opportunity with medical personnel providing timely, efficient movement and ERC of the wounded, injured, or ill persons. Per DODI 6000.11 this includes the combination of at least two mediums (air, rail, road, water) for patient movement.

Key Points

- Builds on Tactical Combat Casualty Care (TCCC) and Prolonged Casualty Care (PCC) principles utilizing the **MARCH**-**PAWS** framework (Massive Hemorrhage, Airway, respirations, Circulation, Hypothermia/Head Injuries, Pain Control, Antibiotics, Wounds, & Splinting).
- Reference the JTS Clinical Practice Guidelines (CPGs) for detailed clinical standards
- Emphasizes standardization, interoperability, and effective communication during patient hand-offs, essential to quality care and patient safety.
- Addresses a wide range of operational contexts, from rapid extractions to prolonged maritime or ground patient movements.

Operational Implications: *ERC Guidelines are to inform and support but not replace local protocols*

Future battlefields will demand ERC adaptable to variable evacuation platforms, times, contested environments, and diverse transport modes. These guidelines provide a **scalable, evidence-informed framework** to optimize outcomes regardless of environment, resource availability, or transport platform.

ERC guidelines unify joint force practices for casualty/patient movement and care, ensuring seamless integration from POI through the roles of medical care. By standardizing treatment expectations and reinforcing TCCC foundations, these guidelines strengthen the DoD's ability to sustain survivability, confidence, and interoperability in current and future combat operations.

Tier 1 All Service Members (ASM)
Tier 2 Combat Lifesaver (CLS)
Tier 3 Combat Medic/Corpsman (CMC)
Tier 4 Combat Paramedic/Provider (CPP)

Key Updates Include

1. Management of Crash Injuries and Sepsis
2. Enhanced Communication and Documentation Standards
3. Emphasis on Patient Hand-Offs Across the Echelons and Platforms

ERC Packaging and Movement

ERC Casualty Packaging Top 10

1. Optimize all interventions prior to transport → the en route care phases is one of the most challenging phases of care delivery and one of the most vulnerable for the patient. Do as much as possible to optimize the casualty's condition prior to movement.
2. Prepare for movement:
    a. Safely secure the patient -- use *separate* securing/retention straps and devices for the casualty and any equipment.
    b. Personal Protective Equipment (PPE): all team members should have access to PPE, to include appropriate transport attire, life preserver (if applicable), helmet or cranial, and a securement device such as a monkey tail or gunners' belt if transporting on an airframe.
3. Fully assess the patient prior to moving them to en route care platform:
    a. Full assessment should be complete prior to movement, if unable, en route care provider will have to perform assessment.
    b. Catalogue all injuries, this includes rolling the patient (using spinal and pelvic precautions depending on injuries). Assess airway, breathing (auscultate lung fields and palpate the chest for expansion) and ensure no missed external bleeding. Wounds and any dressings should be labeled if possible. Tourniquets (TQ) should be assessed and ensure TQ times are documented.
    c. If an advanced airway is in place, assess lung compliance via programmed versus delivered tidal volume and peak inspiratory pressure.
    d. Establishing a solid baseline assessment with your team using the MARCH-PAWS approach is essential for communication along the continuum of care.
        - Use MARCH-PAWS for patient reassessments and as a problem-solving battle rhythm for your team during ongoing care or to mitigate patient decompensation while en route.
4. Prepare medications, secure interventions, and package casualties as needed for the environment.
    a. If there are logistical concerns, be cautious about wasting medication or supplies.
5. Calculate en route O2 requirements to ensure adequate supply during transport
    a. Include altitude considerations
    b. Target SpO2 levels between 92 - 96%.
    c. Account for resource management in mass casualty events, large scale combat operations, distributed maritime operations, and delayed evacuation.
    d. (Tier 3 & 4) See **Appendix A** for Oxygen Tank Conversion Factors and Oxygen Requirement Calculation.
6. Intravenous (IV) line management:
    a. Label where IVs are placed on the outside of HPMK/blanket/warming device with tape or maker
    b. Ensure all IVs are well secured with no tension present
    c. Dedicate an IV line for medication administration only
    d. Separate, mark, and place the administration port that is accessible to all en route team members
7. Prevent hypothermia!
    a. Position the casualty so they are protected from the elements
    b. Monitoring the casualty's core temperature
    c. Use fluid warmers
8. TQ management:
    a. Reassess the need for TQ prior to prolonged movement
    b. TQ conversion is ideally performed prior to en route care

   c. Placing a loose proximal extremity tourniquet 2-3 inches above wounds that initially had a TQ placed and was then transitioned to a pressure dressing – ensure loose and not occluding venous outflow. This is to facilitate rapid hemostasis in the event of re-bleed during challenging movement (e.g., bumpy roads, catapult launch from a carrier, or high sea states).

9. Enable easy communication:
   a. Ensure your ERC team can reliably communicate while en route
   b. Have an internal communication system or written system (i.e. notes, whiteboard, iPad)
10. Postoperative considerations are covered in **Appendix B**.

DETAILED CASUALTY MOVEMENT PLANNING CONSIDERATIONS

GENERAL

Regardless of mode of transport during the ERC, make sure all equipment is adequately secured to the casualty or vehicle/aircraft/boat so they do not become missile hazards.

- ERC, especially by aircraft, is a dynamic and noisy environment.
- A continuous reassessment of casualties is essential to quality patient care. The patient's condition, including mental status, and vital signs should be evaluated every 5-15 minutes.
- All critical interventions, including tourniquets, airway devices, ventilators, and infusions should be checked for effectiveness and security throughout transport.
- Consider the ambient temperature when administering blood products (e.g. blood left in the sun may break down RBCs).
- Secure all interventions (tape for lines, wraps for dressings, etc.).
- Flag invasive lines with tape to feel for line movement in poor visibility conditions.
- Consider measures for comfort and pressure injury prevention for all patients such as padding the litter or utilizing headrests.
- Utilize pressure infusers as needed to maintain flow of blood or fluid (ensure all air is out of bag prior to infusion)
- Utilize equipment/litter mounting options (SMEED, COTs, etc.) as needed and if available.
- Major procedures (such as securing an airway, prophylactic escharotomies, central line or foley catheter placement, etc.) should be performed prior to movement if the tactical situation allows. Space constraints and transport vehicle motion may make it difficult to perform major procedures or interventions during transport.

FOOT TRANSPORT

- Familiarize your team with the foot transport method and litter/sled type.
- Do not place additional supplies or equipment directly on top of the casualty.
- Consider and plan work rest cycles

GROUND TRANSPORT

- Determine how the casualty will be secured in/on the vehicle prior to loading.
- Position the casualty in the vehicle so the most critically injured locations can be easily accessed and re-assessed.
- If both sides of the casualty cannot be accessed during transport, the side with higher risk injuries (large wounds, hemothorax, etc.) should be closer to the provider.

AIR TRANSPORT

- Cover all interventions and secure all lines prior to loading the aircraft as rotor wash may dislodge lines and equipment.
- Position the casualty in the aircraft so the most critically injured locations can be easily accessed and re-assessed.
- Specialized stanchions or mounting systems may be required to secure the casualty litter in the aircraft.
- Ratchet/tie-down straps may be used to secure the litter to the floor/deck.
- Hypothermia and hypoxia are significant risks during flight that may affect casualty outcomes. Communicate temperature and altitude (or cabin altitude) needs with the flight crew.
- Movement via catapult from an aircraft carrier can be violent, often causing re-bleeding or shifting of interventions. Place loose tourniquets on limbs at risk for rebleeding. Reassess all interventions. Discuss patient position with air crew prior to catapult launch.
- Reassess any interventions utilizing pneumatic (air) pressure (e.g. endotracheal tube cuffs) at altitude and on descent.
- Patients need hearing protection.
- Consider how you will communicate with your patient if able. Consider non-traditional means such as whiteboards.

MARITIME TRANSPORT

- Cover dressings and wounds with water resistant materials.
- Keep casualty raised above the deck to avoid pooled water.
- Ratchet/tie-down straps may be used to secure the litter to the deck.

HAND-OFF

At each phase of casualty "Hand-Off", complete the following:

- Repeat the MIST Report
- Perform verbal turnover with receiving team
- Provide/hand off all documentation to receiving team
- Prioritize relay of "invisible interventions" such as medications administered
- Walk through and visualize all interventions performed
- Replace all consumables
- Retain and clean all durable transport equipment (monitors, ventilators, O_2 tanks, etc.)
- Establish means for continued comms should questions arise

Specific sections may also identify additional "**HAND-OFF**" considerations, examples below:

- Relay all medications administered
- Verify all TQs are secure and functioning with the receiving team (Massive Hemorrhage)
- Verify airway placement via auscultation and $EtCO_2$ with the receiving team (Airway)
- Ensure any used blood product/component bags are left with the receiving team (Circulation)

Communication and Documentation

Pre-Deployment, Mission Planning, and Training Considerations:

Communication and documentation in ERC are dual priorities. Since verbal turnover at the receiving facility may be short, thorough documentation of care rendered is vital for patient safety and continuity of care.

Communication

- Communicate with the casualty if possible. Encourage, reassure and explain care.
- Communication with the crew and casualty may be difficult depending on the mode of travel. If traveling by air, extra helmets with an Internal Communication System (ICS) may not be available, so the transport provider may need to use other ways to communicate, such as a notepad or whiteboard.
- Communicate with tactical leadership as soon as possible and throughout casualty treatment as needed. Provide leadership with casualty status and evacuation requirements to assist with coordination of evacuation assets.
- Verify evacuation requests have been transmitted and establish communication with the evacuation platform as soon as tactically feasible.
- Patient Hand-Off: Have a rehearsed script to relay vital information to the next echelon of care; prioritize interventions that cannot be seen by the next provider (e.g. medications).
    - Use the MIST (Mechanism of injury, Injuries sustained, Signs and symptoms, and Treatments rendered) report to pass on pertinent information along with completed documentation.

TCCC ASM (Tier 1) and CLS (Tier 2) Documentation

Complete Basic TCCC Communication and Documentation Principles, then:

1. Identify requirements for communicating care to the casualty, leadership, and medical personnel in accordance with (IAW) CoTCCC Guidelines.
2. Document casualty information on the DA Form 4700/DD3104, or if not available, the DD Form 1380 TCCC card. Ensure proper placement of that card on the casualty IAW DHA-PI 6040.01, *Implementation Guidance for the Utilization of DD Form 1380, Tactical Combat Casualty Care (TCCC) Card*.

TCCC CMC (Tier 3) and CPP (Tier 4) Documentation

Ensure Documentation and Communication is Completed for each Casualty IAW ERC Standards:

1. Ensure that communication is established with evacuation assets and/or receiving facilities
2. Prepare evacuation requests and set up priorities for evacuation for each casualty
3. Ensure DA Form 4700/DD3104, DD1380 TCCC Card, USAF Form 3899 (or unit specific form) are completed for **every** casualty transported.

Complete the After-Action Report (attached to DA Form 4700)

https://jts.health.mil/assets/docs/forms/DA4700_OP5_JTS_TACEVAC-AAR&PCR.pdf

and submit to JTS NIPR: dha.jbsa.healthcare-ops.list.jts-patientevacuation@health.mil
or via SIPR: usarmy.jbsa.medcom.list.joint-trauma-system-prehospital@mail.smil.mil

Massive Hemorrhage

ERC ROLE-BASED GUIDELINES FOR MASSIVE HEMORRHAGE			
TCCC - ASM	TCCC - CLS	TCCC - CMC	TCCC - CPP
All Personnel - Complete TCCC Management Plan for Massive Hemorrhage then: Re-assess and Re-apply Massive Hemorrhage interventions IAW TCCC Guidelines **HAND-OFF** • Ensure Hand-Off (Page 4) • Verify time of injury and TQ placement time			
	Consider applying loose TQs proximal to currently placed interventions Perform full head-to-toe assessment and interventions as required (following MARCH-PAWS)		
		If not yet performed, treat for identified hemorrhagic shock immediately (if currently being treated, move on to Airway) IAW TCCC Guidelines. **IMMEDIATELY RESUSCITATE casualties in hemorrhagic shock.** • Minimum of two >18ga IVs or IO prior to transport, flush if not in use • Administer 2g TXA IV/IO (if not previously given) and if within < 3 hours of injury • Administer blood products immediately: LTOWB, FWB or cold-stored blood (or components in a 1:1:1 ratio). • Administer 1g Calcium Chloride 10% or 3g Calcium Gluconate 10% slow IV/IO push after the first unit (and for every four units thereafter). See CPG: Prehospital Blood Transfusion; CPG: Whole Blood Transfusion, and Damage Control Resuscitation in Prolonged Field Care (Category: "Blood"). • Replace saturated absorbent pads, as needed, to assist in identification of bleeding during transport. • If pads are becoming repeatedly saturated, identify bleeding source and utilize direct pressure, improved wound packing, etc. for hemorrhage control. • Perform standard reassessment as needed (including tube thoracostomy output) **HAND-OFF** • Verify TQ and/or hemostatic interventions, amount transfused, and times of interventions and transfusion.	

			• If aortic occlusion was performed, note zone placement, inflation time, balloon volume, catheter depth, and ensure catheter is well secured to prevent migration during transport.
			• In rare situations when a short-distance evacuation to higher level of care is possible, a Zone 3 REBOA inserted at Role 2 may remain inflated during transport, however this requires **exceptional communication and planning to avoid undue risk of ischemic injury**.
			  ○ Zone 1 REBOA should not be transported inflated
			  ○ Zone 3 REBOA should have an occlusion time of less than 30 minutes, with a maximum of 60 minutes.

- Do not remove the sheath prior to transport
- Monitor balloon occlusion by assessing absence of contralateral lower extremity pulse.
- Should the sheath become dislodged, apply gentle direct pressure for at least 30 min (just enough pressure to occlude the arteriotomy and not enough to limit flow to the leg).
- Obtain guidance from originating team on how long to maintain REBOA occlusion.
- Refer to CPG: REBOA Management (Category: "Chest and Thorax") when moving with aortic occlusion device.

- Assess for potential sites of internal hemorrhage / shock using point of care ultrasound

HAND-OFF

- If aortic occlusion is performed, provide zone placement and time(s) to receiving team
- Provide ultrasound / E-FAST exam findings

Airway

ERC ROLE-BASED GUIDELINES FOR AIRWAY				
TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP	**All Personnel - Complete TCCC Management Plan for Airway then:** Re-assess and Re-apply Airway interventions IAW TCCC Guidelines. **HAND-OFF** • Ensure Hand-Off (page 4)
				• Allow a conscious casualty to assume any position that best protects the airway, to include sitting up, leaning forward, or recovery position, if no contraindications (e.g. spinal injury). • Apply cervical spine stabilization if indicated by MOI, neurologic deficits, etc. C-collar is not indicated for isolated penetrating trauma, including penetrating cervical trauma in a conscious patient with no neurologic deficits. See CPG: Cervical and Thoracolumbar Spine Injury (Category: "Orthopedic"). • Reassess airway before, during, and after casualty movement. **HAND-OFF** • Verify airway and/or airway adjunct is patent, in the correct position, and appropriately secured.
				Assess airway adjuncts for efficacy (work of breathing, $EtCO_2$ and SpO_2) • Auscultate breath sounds prior to movement, if possible • Suction, as needed. Utilize mechanical suction with intermittent suction capability if available. For patients with an advanced airway: • Document tube type, size, depth at the teeth or gumline, and $EtCO_2$ reading / waveform pattern. • Assess proper inflation of cuffs and reassess regularly. Use a manometer if available (20-30 cm H_2O) or, if unavailable, assess pilot bulb which should be moderately firm but still compressible). Be mindful of cuff expansion when at altitude; may deflate and inflate as needed during ascent and descent. • Utilize mechanical suction with intermittent suction capability. An in-line suction catheter is preferred, if available. • Ensure a BMV with PEEP valve, 10 mL syringe, suction, and an alternate airway are immediately available. **If at any time during transport a mechanically ventilated casualty begins to desaturate or show signs of respiratory distress, immediately disconnect casualty from ventilator and manually ventilate via BVM (with PEEP valve, if available) while correcting issues utilizing DOPE algorithm (Displacement, Obstruction, Pressure, Equipment).** **(See Appendix C: Troubleshooting DOPE Algorithm)**

HAND-OFF

- Verify airway adjunct placement (gum/teeth line) and $EtCO_2$

If potential or impending airway compromise, consider definitive airway placement with Rapid Sequence Intubation (RSI).

Examples include:

- inhalation burns in an enclosed space
- burns to the face or neck
- burns > 40% TBSA
- burn victims with stridor, accessory muscle use, or respiratory distress
- anaphylaxis or angioedema compromising the airway
- traumatic injury with GCS ≤ 8
- poor oxygenation or ventilation with standard airway maneuvers
- inability to protect the airway due to facial trauma or hemoptysis

Place NG/OG tube, verify placement, and secure with tape to device holder or definitive airway.

Re-assess cuff pressures using a manometer, if available. If unavailable, check pilot tube during ascent and at cruising altitude; it may deflate (fully) and inflate as needed. Check for cuff leaks.

See **Appendix D** for Airway Assessment Acronyms

See **Appendix E** for Difficult Intubation Assessment

HAND-OFF

- Verify airway adjunct placement (gum/teeth line) and $EtCO_2$
- Verify NG/OG tube placement

ADDITIONAL CONSIDERATIONS

General Movement:

- ERC, by any platform, is a dynamic and noisy environment. It is important that all equipment is checked frequently to identify malfunctions and alarms that will be difficult to hear. Position your equipment (e.g. mechanical ventilator) so you can monitor ventilatory mechanics (e.g. PIP, TV, RR, PEEP, etc.) and $EtCO_2$ waveforms.
- Ensure a provider with required airway equipment is located near the head of the casualty.
- Ensure lung sounds have been obtained prior to embarkation

Respiration and Ventilation

ERC ROLE-BASED GUIDELINES FOR RESPIRATION AND VENTILATION			
TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP
All Personnel - Complete TCCC Management Plan for Respiration then: Re-assess and Re-apply Respirations interventions IAW TCCC Guidelines **HAND-OFF** • Ensure Hand-Off (page 4)			
Place chest seals and perform needle decompression (NDC) IAW TCCC Guidelines **HAND-OFF** • Location and number of chest seals and/or needle decompressions performed and effect on clinical condition.			
Establish waveform $EtCO_2$ monitoring to ensure proper airway placement. Normal range is 35-45 mmHg, but may decrease suddenly due to: • Shock/Cardiac arrest • Displacement of airway intervention • Obstruction • Pneumothorax • Equipment malfunction See **Appendix F** for EtCO2 waveforms See **Appendix G** for Hypocapnia and Hypercapnia causes **Note**: Colorimetric capnography is NOT to be used for continuous monitoring. Tube thoracostomy management: • If not already done; Suture in the chest tube and over tape/chest seal to chest wall • Ensure appropriate occlusive dressing (e.g. petroleum gauze)/seal at the chest tube insertion site. • Reinforce the connections to the Heimlich valve, suction tubing, and Pleurevac • Record the depth of insertion and mark it with tape • Verify function or tidaling in the drainage system • Monitor pulse oximetry (SpO_2) and maintain SpO_2 90-96%			

Supplemental Oxygen - most combat casualties do not require, but consider for the following:

- Low SpO_2 (< 90%)
- Transporting casualty at increased altitude (mountainous terrain or in-flight) – For expected SpO_2 at various altitudes see CPG: Altitude Emergencies in the Prehospital Environment, page 4 (Category: "Altitude")
- Known or suspected carbon monoxide poisoning: goal SpO_2 100%
- Known or suspected smoke inhalation

If wheezing is present (airway burns, asthma anaphylaxis, etc.), administer bronchodilators:

Severity	Good	Better	Best
Mild to Moderate	Albuterol inhaler	Albuterol, nebulized	Albuterol, nebulized + Ipratropium Bromide
Moderate to Severe (above medications, plus)	Epinephrine IM or Epinephrine Nebulized	Magnesium Sulfate IV/IO, Solumedrol IV/IO	Epinephrine IM Magnesium Sulfate IV/IO Solumedrol IV/IO

HAND-OFF

- Verify position/patency of tube thoracostomy with receiving team (consider using tape for visual reference of position).

If indicated, perform finger thoracostomy and/or chest tube in the 5th intercostal space at the anterior axillary line.

- Utilize a one-way valve (Heimlich valve) on all tube thoracostomies, if available.
- **Preferred**: Chest tube drainage system with suction (water seal or Pleurevac to suction)

Low $EtCO_2$ may not be a reliable indicator of ventilatory status in hypo-perfused (hypovolemic) casualties.

If chest burns are causing difficulty in breathing/ventilation, perform chest escharotomy, if trained. (See Burn section for further information.)

Provide appropriate sedation and pain control.

Paralytics should NOT be given unless adequate sedation is available

Ventilated Casualties

- Ensure ventilator (as applicable) has been pre-set to utilize parameters of the user's choice.
- If moving a casualty from one vent to another, use the current ventilator setting and adjust as needed.

- Assess casualties' prior interventions: ETT, chest tube, etc.
- Assess casualties' respiratory status: Rate, Rhythm, Depth, Effort
- Assess monitors: oxygenation (SpO2), EtCO2 (with advanced airway), cardiac monitoring.
- See **Appendix H** for Mechanical Ventilation Setup Infographic

Tidal Vol(T_V)Quick Reference (Male)	Tidal Vol Quick Reference (Female)
66" = ~380cc [min: 255 / max: 510]	60" = ~273cc [min: 182 / max: 364]
69" = ~420cc [min: 283 / max: 566]	63" = ~314cc [min: 210 / max: 419]
72" = ~465cc [min: 310 / max: 621]	**66" = ~356cc [min: 237 / max: 474]**
75" = ~505cc [min: 338 / max: 676]	69" = ~397cc [min: 265 / max: 530]

- Normal Minute Ventilation (T_VxRR) is 100-120 ml/kg Ideal Body Weight (IBW) in adults. Patients with metabolic or respiratory acidosis may require 200-240 ml/kg IBW in adults. Initial ventilator setting should be set to the casualty's spontaneous rate and titrated as they are resuscitated.
- See **Appendix I** for Ideal/Predicted Body Weight Table.
- Ensure adequate resuscitation before PEEP is increased above 5 cmH2O (especially in chest trauma).
- Ensure BVM w/PEEP valve is immediately available.
- Set transport ventilator to current casualty settings prior to switching ventilators [See CPG: Mechanical Ventilation (Category: "Respiratory") for ventilator setup].
- Place NG/OG tube, secure and document depth at teeth/gum.

If at any time the casualty begins to desaturate or develop respiratory problems:

- **Immediately disconnect the ventilator** and manually ventilate with BVM (with PEEP valve if available).
- Increase FiO2 to 100%
- Utilize the **DOPE** algorithm to troubleshoot:
  - Displacement
  - Obstruction
  - Pneumothorax
  - Equipment
- See **Appendix C** for Troubleshooting DOPE Algorithm

HAND-OFF

- Communicate mechanical ventilation settings
- Communicate placement/presence of tube thoracostomy and other interventions

Circulation and Resuscitation (including Crush Injuries)

ERC ROLE-BASED GUIDELINES FOR CIRCULATION AND RESUSCITATION				
TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP	**All Personnel - Complete TCCC Management Plan for Circulation and Resuscitation then:** • Re-assess and Re-apply Circulation interventions IAW TCCC Guidelines. • All TQs and dressings (hemostatic and pressure) require reassessment upon casualty movement. **Cardiopulmonary Resuscitation (CPR) may be attempted during ERC if the casualty does not have obviously fatal wounds and will be arriving at a facility with a surgical capability within a short period of time.** **CPR should not be done at the expense of compromising the mission or denying life-saving care to other casualties.** **Prior to CPR, ensure the following reversible causes of cardiac arrest have been addressed: Hypovolemia, Hypoxia, Hyperkalemia, Tension pneumothorax, Cardiac Tamponade (in the ERC setting cardiac tamponade should be treated with volume (blood) administration).** **HAND-OFF** • Ensure Hand-Off (page 4)
				Casualties with torso trauma or polytrauma who have no pulse or respirations during ERC should have bilateral needle decompressions/finger thoracostomy performed to ensure they do not have a tension pneumothorax. *See CPR above. • Convert tourniquets IAW TCCC guidelines: Limb tourniquets and junctional tourniquets should be converted to hemostatic or pressure dressings as soon as possible if three criteria are met: the casualty is not in shock; it is possible to monitor the wound closely for bleeding; and the tourniquet is not being used to control bleeding from an amputated extremity. Every effort should be made to convert tourniquets in less than 2 hours if bleeding can be controlled with appropriate pressure dressings, ideally using hemostatic dressings. Do not remove a tourniquet that has been in place for more than 4 hours unless close monitoring, ability to manage hyperkalemia, and lab capabilities are available.
				If able, obtain blood products, blood tubing and calcium required for ERC (consider cold storage for prolonged transport) prior to movement. **PREPARE FOR MOVEMENT** **<u>Initiate/continue resuscitation</u> for casualties in hemorrhagic shock:** • Minimum of two >18ga IVs or IO prior to transport, flush if not in use • Administer 2g TXA IV/IO (if not previously given) and if within < 3 hours of time of injury • Administer blood products: LTOWB, FWB or cold-stored blood (or components in a 1:1:1)

- Administer 1g Calcium Chloride 10% or 3g Calcium Gluconate 10% slow IV/IO push after the first unit (and for every four units thereafter). See CPG: Prehospital Blood Transfusion (Category: "Blood").

Set up fluid warming method for blood and remove from cold storage if anticipated usage.

For large volume replacement or inability to use gravity in transport method (e.g. By Foot, infusion through IO catheter, etc.), consider the following infusion options:

- **Minimum:** push/pull or manual device
- **Better:** pressure infuser
- **Best:** automatic infuser

Reassess the casualty during and after each unit of blood.

- Vital signs: HR, RR, BP, Temp, SpO_2, and $EtCO_2$
- Mental Status
- Pulse quality
- Capillary refill

Therapeutic endpoints:

- Return to a normal level of consciousness (LOC)
- Return of palpable radial pulse
- Increase of systolic blood pressure (SBP) to 100 mmHg (> 110 mmHg for TBI)
- Stabilization of vital signs: Heart rate, respiratory rate, blood pressure, oxygen saturation, etc.

If the casualty has signs of ongoing shock despite hemorrhage control and adequate resuscitation, consider alternate causes of shock and treat accordingly:

- Hypovolemic (non-hemorrhagic, burn losses)
- Obstructive (tension pneumothorax, cardiac tamponade, etc.)
- Distributive (sepsis, anaphylaxis, neurogenic, etc.)

Place Foley catheter if indicated, to monitor urine output (UOP)

When therapeutic endpoints are met, maintain crystalloid IV/IO at maintenance dose or discontinue IV/IO resuscitation and have the casualty drink water until 0.3 – 0.5 mL/kg/hr urine output (UOP) is achieved (consider an oral rehydration solution with either proprietary mixtures or fabricated – 6 teaspoons of granulated sugar with ½ teaspoon of table salt in 1 liter of water).

Assess pelvis and apply pelvic compression device (PCD) if indicated. If PCD previously placed, assess integrity and position of PCD, particularly after casualty movement.

Reassess TQs and dressings (hemostatic and pressure), Improve and continue interventions as needed.

Crush Injuries: See table below

HAND-OFF

- Time and dose of TXA, if given
- Number and type of blood product/components used
- Total grams of Calcium administered
- Casualty blood type, if known

- Leave used blood product/component bags with receiving facility.

  - Perform EFAST, if trained and available
  - Consider invasive hemodynamic monitoring (e.g. A-line), if available and trained
  - Consider use of autotransfusion device
  - Maintain goal SBP 100 mmHg (or MAP 60-65 mmHg) with initial fluid/blood product resuscitation (> 110 mmHg with TBI, MAP > 60)

HAND-OFF

- Provide E-FAST exam findings

CRUSH INJURY CONSIDERATIONS

ERC personnel should follow unit protocols if established
CPG: Crush Syndrome (Category: "Orthopedic")

Tier 3 Crush Injury Treatment

If the casualty is entrapped, initiate intravenous (IV) or intraosseous (IO) crystalloid administration IMMEDIATELY (before extrication).

- Rate and volume: initial bolus, 2 L; initial rate: 1 L/h, adjust to urine output (UOP) goal of 100 – 200 mL/h (≈300ml/h first 24 hrs to reduce AKI).
- If unable to establish IV/IO access: oral intake of electrolyte solution. Sufficient volume replacement may require "coached" drinking on a schedule.
- May use rectal infusion of electrolyte solution if PO is not possible. Rectal infusion of up to 500mL/h can be supplemented with oral hydration.
- 15-20 puffs of a 90mcg/dose albuterol metered dose inhaler (MDI) is roughly equivalent to 10mg of an albuterol continuous nebulizer (this is a temporary measure to shift potassium intracellularly until further hyperkalemic diagnostic or treatment methods can be performed).

ASSESS FOR COMPARTMENT SYNDROME: For casualties with a crush injury to an extremity who are already being treated, frequently reassess the injured extremity for signs of acute compartment syndrome:

- **Pain out of proportion upon passive movement***
- **Paralysis**
- **Paresthesia/tingling**
- **Pallor/Cool extremities**
- **Poikilothermia**
- **Pulselessness**

***Severe pain that appears out of proportion to examination is the earliest and may be the only sign of compartment syndrome. Pay attention to the need for increasing analgesic doses.**

Tier 4 Crush Injury Treatment

- Use electrocardiography to monitor for evidence of hyperkalemia. ECG changes include T-waves, a widened QRS complex, bradyarrhythmias, conduction blocks, among others. If noted:
  - Administer 1g of 10% calcium chloride or 3g of 10% calcium gluconate
  - Administer 10 mg of nebulized albuterol
  - Administer 10 units of IV insulin with 50 mL (25 g) of 50% dextrose (D50).
    - Check the serum glucose at 30 min, 1 hour, 2 hours, and 3 hours post administration
- If the casualty is producing urine, consider alternating normal saline solution with an alkaline solution.
- 1 L of 0.9% normal saline, followed by 1 L of 0.45% normal saline with 50 mEq of sodium bicarbonate. D5 1/2NS + 1 amp of HCO3 is an alternative and often recommended maintenance fluid solution.
- Administer up to 200 mEq total of sodium bicarbonate in the first 24 hours without urinary pH monitoring during ERC.
- Monitor for signs of hypocalcemia – tetany, carpopedal spasm, seizures, arrhythmias, etc. If clinical or laboratory evidence of hypocalcemia, administer 1 g of 10% calcium chloride or 3 g of 10% calcium gluconate.
- CAUTION: Calcium and Sodium Bicarbonate ARE NOT to be administered in the same IV line.

ADDITIONAL CONSIDERATIONS

OVERALL ERC CONSIDERATIONS:

- Crush injuries can quickly develop into crush syndrome (hyperkalemia, hypocalcemia, rhabdomyolysis due to muscle necrosis leading to acute tubular necrosis and kidney injury), which can result in fatal arrhythmias and death. The most important prehospital intervention to prevent development of crush syndrome is aggressive fluid resuscitation (up to 1.5L/hr.), ideally prior to extrication. Recent literature from earthquake patient treatment suggests achieving ≈300ml/h first 24 hrs can significantly reduce rhabdomyolysis associated with AKI.
- Position the casualty in the transport platform so that the provider can easily assess and re-evaluate any injured body part during movement. Continue to closely monitor for clinical signs of acute compartment syndrome.
- Continuous electrocardiographic monitoring during transport is critical to monitor for arrhythmia and complications of hyperkalemia.

MOVEMENT BY FOOT:

- Try to keep the injured extremity of body part elevated during movement
- If feasible, initiate IV access prior to movement and administer fluids with devices such as a manual rapid infuser. Use of gravity and pressure bags may be limited in this setting.

MOVEMENT BY GROUND TRANSPORT:

- No specific considerations

MOVEMENT BY AIR:

- No specific considerations

MOVEMENT BY SEA:

- No specific considerations

Hypothermia

ERC ROLE-BASED GUIDELINES FOR HYPOTHERMIA				

TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP	**All Personnel - Complete TCCC Management Plan for Hypothermia then:**
				Re-assess and Re-apply Hypothermia interventions IAW TCCC Guidelines.
				• Minimize casualty's exposure to cold ground, wind, and air temperatures.
				  ○ Place insulation material between the casualty and any cold surface or litter as soon as possible.
				  ○ Ensure hypothermia management from the field is still in place and has not moved and or shifted during turnover. Ensure the hypothermia management system covers the patient's back and the system is protecting the patient from wind blowing over or under them, especially in a rotary wing environment.
				  ○ Keep protective gear on or with the casualty, if feasible.
				  ○ Replace wet clothing with dry clothing and protect from further heat loss. If unable to replace the dry clothing, wrap an impermeable layer around the casualty.
				  ○ When moving patients in the maritime environment, double up outer layering of impermeable systems to protect the patient from winds and sea spray.
				• Obtain temperature
				• Reassess and replace active warming blanket per manufacturer guidelines.
				HAND-OFF
				• Ensure Hand-Off (page 4)

				• Place an active heating blanket on the casualty's anterior torso and under the arms in the axillae.
				  ○ When using an active warming blanket, perform frequent skin checks to monitor for contact burns and ensure there is a sheet or other barrier between the skin and the heating element.
				Caution: DO NOT place any active external heating directly on the skin or on areas of skin which are under pressure or have poor blood flow as this increases risk of injury and/or skin burns. Place a sheet or dry clothing between the heating device and the skin.
				• Vehicle or aircraft Environmental Control Systems (ECS) should be used to create an ambient control temperature to allow passive room warming. ECS can be unreliable, especially in rotary-wing when power is limited. In preplanning, the ECS can be used to set a warm environment prior to or after receiving the casualty, to prevent drastic temperature loss.
				• Use an approved warming device to deliver IV/IO resuscitation fluids, in accordance with current CoTCCC guidelines, at an output temperature of 38°C (100.4°F) capable of flow rates of >150 ml/min.
				• Convert to continuous temperature monitoring, if equipped. Temperatures should be recorded to establish and track warming trends.
				  ○ **Minimum**: Scheduled temperature measurement with vital sign evaluations
				  ○ **Best**: Continuous core temperature monitoring
				• Communicate re-supply requirements
				HAND-OFF
				• Record current temperature and any decrease or increase in body temperature

Head Injury

ERC ROLE-BASED GUIDELINES FOR HEAD INJURY

TCCC-ASM

TCCC-CLS

TCCC-CMC

TCCC-CPP

All Personnel - Complete TCCC Management Plan for Head Injury then:

Re-assess and Re-apply Head Injury interventions IAW TCCC Guidelines

- Identification and local wound management of any open head wounds/skull fractures
- Priorities should include hemorrhage control and protection/coverage of any open skull injuries.
- If a head injury is suspected, ensure the head of litter/casualty is maintained at 30º elevation if possible (can use clothing or blankets as a ramp).
- Loosen c-collar or other constricting devices on the neck to ensure proper venous drainage.
- Protect airway from vomiting, as required

HAND-OFF

- Ensure Hand-Off (page 4)

Refer casualty to Tier 3 or Tier 4 level provider if TBI is suspected, conduct MACE2 examination IAW TCCC guidelines, if able.

Signs and Symptoms of Head Injury (IED & HEADS Checklist)

Injury	Physical damage to body or body part of a Service Member	Yes / No
Evaluation (HEADS)	**H** – Headaches and/or vomiting?	Yes / No
	E – Ear ringing?	Yes / No
	A – Amnesia, altered consciousness and/or loss of consciousness?	Yes / No
	D – Double vision and or Dizziness?	Yes / No
	S – Something feels wrong or is not right?	Yes / No
Distance	Was the Service Member within 50 meters of the blast? Record distance	Yes / No

- Upgrade evacuation priority and destination (facility with neurosurgical capabilities) for any casualty with initial mild TBI whose condition worsens (no longer awake or following commands).
- Complete AVPU assessment
- Casualties with severe TBI may require altitude restrictions or cabin pressurized to 5000 ft.

HAND-OFF

- Report any changes in mental status or casualty status to receiving facility

**** Note: One incidence of hypotension (SBP<90 mmHg) or hypoxia (SpO2<90%) doubles mortality.**

- Maintain goal SBP > 110 mmHg with initial fluid/blood product resuscitation
- Supplemental oxygen to maintain SpO_2 > 93%
- $EtCO_2$ should be monitored for all casualties with goal of 38-42 mmHg
- Hyperventilation (PaCO2<35mmHg) increases mortality
- Serial neurologic checks and identify signs of elevated or rising intracranial pressure (widening pulse pressure, bradycardia, irregular respirations).

Assess Glasgow Coma Scale (GCS) (**Table 1**).

- Identification and local wound management of any open head wounds/skull fractures. Priorities should include:
  - Hemorrhage control
  - Removal of gross contamination, irrigation if possible
  - Protection/coverage of any exposed dura or brain matter
  - Administer antibiotics if signs of open skull fracture.
- Eye Injuries: Perform visual acuity and treat IAW TCCC Guidelines
- Complete MACE2 examination IAW TCCC Guidelines, if able
- Identify signs of elevated or rising intracranial pressure (ICP):
  - Changes in mental status (decrease in AVPU or GCS)
  - Headache, nausea, vomiting
  - Shallow respirations
  - Sluggish or poorly reactive pupils
  - Focal motor deficits
  - Upper motor neuron dysfunction (e.g. Babinski reflex or upward spreading toes)
  - Increasing blood pressure/widening pulse pressure (often a compensatory response to elevated ICP to maintain cerebral perfusion pressure)
- Initiate immediate treatment for signs of elevated ICP:
  - Initial bolus of 3% sodium chloride, 250 mL over 10 minutes (1-3 ml/kg up to 250 mL pediatrics).
  - Alternative: 23.4% sodium chloride 30 mL given over 15 minutes
  - Alternative: 3 ampules of 8.4% sodium bicarbonate (150 meq)
  - Alternative: Mannitol 0.5-1 g/kg over 10 minutes adult or pediatrics (**avoid in hypotension**).
- Can be followed by a continuous infusion of 3% sodium chloride 50 – 100 mL/hr.
- Communicate evacuation requirements (need for TBI evaluation, neurosurgery)
  - If the casualty has been given repeated hypertonic boluses or a prolonged hypertonic drip, Chloride levels should be monitored at the sending or receiving facility to ensure the casualty is not becoming acidotic.

**** Note: there is no data that indicates that hypertonic saline improves outcomes. Avoiding hypotension improves mortality. If the patient needs blood products – use blood or plasma to maintain a normal SBP.**

- Impending brain herniation
  - Signs
    - "Blown" pupil - pupil that is fixed (unresponsive to light) and dilated

- **Cushing's Triad**: Bradycardia, Wide pulse pressure, and Kussmaul breathing (deep, slow, irregular breaths) or other abnormal respiratory patterns.
- Brief (less than 20 minutes) moderate hyperventilation to goal pCO_2/$EtCO_2$ 30-35mmHg may be performed for signs of impending/active herniation if the patient can be in the operating room rapidly. Otherwise, hyperventilation increases mortality.
- Administer an additional bolus of hypertonic solution

**** Note: Hyperventilation should be used only as a temporizing measure while additional ICP treatments are being administered when neuro interventional care is expected within 30 minutes.**

DO NOT perform intracranial procedures without appropriate training or resources.

Intracranial procedures should only be performed by adequately trained surgeons in consultation with neurosurgery.

- Complete serial GCS exams
- Repeat MARCH-PAWS assessment for any abrupt decline in the Glasgow Coma Scale (GCS) or change in pupil exam to rule out non-neurologic causes.
- Upgrade evacuation priority and destination (facility with neurosurgical capabilities) for any casualty with initial mild TBI who deteriorates to moderate/severe TBI category (see page 18 for GCS score and TBI classification).
  - Repeat triage evaluation and identification of likely non-survivable condition (or associated injuries) based on injury types/severity and required vs available resources.

HAND-OFF

- Perform neurological exam with receiving facility
  - Reassess and Re-apply MARCH interventions IAW TCCC Guidelines
  - Perform serial blood glucose checks every 6 hours, if able
- For severe TBI, seizure prophylaxis should be administered if not already given:
  - Levetiracetam (Keppra®) 1500mg IV/IO and redosing 1000 mg IV/IO q12hr
- For active seizure activity, administer:
  - Midazolam 5 mg IV/IO or 10 mg IM
  - If unavailable, consider Lorazepam 4 mg IV/IO
  - Consider teleconsultation
- Initiate appropriate interventions to attain the following goals
  - Cerebral perfusion pressure (CPP) > 60 mmHg and ICP < 20 mmHg (if intracranial monitoring device or ventriculostomy is in place)
  - Temperature < 99ºF
  - INR < 1.3
  - Hemoglobin > 10 g/dL
  - Sodium 155 - 160 mmol/L
  - Glucose 80 - 180 mg/dL
- If SBP remains less than < 110 mmHg despite appropriate resuscitation and hemorrhage control, a vasopressor agent should be started, if available, and titrated to a SBP > 110 mmHg or to maintain a CPP > 60 mmHg.

- **Do not prioritize pressors over blood or plasma.**
  - Norepinephrine continuous infusion 0.1–0.5 mcg/kg/min (see page 26 for drug chart)
  - Vasopressin continuous infusion 0.03 units/min
- If a ventriculostomy is in place and the team has been trained on proper operation, follow the neurosurgeon's guidance for drainage for elevated ICPs.

Orbital Compartment Syndrome

Patients with cranial trauma are at increased risk of developing this vision threatening condition.

Exam:

- Decrease or loss of visual acuity
- "Rock hard" eyelids, or eyelids tight against the globe on palpation. Palpate eyelids to see if one eye has increased firmness and resistance compared with the opposite eye.
- Proptosis: bulging of the affected eye compared to the other
- Relative afferent pupillary defect (RAPD)

Management:

- If suspected, perform emergent lateral canthotomy and inferior cantholysis
- Assess and document vision if possible
- Seek tele-ophthalmology consultation with eye surgeon
- **SHIELD AND SHIP**

Lateral Canthotomy

- See CPG: Eye Trauma Initial Care Pages 31-33 (Category: "Ophthalmology")

Table 1. Glasgow Coma Scale

Behavior	Response	Score
Eye Opening	Spontaneous	4
	To Speech	3
	To Pain	2
	None	1
Verbal Response	Oriented to Person, Place and Time	5
	Confused	4
	Inappropriate Words	3
	Incomprehensible Sounds	2
	None	1
Motor Response	Obeys Commands	6
	Moves to Localized Pain	5
	Flexion Withdrawal to Pain	4
	Abnormal Flexion (decorticate)	3
	Abnormal Extension (decerebrate)	2
	None	1

TBI Classification

- Mild: GCS 13-15
- Moderate: GCS 9-12
- Severe: GCS 3-8

Pain Management (Analgesia and Sedation)

ERC ROLE-BASED GUIDELINES FOR PAIN MANAGEMENT

TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP

All Personnel - Complete TCCC Management Plan for Pain Management then:
• Re-assess and Re-apply Pain Management interventions IAW TCCC Guidelines.
• Under direction from a CLS Provider or higher, assist with PO medication, if not previously administered:
  ○ Acetaminophen 500 mg tablet x 2 PO every 8 hours
  ○ Meloxicam 15 mg tablet x 1 PO, once per day
HAND-OFF
• Ensure Hand-Off including time of last medication administration			

	Under direct supervision of CMC or CPC, assist with administration: • Fentanyl OTFC (do not re-administer without approval of Tier 3/4 provider) • Nausea: Inhale vapor from isopropyl alcohol pad		
		MILD TO MODERATE PAIN MANAGEMENT **IV Fentanyl:** 25-50 mcg x 1, may repeat in 30 minutes to desired pain control ***or*** **Ketorolac (non-hemorrhagic injuries):** • IV/IO: 15 mg every 6 hours • IM: 15 - 30 mg every 6 hours **MODERATE TO SEVERE PAIN MANAGEMENT** **Ketamine (analgesic dose)** • IV/IO: 20 mg (or 0.15 - 0.3 mg/kg) slow IV or IO push over 2 min. May repeat every 20 min or as needed. • IN/IM: 50 - 100 mg (or 0.5 - 1 mg/kg) IM or IN every 30 min or as needed *__A note on IN Ketamine__: This is only indicated if the Ketamine concentration allows for <1 mL to be administered to each nostril. Divide total dose between both nostrils. ***or*** **Fentanyl** • IV/IO: 0.5 - 1 mcg/kg x 1, repeat every 30 min as needed • IN: 100 mcg x 1, repeat in 30 min as needed	

Naloxone Hydrochloride (Narcan®)

For Reversal of Opioid Overdose:

- Open the airway and provide respiratory support with assisted ventilation (BVM) and airway adjuncts as needed.
- Administer 0.4 - 2 mg IV/IO/IN/IM, repeat every 2-3 minutes as needed until the return of spontaneous respirations.
- Full opioid reversal should be avoided, if possible, to allow ongoing pain control
- The patient's respiratory drive should be continuously monitored after administration (through EtCO2, SpO2, and direct reassessment) as naloxone may have a shorter half-life than the opioid.

EMERGENCY SEDATION (UNIT APPROVAL for Tier 3)

***** NOTE: Sedation does NOT provide analgesia (except Ketamine which provides both) *****

If sedation is used for traumatic injuries, pain medications MUST also be used

SEDATION PREPARATION

All patients need:

- **Airway equipment must be immediately available**
- **Suction device**
- **Cardiac monitoring and $EtCO_2$, if available**

Ketamine (sedation dosing):

- Initial dose: 1-2 mg/kg IV/IO push over 2 min
- If IV/IO is not available: 300 mg IM (or 2-3 mg/kg)
- Have additional 50 mg doses available in case the initial dose is insufficient or for prolonged sedation.

Ketamine administration for sedation:

1. Administer 1 - 2 mg/kg slow IV/IO push and assess patient response.
2. Administer additional 0.25 - 0.5 mg / kg doses every 5 to 10 minutes until desired sedation level (up to 2 mg/kg has been given).
3. **Note**: rapid administration of 2 mg/kg of ketamine may result in apnea.
4. For emergence reaction: treat with midazolam:

Midazolam: 0.5 - 2.5 mg IV/IO/IN/IM for emergence reaction

*Must have airway equipment ready, cardiac monitoring, $EtCO_2$ in place if available.

ANTIEMETICS

Consider one of the following:

- **Ondansetron:** 4 mg IV/IO/IM/ODT/PO tablet every 8 hours (no more than 8 mg in 8 hrs).
- **Metoclopramide:** 10 mg in 0.9% NS over 20-30 min x 1 (max dose 20 mg per day).

Dystonia/akathisia from metoclopramide, treat with:

- **Diphenhydramine:** 25 mg IV/IO x 1. May repeat dose in 15 min if ineffective.

or

- **Promethazine:** 25 mg PO every 6 hours

MOTION SICKNESS

Consider one of the following:

- **Scopolamine:** 1 mg per 3 days transdermal patch.

  or
- **Meclizine:** 12.5 - 25 mg PO every 6 hours

  or
- **Promethazine:** 25 mg PO every 6 hours

HAND-OFF

- Medications used and pain/sedation levels before and after administration

Re-assess and Re-apply MARCH interventions IAW TCCC Guidelines.

PARENTERAL MEDICATIONS

PAIN MANAGEMENT

**** Note: starting infusions when available will conserve analgesia and should be considered instead of bolusing.**

Ketamine infusion (analgesic dosing):

- 0.3 mg/kg in 100mL 0.9% sodium chloride over 5-15 minutes. Repeat every 30 minutes, as needed.
- **End Points:** Control of pain or development of nystagmus

Fentanyl infusion

Use during mechanical ventilation:

- Bolus 1-2 mcg/kg IV/IO, as needed, for acute pain control.
- When continuous infusion: 0.5 - 1 mcg/kg/hr (may combine with midazolam if hemodynamically stable).

Hydromorphone

- IV/IO: 0.2 - 1 mg every 1-3 hours prn
- Infusion: 0.5 - 3 mg/hr. Determine rate based on previous intermittent doses (e.g. 1 mg pushes every 2 hrs. equates to a drip rate of 0.5 mg/hr).

Acetaminophen, Inj (Ofirmev®)

- 1g IV/IO every 6 hours

Morphine Sulfate (caution with SBP less than 100mmHg)

- IV/IO: 2 - 5 mg slow push over 2 min, repeat every 30-45 min as needed.
- IM: 5 - 10 mg, repeat every 30-60 min as needed

PARENTERAL SEDATION

Ketamine infusion (sedation dosing)

- 1 – 2 mg/kg/hr
- For standard 100 kg patient: 1,000 mg ketamine in 250 mL NS (4 mg/mL) infused at 25 – 50 mL/hr (100 - 200 mg/hr), titrated to adequate response

Midazolam:

- Sedation and anxiety: 2 mg IV/IO, 5 mg IM/IN used in increments every 15 min up to 10 mg.
- Ketamine Emergence Reaction: 2.5mg IV/IO, repeated every 5 min up to 5 mg

Lorazepam:

- Anxiety: 0.5 - 2 mg IV/IO, repeat every 2 - 6 hours as needed
- Procedural Sedation: 1 - 2 mg IV/IO
- Agitated/Combative: 2 - 4 mg IV/IO every 30 - 60 min prn

Propofol (use with caution with SBP less than 100mmHg)**:**

- Bolus: 1 - 2.5 mg/kg, every 5-10min prn
- Infusion: 10 - 100 mcg/kg/min

PO MEDICATIONS

Pain Management	Sedation
5 mg/325 mg **Acetaminophen/Hydrocodone (Norco®)** 1 - 2 tabs PO every 4 - 6 hours PRN 5 mg/325 mg **Oxycodone/Acetaminophen (Percocet®)** 1 - 2 tabs PO every 4 - 6 hours PRN **Codeine/Acetaminophen** Moderate-severe pain 1 - 2 tabs PO every 4 - 6 hours PRN (for tabs with 15 mg Codeine)	**Lorazepam** 1 mg tablet every 8 - 12 hours as needed **Alprazolam** 0.25 - 0.5 mg tablet every 6 - 8 hours as needed **Clonazepam** 0.25 mg tablet every 12 hours as needed

Antibiotics and Other Medications

ERC ROLE-BASED GUIDELINES FOR ANTIBIOTICS AND OTHER MEDICATIONS

TCCC-ASM

TCCC-CLS

TCCC-CMC

TCCC-CPP

All Personnel - Complete TCCC Management Plan for Antibiotics, Sepsis, and Other Drugs then:

Re-assess and Re-apply Antibiotic interventions IAW TCCC Guidelines.

Antibiotics should be given immediately after penetrating injury or as soon as possible after the management of MARCH and Pain Management and appropriately documented (medication administered, dose, route and time).

Per TCCC guidelines, antibiotics are recommended for all open combat wounds and invasive procedures.

If not already administered and able to take oral medication:

- Cefadroxil 1 gram by mouth once a day (recommended)
- Cephalexin 500mg by mouth four times a day (alternative)

HAND-OFF

- Ensure Hand-Off - time of last medication administration, any allergies, medication reactions

May assist with other PO antibiotics as directed by Tier 3 or Tier 4 TCCC personnel

Antibiotics:
If unable to take oral medication:

- Ceftriaxone 2 grams IM/IO/IV every 24 hours

Penetrating Eye Trauma:
Administer Ceftriaxone 2 grams IV or IM (recommended), or cephalexin 500mg or cefadroxil 1 gram orally as soon as possible.

Other:

- Administer Tetanus Toxoid 0.5 mL IM, if available and not previously administered.
- Treat fever due to known or suspected infection (NOT for heat illness/injury)

Treatment for fever:

- Acetaminophen 975 - 1000 mg PO (three 325 mg tablets or two 500 mg tablets) every 6 hours.
  - May add on Meloxicam PO if persistently febrile or use if acetaminophen is not available.
- If unable to take PO:
  - Acetaminophen 1000 mg IV/IO every 6 hours; or
  - Acetaminophen 650 mg or 1000 mg suppository PR; or
  - Ketorolac 15 mg IM/IV/IO every 6 hours

HAND-OFF

- Antibiotic/dose/route given and time
- If tetanus toxoid was given

See **Appendix J** for a Drip Chart

SEPSIS CONSIDERATIONS

Evaluation & Management:

ERC personnel should follow unit protocols for the treatment of sepsis or suspected sepsis CPG: Sepsis Management in Prolonged Field Care (Category: "Infection Treatment")

SIRS is defined by the satisfaction of any two of the criteria below:

- Body temperature over 38 or under 36 degrees Celsius
- Heart rate greater than 90 beats/minute
- Respiratory rate greater than 20 breaths/minute or partial pressure of CO2 less than 32 mmHg
- Leukocyte count greater than 12000 or less than 4000 /microliters or over 10% immature forms or bands.

Vasopressors - Target MAP = 65 mm Hg

All vasopressors should utilize 60 gtt tubing to allow for better titration by hand if an infusion pump fails or is not available.

Vasopressor recommendations based on the Surviving Sepsis Campaign Guidelines, 2021:

1st Line

- Norepinephrine IV/IO 0.1- 1.0 mcg/kg/min (Consider starting rate of 5-30 mcg/min.) (See drip chart below.)
- Consider invasive monitoring of arterial blood pressure.
- Vasopressors can be administered peripherally until central access is available.
- Start 2nd line medication if MAP remains inadequate rather than escalating the dose of Norepinephrine (typically when dose of Norepinephrine is in the range of 0.25-0.5 mcg/kg/min).

2nd Line

- Vasopressin IV/IO 0.03 units/min (do not titrate rate)
- Start 3rd line if MAP remains inadequate

3rd Line

- Epinephrine IV/IO 2-20 mcg/min (See drip chart below)

Epinephrine Push Dose:

- Mix push dose epinephrine (Note the starting epinephrine concentration and perform the correct dilution).
- Redosing: Administer 1 - 2 mL every 3 to 5 minutes 10mcg/1mL/min to maintain SBP of >90 mmHg.

How to Mix Push Dose Epinephrine:

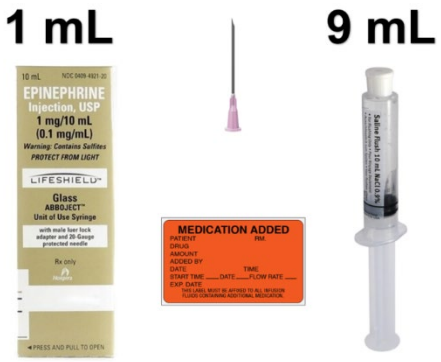
Using Epi 1:10,000:

- Draw 1 mL of Epi 1:10,000 (1mg / 10mL) into 9 mL NS (this will dilute epi to 10 mcg/ 1 mL)
- Loading dose: 20 mcg (2 mL)

Using Epi 1:1000

NOTE: This process is the same as using Epi 1:10,000 however due to the increased concentration, the dilution will be performed twice.

- Draw 1 mL of Epi 1:1,000 (1 mg / 1 mL) into a 9 mL NS flush (this will dilute epi to 100 mcg / 1 mL)
- Draw 1 mL of the diluted 100 mcg/1 mL epi into a new 9 mL NS flush (this will dilute epi to 10 mcg / 1 mL)



Steroids For Refractory Shock:

If persistent hypotension despite adequate fluid resuscitation (or adrenal insufficiency):

- IV Hydrocortisone 100 mg every 8 hours x 3 days

Vasopressor Drip Table

Norepinephrine 0.1 - 1.0 mcg/kg/min				
4 mg in 250mL 0.9% NS (16 mcg/mL)				
Dose	**0.1 mcg /kg/min**	**0.3 mcg/kg/min**	**0.5 cg/kg/min**	**1 mcg/kg/min**
Wt (kg)	**mL/hr**	**mL/hr**	**mL/hr**	**mL/hr**
40	15	45	75	150
45	17	51	84	168
50	19	56	94	188
55	21	62	103	206
60	23	68	113	226
65	24	73	122	244
70	26	79	131	262
75	28	84	141	282
80	30	90	150	300
85	32	96	159	319
90	34	101	169	338
95	36	107	178	356
100	38	113	188	375
If using 60gtt tubing, mL/hr = drops per minute				

Epinephrine 2-10 mcg/min			
4mg in 250mL 0.9% NS (16mcg/mL)			
Dose	**mL/hr**	**Dose**	**mL/hr**
2 mcg/min	8	**7 mcg/min**	26
3 mcg/min	11	**8 mcg/min**	30
4 mcg/min	15	**9 mcg/min**	34
5 mcg/min	19	**10 mcg/min**	38
6 mcg/min	23		
If using 60 gtt tubing, mL/hr = drops per minute			

Wounds

ERC ROLE-BASED GUIDELINES FOR WOUNDS				
TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP	**All Personnel - Complete TCCC Management Plan for Wounds then:** Re-assess and Re-apply Wound interventions IAW TCCC Guidelines **HAND-OFF** • Ensure Hand-Off (page 4) • Wound location, mechanism and treatment
				• Abdominal Evisceration treatment IAW TCCC Guidelines (do not force contents into abdomen). • If not performed, initiate TQ conversion if TQ has not been on for more than 6 hrs (see circulation).
				Venous Thromboembolism (VTE) Prophylaxis • Continue VTE prophylaxis if started by the originating team/facility • Do not initiate VTE prophylaxis en route unless instructed to by medical direction or receiving facility. **HAND-OFF** • VTE prophylaxis/treatment, if provided

Burns

ERC ROLE-BASED GUIDELINES FOR BURNS			
TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP

All Personnel – STOP THE BURNING PROCESS - Complete Basic TCCC Management Plan for Burns then:

Re-assess and Re-apply Burn interventions IAW TCCC Guidelines

All TCCC interventions can be performed on or through burned skin in a burn casualty

- Remove any constrictive clothing or gear near the affected burned areas
- Cover burned areas with dry sterile dressings
- Ensure adequate treatment for hypothermia
- If possible, direct use of heating system on evacuation platform

HAND-OFF

- Ensure Hand-Off (page 4)

Facial burns, especially from closed spaces, may be associated with inhalation injury. Closely monitor airway status and SpO2.

Extensive burns (>20% TBSA):

- Consider placing the casualty in a hypothermia enclosure bag/shell (use insulated system if available) to cover burned areas and prevent hypothermia.
- Elevate burned extremities 30-45° to decrease edema, if able
- Monitor peripheral pulses (if burned) every hour

HAND-OFF

- Notify if pulses change on burned extremities

Aggressive airway management, if needed, particularly for burns over 40% total body surface area or facial burns. **If any concern, must have definitive airway PAST vocal cords - cricothyroidotomy (tier 3-4) or intubation (tier 4) should be performed prior to movement.**

Smoke Inhalation / Fire victims (**Closed space exposure** with evidence of airway injury): May present with both carbon monoxide and cyanide toxicity:

- **If suspected - begin 100% O2 delivery via NRB immediately** administer hydroxocobalamin 5 g over 15 min IV/IO.
- Repeat second 5-gram dose based on severity and clinical response. Utilize co-oximeter, if available (SpO2 will be artificially high on pulse ox).
- Normal carboxyhemoglobin (COHb) in nonsmokers is ~1%, normal value in smokers may be up to 10%.
- Maintain 100% O2 for additional 2-3 hours after carboxyhemoglobin levels reach <

10%.
- Use PEEP on all intubated patients.

Fluid resuscitation
- Start IV fluids immediately. Begin rate at 500 mL/hr while completing initial assessment.
- Calculate an estimated TBSA (total body surface area).
  - See **Appendix K** for the Rule of 9s.

TBSA calculations should only include partial- or full-thickness burns (not superficial burns).

Use ISR Rule of 10 to start fluid resuscitation:
- 40 - 80 kg: 10 × % TBSA = Initial fluid rate in mL/hr.
- For every 10 kg over 80 kg: add 100 mL/hr to the initial fluid rate.
- See **Appendix L** for Rule of 10s Quick Reference Chart.

Start fluid resuscitation with LR (or blood products/components) if > 20% TBSA burned.
- Consider oral fluids for burns up to 30% TBSA if casualty is conscious and able to drink PO fluid.
- Adjust IV/IO fluids by 20-25% to maintain urine output (UO) 30–50 mL/hr.
  - Patients with high-voltage electric injury causing muscle damage and gross pigment in the urine (and similar patients, such as rhabdomyolysis or crush injury) have a higher target UOP of 70–100 mL/hr.

Securing devices
- All intravenous and arterial catheters should be sutured or stapled (do not tape or circumferentially tie).

HAND-OFF

- Provide Burn estimate and I&Os to receiving facility (on Burn Resus Flow sheet, if used)

Re-assess and Re-apply Burn interventions IAW TCCC Guidelines.

- For intubated casualties, continue to ventilate using low tidal volume / lung protective strategies (4-6 mL/kg).
- Ventilation settings may need ongoing adjustments as pulmonary conditions change due to volume overload/edema and acute respiratory distress syndrome (ARDS) - Telemedicine consultation is recommended.
- Intubated burn patients may require **extremely large doses** of analgesia. Many intubated burn patients reach maximum allowed analgesia and sedation doses early in transport. Stimulation and hypermetabolic state require additional dosing to maintain a goal RASS and Pain scale.

Continue to adjust fluids to meet hemodynamic goals.
- MAP > 55 mmHg [CPG: Burn Care (Category: “Burns”)]
- Urine output 30 – 50 mL/hr (or 1-2 mL/kg/hr for electrical burns)
- SpO2 90-96% (100% for confined space exposure)

If MAP >55 mmHg and urine output is > 50 mL/hr, decrease the fluid rate 20% for the next hour.

A foley catheter should be placed for all casualties getting IV/IO fluid management for burns.

Management of Persistent Oliguria and Hypotension

- If persistent Oliguria and hypotension despite adequate fluid resuscitation, reassess hemodynamic status and intravascular volume.
  - Perform RUSH exam - assess IVC.
  - Assess for possible missed injury or ongoing bleeding.
  - Monitor central venous pressure (CVP) when available - goal CVP is 6-8 mmHg, if CVP is low, increase IVF rate.
  - Add vasopressors.
  - If resistant to vasopressors, consider: acidemia (adjust ventilator settings, consider sodium bicarbonate), adrenal insufficiency (start hydrocortisone 100 mg IV every 8 hours), hypocalcemia (consider administering calcium chloride 8-16 mg/kg IV for refractory hypotension especially in patients who have received a blood transfusion).
  - If oliguria persists, **STOP** increasing the IVF rate. Oliguria is likely from renal dysfunction in patients with large burns. Continued increases in IVF rate may be harmful.

Escharotomy *if trained*

- Need for escharotomy typically presents in the first 6-24 hours after injury.
- For circumferential burns with progressive pain, tension to palpation, and evidence of poor distal perfusion (pallor, delayed capillary refill, weak or absent pulses, etc.).
- CHEST: decompressed with incisions in the mid-axillary line from clavicle to costal margin inferiorly and may be joined by transverse incisions connecting the mid-axillary incisions if adequate relief of constriction is not obtained.
- FINGERS: incised along both sides of each finger involved.
- LEGS: decompressed with mid-medial and mid-lateral incisions.
- TOES: done in similar manner as fingers.
- See **Appendix M** for Escharotomy Picture Reference.

HAND-OFF

- Ventilator settings, if any ventilator trends have been observed
- Analgesia
- If escharotomy not performed, identify areas of concern requiring increased attention/reassessment.
- Escharotomy location, if performed

ADDITIONAL CONSIDERATIONS

GENERAL

- Casualties with significant burns that initially appear stable can quickly develop airway compromise, hypotension, poor perfusion of the extremities, and impaired respiratory ventilation.
- Equipment planning
  - Fluids: IV fluid (lactated Ringer's solution or Plasma-Lyte)
  - Medications: Analgesia (may require more than typical patients)
  - Portable monitor with capnography
  - Burn specific dressings
  - Nonspecific dressings
  - Electrocautery or scalpel
  - Saline flushes and suction
  - Hypothermia prevention

MOVEMENT BY GROUND TRANSPORT:

- Increase the ambient temperature in the passenger compartment to maintain normothermia.
- If already high ambient / vehicle temperatures, assess patient temperature to determine if hypothermia prevention is adequate or whether clothing removal / cooling measures may be needed to prevent hyperthermia
- Attempt to keep any injured extremities elevated

MOVEMENT BY AIR:

- Adjust ambient temperature in the passenger compartment to maintain normothermia.
- Ensure you can easily access any injured extremities to monitor their neurovascular status while en route.

MOVEMENT BY SEA:

- Keep the casualty dry and, if feasible, in a protected compartment

Splints

ERC ROLE-BASED GUIDELINES FOR SPLINTS				
TCCC-ASM	TCCC-CLS	TCCC-CMC	TCCC-CPP	**All Personnel - Complete Basic TCCC Management Plan for Splints then:** • Re-assess and Re-apply Splint interventions IAW TCCC Guidelines. • Early stabilization of fractures/orthopedic injuries is essential to reduce ongoing hemorrhage, prevent pulmonary complications (especially with long bone fractures), reduce further soft tissue damage, and improve pain management especially with increased patient movement during ERC. • Caution should be utilized so splints are not constrictive/circumferential or predispose to compartment syndrome, especially prior to long evacuations. • Ensure splinted extremity is not touching the sides of the transport platform or mounted stanchion, as vibrations and sudden movement can significantly increase pain. **HAND-OFF** • Ensure Hand-Off (page 4)
				If air splints are used, evaluate distal circulation, sensation and movement on ascent, at altitude and on descent. **HAND-OFF** • Notify if there were changes in distal pulses on splinted extremity

Appendix A: Oxygen Conversion Factors and Oxygen Requirement Calculation

Tank	Conversion Factor	Calculations	
D	0.16	Calculate Cylinder Volume	Cylinder PSI x Tank Factor
E	0.28	Calculate Minutes Available on Tank	Cylinder Volume / Liters Per Min
M	1.56	Calculate Transport Requirement (in minutes)	(LPM x Minutes) / Cylinder Volume
G	2.41	Consider adding 1 hr pre/post flight (2 hours total) to account for delays. Ex. If flight time is 1 hr, calculate 3 hours for the requirement.	
H	3.14		
LOx	860	1L LOx = 860 L gaseous oxygen	

Calculate the oxygen tank requirements for the following casualties:

Example: D Tank and casualty on 5 LPM NC for 2.5 hr flight

- Calculate Cylinder Volume: 2200 x 0.16 = 352 L
- Calculate Minutes Available on Tank: 352 L / 5 LPM NC = 70.4 minutes
- Calculate Transport Requirements: $\frac{5 \text{ LPM} \times 150 \text{ min}}{352 \text{ L}}$ = 2.13 "D" Tanks (round up to 3 tanks)

Example: E Tank and Mechanically Ventilated casualty with Minute Volume of 8.2 L for 2 hr flight

- Calculate Cylinder Volume: 2200 x 0.28 = 616 L
- Calculate Minutes Available on Tank: 616 L / 8.2 LPM = 75.4 minutes
- Calculate Transport Requirements: $\frac{8.2 \text{ LPM} \times 120 \text{ min}}{616 \text{ L}}$ = 1.59 "E" Tanks (round up to 2 tanks)

Calculate LOx Requirement

NOTE: For patients on facemask/nasal cannula use LPM for O2 flow rate; for mechanically ventilated patients, use minute volume.

Example: Casualty on 15 LPM NRB for 1.5 hr flight

- O2 flow rate x flight time = Liters gaseous oxygen
- 15 LPM x 90 min = 1350 L gaseous oxygen
- 1350 L gaseous oxygen / [conversion factor] = Liter's liquid oxygen (LOx)
- 1350 L gaseous oxygen / 860 = 1.6 L LOx

Example: Mechanically Ventilated casualty with Minute Volume of 7.4 LPM for 6 hr flight

- 7.4 LPM x 360 min = 2664 L
- 2664 L / 860 = 3.1 L LOx

Appendix B: Post Operative Considerations

HEAD/FACE

Surgical procedures in this anatomic region include craniotomy, lateral canthotomy, mandibular/maxillary fracture stabilization, and hemorrhage control measures.

- If drain is in place, consult with neurosurgeon for CSF drainage and pressure goals. (If unable to locate neurosurgeon, can drain 5-10 mL for sustained ICPs > 20 mmHg, no more than 30 mL/hr, with pop-off set to 20 mmHg).
- If intracranial device becomes dislodged during transport, do not attempt to reinsert. Place sterile dressing over surgical site.
- Alert patients with facial fractures who are protecting their own airway should be transported in a position of comfort.

DEVICES

- External Ventricular Drain: Leveled at the tragus of the ear. Drainage per provider order.

NECK/TORSO

- Surgical procedures in this anatomic region include airway management, temporary repair of organs and great vessels and placement of drains into the thorax or abdomen. Special care must be taken during casualty movement to not disrupt these interventions.
- Hemorrhage in this region is generally NOT amenable to tourniquet or direct pressure. Early recognition of re-bleeding is paramount.
- Signs of ongoing hemorrhage: Tachycardia, hypotension, increased blood in collection devices (chest tubes, foley, wound vacs), increased abdominal girth, or increased pulmonary/ abdominal pressures. Resuscitate with blood product, targeting MAP of 65 mmHg. Discuss actions to take with surgical team prior to transport, advanced providers may be able to perform abdominal packing in a crashing casualty. Circumferential dressings should be evaluated to ensure chest expansion is not restricted.
- Thoracotomy sites shall be inspected after all casualty movements. If the chest tube has become dislodged, do not advance into the chest cavity.
- Reassess at appropriate intervals. Clamp and drain chest tube intermittently; if clamped, closely monitor for recurrent tension pneumothorax. If available, use low continuous suction. Ensure a one-way valve is attached and working. One-way valves are required for all flight transports.
- Any casualty with a surgical procedure requires Ertapenem if they have not already received it

DEVICES

Airway: The back-up airway for accidental removal of established definitive airway should be discussed and decided prior to movement depending on skill level of the provider. The minimum airway skills required for transport of an intubated casualty are BVM with PEEP, supraglottic airway, and cricothyroidotomy. Cricothyrotomy and tracheostomy tubes should be secured prior to transport. Sutures are preferred, but commercial securing device, or other methods such as chest seal may be acceptable).

Thoracostomy tube (Chest tube): All fenestrations (drainage holes) should be within the chest cavity. Tube should be secured with sutures and covered with occlusive dressing. Chest tube should have a one-way valve in place between tube and collection device. Collection device should be placed below the level of insertion if possible and placed to suction (if available) per provider order (generally -15-20 cmH2O). If collection device is damaged, maintain drainage below the level of insertion and use suction canister or other improvised device to collect drainage. **DO NOT CONNECT DIRECTLY TO SUCTION**. If chest tube is dislodged, cover insertion site with occlusive drainage (three sided or drainage capable). Monitor for

pneumo/hemothorax and treat per provider level (Needle decompression / Finger thoracostomy / Chest tube).

Arterial Line / CVP Transducer: Leveled at phlebostatic axis. Zero/re-zero as needed.

Bladder Pressure Monitoring: Pressure monitoring connected to foley catheter. Pressure > 20 mmHg with concerning abdominal exam considered surgical emergency.

Wound vac: All drainage holes should be within cavity/compartment and covered with occlusive dressing. If emptying of collection device is required during transport, document time and amount removed and reset vacuum seal. If collection device is damaged, cover with biohazard bag or other improvised method. If device is dislodged/removed, do not attempt to replace. Cover insertion site with occlusive dressing.

EXTREMITIES

Hemorrhage is the most likely postoperative complication in this region. Bleeding accompanied by any hemodynamic change should initially be controlled by tourniquet application.

Prior to transport, place a loose tourniquet high on the injured extremity. This will expedite hemorrhage control when recognized. Minimal bleeding from a surgical site without hemodynamic changes may be controlled with direct pressure and hemostatic agents.

DEVICES

Wound vac: All drainage holes should be within cavity/compartment and covered with occlusive dressing. If emptying of collection device is required during transport, document time and amount removed and reset vacuum seal. If collection device is damaged, cover with biohazard bag or other improvised method. If device is dislodged/removed, do not attempt to replace. Cover insertion site with occlusive dressing.

External Fixator: Minimal bleeding is expected around pin insertion. Pad around device to avoid transmitting vehicle vibration to the casualty. Check for evidence of infection.

Casting/Dressing: Circumferential rigid casts should be avoided initially. Pulse, motor, and sensory checks should be performed routinely. If any are diminished, cast/dressings must be loosened (bivalve) or removed.

Pelvic binders and/or Junctional Hemorrhage devices shall be routinely checked for proper placement and security, especially after casualty transfers. In flight, inflating hemorrhage control devices could increase, or decrease based on pressure and should be checked often.

Femur traction splints need to be stabilized and secured during transport. Movement and vibrations can cause traction to slip, potentially causing harm. Frequently reassess pulses of the extremity. If pulses diminish, check the splint to ensure limb is out to length and ensure dressing is not having a tourniquet effect.

Appendix C: Troubleshooting DOPE Algorithm

Alarm	DOPE	Possible Cause	Troubleshooting
High Pressure	D	Mainstem intubation	If the tube has advanced and unilateral ventilation is confirmed, retract the tube to proper depth using bougie technique to maintain placement.
High Pressure	D	Esophageal intubation	If the tube is advanced and unilateral ventilation is not present, rule out esophageal intubation – evaluate with DL or VL. If breath sounds are present over abdomen, or gastric distention noted, remove the ET tube and secure airway by other means and place gastric tube for evacuation of gastric contents.
High Pressure	O	Obstruction of ET tube	Place patient on FiO_2 1.0 (100%) and prepare suction equipment. Suction airway using standard technique. If inhalation injury is suspected (burn, agent), saline may be used to facilitate suctioning.
High Pressure	O/E	Obstruction of ventilator circuit	Ensure circuit connections are attached and not kinked paying particular attention to connections and sharp bends.
High Pressure	P	Pulmonary circuit	Rule out/treat hemothorax / pneumothorax.
High Pressure	P	Pulmonary circuit	Consider Pulmonary Edema. Prolong Inspiratory time if appropriate (i.e. adjust from 1:3 to 1:2 to 1:1).
High Pressure	P	Pulmonary circuit	Consider airway swelling; may need to add or increase Pressure Support
High Pressure	P	Pulmonary circuit	Evaluate Tidal Volume. Consider lowering by 1cc/kg (min. 4cc/kg).
High Pressure	P	Patient arousal	Address analgesia/sedation needs.
High Pressure	P	Stacked breath/air trapping	Disconnect patient from the circuit and allow full exhale. Address cause (patient triggering, high rate, incomplete exhalation).
High Pressure	P	Chest tube malfunction	If hemothorax / pneumothorax are suspected, disconnect all attachments and troubleshoot chest tube and components.
High Pressure	P	Patient position	If laying supine, elevate head of bed to reduce gravitational pressure on the chest.
High Pressure	E	Alarm setting	After ensuring patient optimization, adjust alarm settings.
Low Pressure	D	Extubation	If tube has been removed from the trachea, secure the airway using method within scope/skill of the provider.
Low Pressure	D	Esophageal intubation	If tube is advanced and unilateral ventilation is not present, rule out esophageal intubation. If breath sounds present over abdomen, or gastric distention noted, remove ET tube and secure airway by other means and place gastric tube for evacuation of gastric contents.
Low Pressure	E	ET tube balloon	Ensure ET Tube cuff is inflated (25-35 cmH2O). If the cuff will not maintain inflation, exchange ET tube using bougie technique.
Low Pressure	E	Ventilator disconnect/leak	Ensure all connections are attached securely to the appropriate point. Run bare hand along circuit to feel any air escaping during inhalation paying special attention to valves and connections.
Low SpO2	DOPE	Assess patient	For acute desaturation, place FiO_2 at 1.0 (100%). Check chest rise and fall, $EtCO_2$, SpO2 probe placement. Check all conditions from high/low pressure chart to rule out other alarm failures.
Low SpO2	x	Increase in altitude	Increase FiO_2 to compensate for decrease in pressure.
Low SpO2	x	Patient deterioration	If desaturation is gradual and presumed to be caused by patient pathology, increase PEEP and FiO_2 in a stepwise fashion according to ARDSNet table.
Low SpO2	x	Patient deterioration	Attempt alveolar recruitment maneuvers. Inflation to 30 - 40 cm H_2O for 30 - 40 seconds (difficult with PMI).

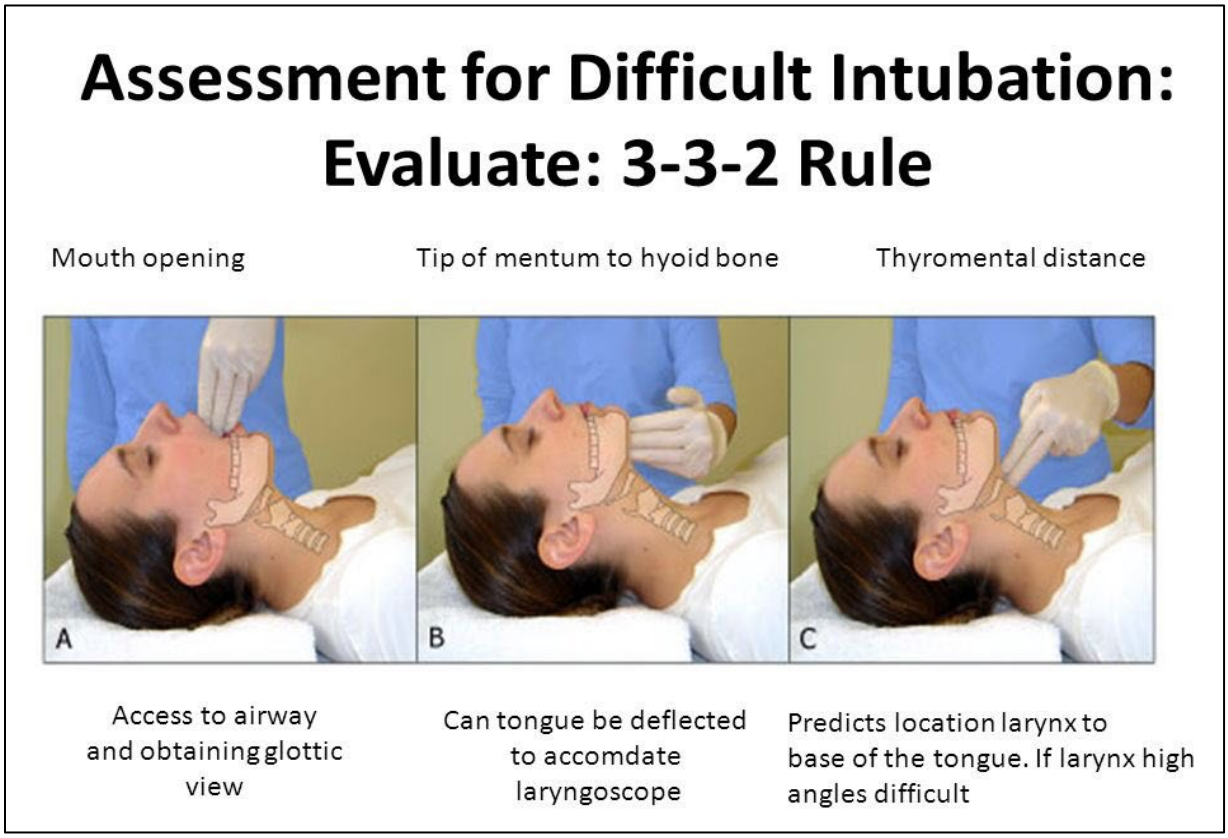
Alarm	DOPE	Possible Cause	Troubleshooting
			Recruitment maneuver can be performed with bag-valve manual ventilation. 1. Set PEEP valve on bag-valve unit to 15 - 20 cm H_2O. 2. Deliver five sequential breaths, each held for 5 - 8 seconds. 3. Watch blood pressure closely. Terminate if hypotension develops. 4. Clamp endotracheal tube while switching between ventilator and bag. 5. Immediately assess for tension pneumothorax, if applicable.
Low SpO2	E	O2 supply	Check O2 PSI and condition of hose/connections.)
High $EtCO_2$	E	Incorrect vent settings	V_E may be too low (Adjust V_T f/I:E for patients IWB).
High $EtCO_2$	x	Hypermetabolic state	Address pain, shivering, hyperthermia / infection.
High $EtCO_2$	x	Respiratory insufficiency	Increase rate (current $EtCO_2$ x current rate/40).V_E may be too high (Ensure proper V_T/f/I:E for patients IWB).
Low $EtCO_2$	E	Incorrect vent settings	V_E may be too high (Ensure proper V_T/f/I:E for patients IWB).
Low $EtCO_2$		Ventilator dyssynchrony	If on AC and patient is not properly sedated, the patient may be breathing over the ventilator settings, increasing their V_E. Consider sedation medications followed by paralytics, as needed.
Low $EtCO_2$	x	Low perfusion state (hypovolemia or sepsis)	CHECK PATIENT'S PULSE FOLLOWING RAPID DROP. Continue to resuscitate patient within scope and skill.
Low $EtCO_2$	x	Decrease in alveolar ventilation	Suction patient if suspected mucus/secretion plug. If associated with high pressure alarm, consider alveolar distention (air trapping/stacked breathing): remove patient from ventilator and allow full exhale.
Low $EtCO_2$	x	Respiratory compensation (metabolic acidosis)	DO NOT ATTEMPT TO NORMALIZE patient's breathing without ABG and expert consultation.
Low $EtCO_2$	x	Low perfusion state (hypovolemia or sepsis)	CHECK PATIENT'S PULSE FOLLOWING RAPID DROP. Continue to resuscitate patient within scope and skill.
Low $EtCO_2$	x	Decrease in alveolar ventilation	Suction patient if suspected mucus/secretion plug. If associated with high pressure alarm, consider alveolar distention (air trapping/stacked breathing): remove patient from ventilator and allow full exhale.
Low $EtCO_2$	x	Respiratory compensation (metabolic acidosis)	DO NOT ATTEMPT TO NORMALIZE patient's breathing without ABG and expert consultation.

Source: USASAM, Enroute Care Branch Ventilator Guide[10]

Appendix D: Airway Assessments Acronyms

DOPE (Change in condition, decreased SpO2 / vent alarms): **D**islodgement **O**bstruction **P**neumothorax **E**quipment	**MOANS (Difficult BVM seal):** **M**ask seal, **O**besity/**O**bstruction **A**ge (> 55) **N**o Teeth **S**leep Apnea/**S**tiff Lungs	**RODS (Difficult Extraglottic Device):** **R**estricted mouth opening, **O**bstruction, **D**isrupted/**D**istorted Airway, **S**till Lung/Cervical **S**pine
BURP (vocal cord view): **B**ackwards **U**pwards **R**ightward **P**ressure	**LEMON (Difficult Laryngoscopy, see below):** **L**ook **E**valuate (3-3-2) **M**allampati **O**bstruction/**O**besity **N**eck Rigidity	**SHORT (Difficult Cricothyroidotomy):** **S**urgery/**S**cars (or other obstruction) **H**ematoma (or infection/abscess/mass) **O**besity **R**adiation distortion (and other deformity) **T**umor

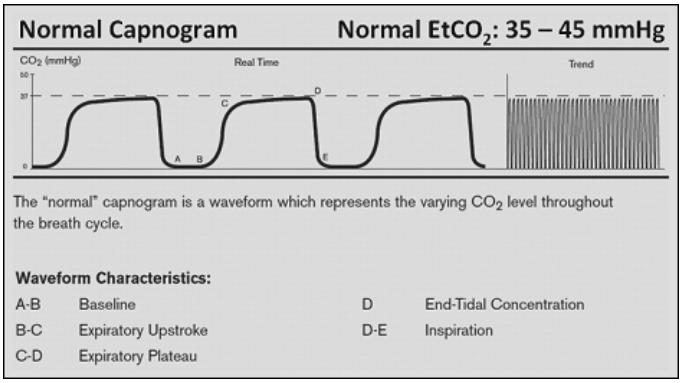
Appendix E: Difficult Intubation Assessment (3-3-2)

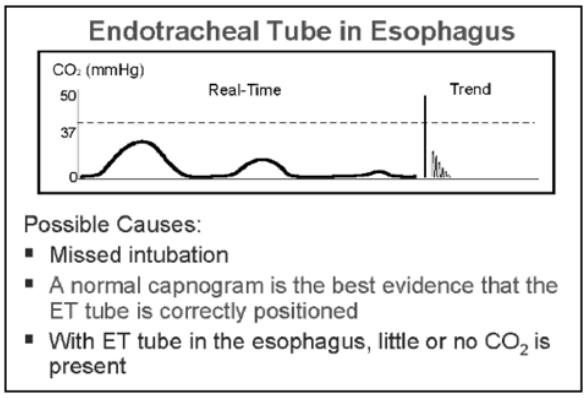


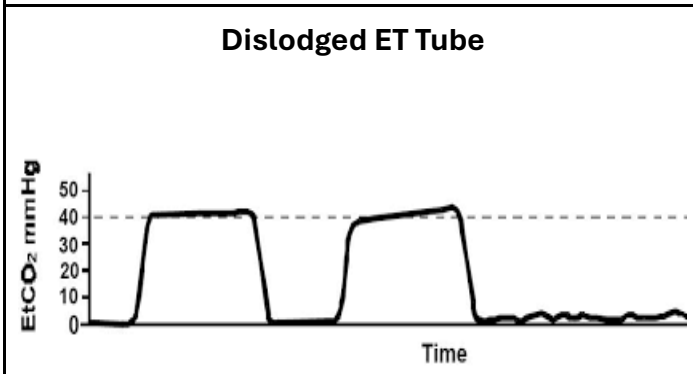
Source: Anesthesia. https://twitter.com/anespsmchs/status/985108484764127232

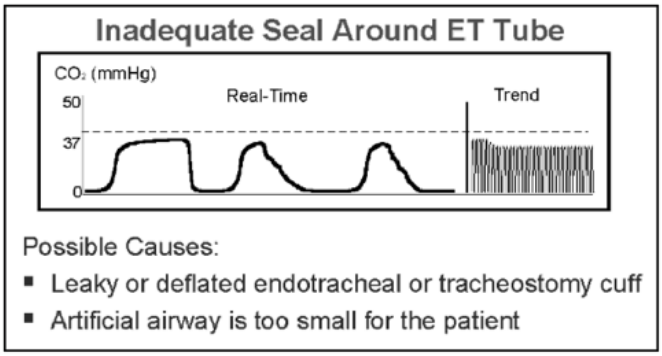
Appendix F: EtCO2 Waveforms

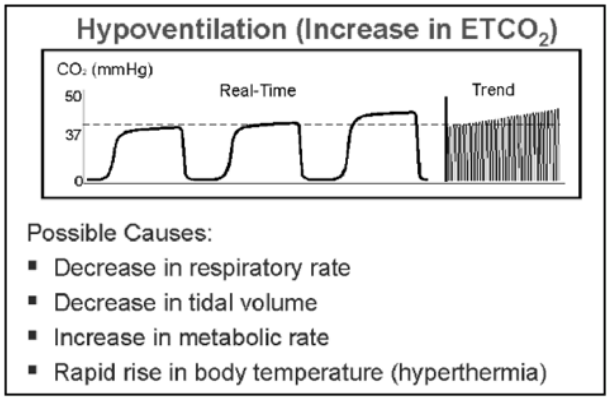
(https://openairway.org/capnography/)

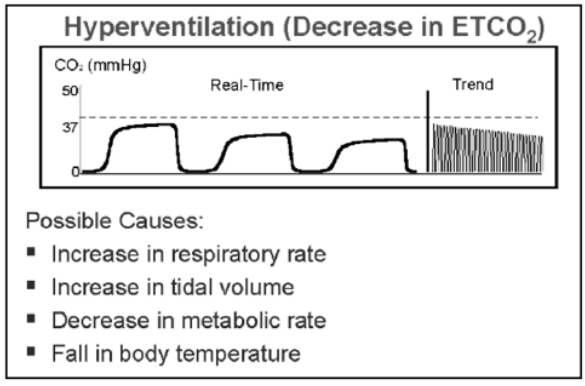




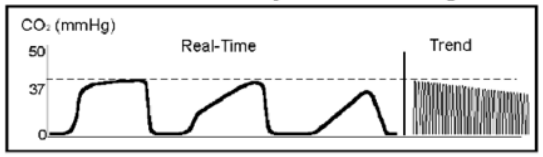








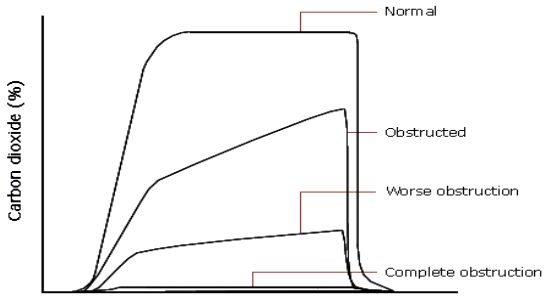
Obstruction in Airway or Breathing Circuit



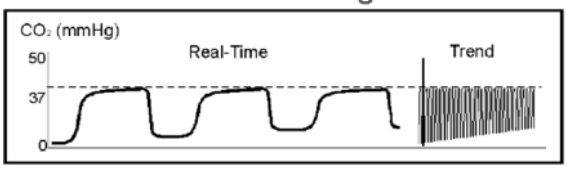
Possible Causes:

- Partially kinked or occluded artificial airway
- Presence of foreign body in the airway
- Obstruction in expiratory limb of breathing circuit
- Bronchospasm

Worsening Bronchospasm



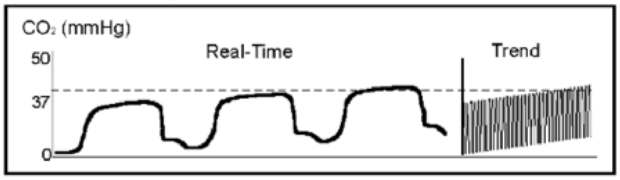
Rebreathing



Possible Causes:

- Faulty expiratory valve
- Inadequate inspiratory flow
- Insufficient expiratory time
- Malfunction of CO_2 absorber system

Faulty Ventilator Circuit Valve

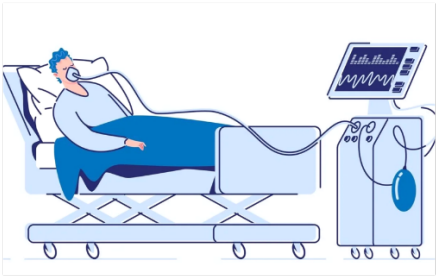


- Baseline elevated
- Abnormal descending limb of capnogram
- Allows patient to rebreathe exhaled gas

Appendix G: Hypocapnia and Hypercapnia Causes

Physiological Reason	Hypocapnia (<35mmHg)	Hypercapnia (>45mmHg)
CO2 Production	• Hypothermia, head injury, overdose, increased altitude	• Fever, Sodium Bicarbonate, TQ release, Venous CO2 embolism, overfeeding
Pulmonary Perfusion	• Hypotension, Hypovolemia (trauma), pulmonary embolism, decreased cardiac output, cardiac arrest	• Increased cardiac output or blood pressure
Alveolar Ventilation	• Hyperventilation, apnea, total airway obstruction or extubation	• Hypoventilation, bronchial intubation, partial airway obstruction, rebreathing
Troubleshooting	• Low Perfusion: CHECK PULSE FOLLOWING RAPID DROP. Continue to resuscitate casualty within scope and skill. • Decrease in alveolar ventilation: Suction casualty if suspected mucus/secretion plug. If associated with high pressure alarm, consider alveolar distention (air trapping/stacked breathing): remove casualty from ventilator and allow full exhale. • Respiratory Compensation (Metabolic Acidosis): **DO NOT ATTEMPT TO NORMALIZE** without ABG and expert consultation.	• Hypermetabolic: Address pain, shivering, hyperthermia. • Respiratory Insufficiency: Increase rate (current ETCO2 x current rate / 40).

Appendix H: Mechanical Ventilation Setup Infographic



MECHANICAL VENTILATION BASICS

Initial Ventilator Settings

- Set ventilator to Volume Assist/Control: Consider pressure support as needed
- Set driving mechanics by type of ventilation
  - Tidal Volume at 4-6 ml/kg Ideal Body Weight
  - Quick Reference (Male): (Appendix A)
  - 66" = ~380cc [min: 255 / max: 510]
  - 69" = ~420cc [min: 283 / max: 566]
  - 72" = ~465cc [min: 310 / max: 621]
  - 75" = ~505cc [min: 338 / max: 676]
- Set Rate to maintain proper minute ventilation (Ve) of 4-8 L/min (Vt x RR) Example: Ve of 6L/min=Vt of 500ml x RR of 12/min
- Set FiO2: Start at 100% and titrate down using ABGs/SpO2
- Set Inspiration:Expiration (I:E) ratio: 1:2
- Set appropriate PEEP
  - Min of 5 cmH20 and titrate as needed
  - Consider starting hypoxic patients at 10 cmH20
- Use continuous capnometry/capnography (ETC02), Especially in TBI patients
- Calculate O2 requirements
  - Minute Ventilation x FiO2 = LPM of pure O2
  - LPM x mission length (min) = Total L of pure O2
  - Example: Ve of 6LPM @ 50% FiO2 = 3 LPM of O2 required D cylinder (425L O2) will last ~141 min using 3 LPM
  - Consider 1.5x planning factor

Troubleshooting using DOPE

Displacement of Advanced Airway/Endotracheal Tube AA/ETT

- Pull back if advanced
- Do NOT advance blindly without bougie
- If in doubt remove AA/ETT and use BVM
- Consider advanced airway (supraglottic or cricothyroidotomy)
- If AA/ETT moves freely, assess bulb for rupture

Obstructions

Suction secretions in AA/ETT as needed

Pressure

- Tension pneumothorax/hemothorax
  - Chest tube in place/properly
  - Suctioning/not kinked or clamped
  - If suspected tension pneumothorax → needle thoracentesis
- Circumferential burns
  - Consider escharotomy
  - Patient not tolerating ventilation
  - Consider additional paralysis/sedation

Equipment

- Ventilator failed?
- O2 tank empty?
- Trace circuit to/from patient ensuring patency/connections

(Utilize waveform capnography to assist in determining cause if available)

Airway Compromise/Lost Airway
Immediately disconnect ventilator and use manual BVM (plus PEEP if avail) with 100% O2

METRICS

- Initial Tidal Volume based on IBW (target 6cc/kg IBW)
- ETCO2 monitored when available (target 35-45 mmHg)
- Adjustments to RR, Vt, FiO2, and PEEP based on clinical indicators and documented
- Patients arrive with PaCO2 of 35 – 45 mmHg

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

Joint Trauma System. Mechanical Ventilation Basics *Clinical Practice Guideline.* 2025.

Appendix I: Ideal/Predicted Body Weight Table

Predicted Body Weight and Tidal Volume (V_T)

Male PBW and Tidal Volume							
Height		Predicted Body Weight	ml per kg of PBW (total V_T)				
Ft'In"	Inches		4.0 ml	5.0 ml	6.0 ml	7.0 ml	8.0 ml
4'0"	48	22.4	90	112	134	157	179
4'1"	49	24.7	99	124	148	173	198
4'2"	50	27	108	135	162	189	216
4'3"	51	29.3	117	147	176	205	234
4'4"	52	31.6	126	158	190	221	253
4'5"	53	33.9	136	170	203	237	271
4'6"	54	36.2	145	181	217	253	290
4'7"	55	38.5	154	193	231	270	308
4'8"	56	40.8	163	204	245	286	326
4'9"	57	43.1	172	216	259	302	345
4'10"	58	45.4	182	227	272	318	363
4'11"	59	47.7	191	239	286	334	382
5'0"	60	50	200	250	300	350	400
5'1"	61	52.3	209	262	314	366	418
5'2"	62	54.6	218	273	328	382	437
5'3"	63	56.9	228	285	341	398	455
5'4"	64	59.2	237	296	355	414	474
5'5"	65	61.5	246	308	369	431	492
5'6"	66	63.8	255	319	383	447	510
5'7"	67	66.1	264	331	397	463	529
5'8"	68	68.4	274	342	410	479	547
5'9"	69	70.7	283	354	424	495	566
5'10"	70	73	292	365	438	511	584
5'11"	71	75.3	301	377	452	527	602
6'0"	72	77.6	310	388	466	543	621
6'1"	73	79.9	320	400	479	559	639
6'2"	74	82.2	329	411	493	575	658
6'3"	75	84.5	338	423	507	592	676
6'4"	76	86.8	347	434	521	608	694
6'5"	77	89.1	356	446	535	624	713
6'6"	78	91.4	366	457	548	640	731
6'7"	79	93.7	375	469	562	656	750
6'8"	80	96	384	480	576	672	768
6'9"	81	98.3	393	492	590	688	786
6'10"	82	100.6	402	503	604	704	805
6'11"	83	102.9	412	515	617	720	823
7'0"	84	105.2	421	526	631	736	842

PBW Males = 50 + 2.3 [height (inches) – 60]

Female PBW and Tidal Volume							
Height		Predicted Body Weight	ml per kg of PBW (total V_T)				
Ft'In"	Inches		4.0 ml	5.0 ml	6.0 ml	7.0 ml	8.0 ml
4'0"	48	17.9	72	90	107	125	143
4'1"	49	20.2	81	101	121	141	162
4'2"	50	22.5	90	113	135	158	180
4'3"	51	24.8	99	124	149	174	198
4'4"	52	27.1	108	136	163	190	217
4'5"	53	29.4	118	147	176	206	235
4'6"	54	31.7	127	159	190	222	254
4'7"	55	34	136	170	204	238	272
4'8"	56	36.3	145	182	218	254	290
4'9"	57	38.6	154	193	232	270	309
4'10"	58	40.9	164	205	245	286	327
4'11"	59	43.2	173	216	259	302	346
5'0"	60	45.5	182	228	273	319	364
5'1"	61	47.8	191	239	287	335	382
5'2"	62	50.1	200	251	301	351	401
5'3"	63	52.4	210	262	314	367	419
5'4"	64	54.7	219	274	328	383	438
5'5"	65	57	228	285	342	399	456
5'6"	66	59.3	237	297	356	415	474
5'7"	67	61.6	246	308	370	431	493
5'8"	68	63.9	256	320	383	447	511
5'9"	69	66.2	265	331	397	463	530
5'10"	70	68.5	274	343	411	480	548
5'11"	71	70.8	283	354	425	496	566
6'0"	72	73.1	292	366	439	512	585
6'1"	73	75.4	302	377	452	528	603
6'2"	74	77.7	311	389	466	544	622
6'3"	75	80	320	400	480	560	640
6'4"	76	82.3	329	412	494	576	658
6'5"	77	84.6	338	423	508	592	677
6'6"	78	86.9	348	435	521	608	695
6'7"	79	89.2	357	446	535	624	714
6'8"	80	91.5	366	458	549	641	732
6'9"	81	93.8	375	469	563	657	750
6'10"	82	96.1	384	481	577	673	769
6'11"	83	98.4	394	492	590	689	787
7'0"	84	100.7	403	504	604	705	806

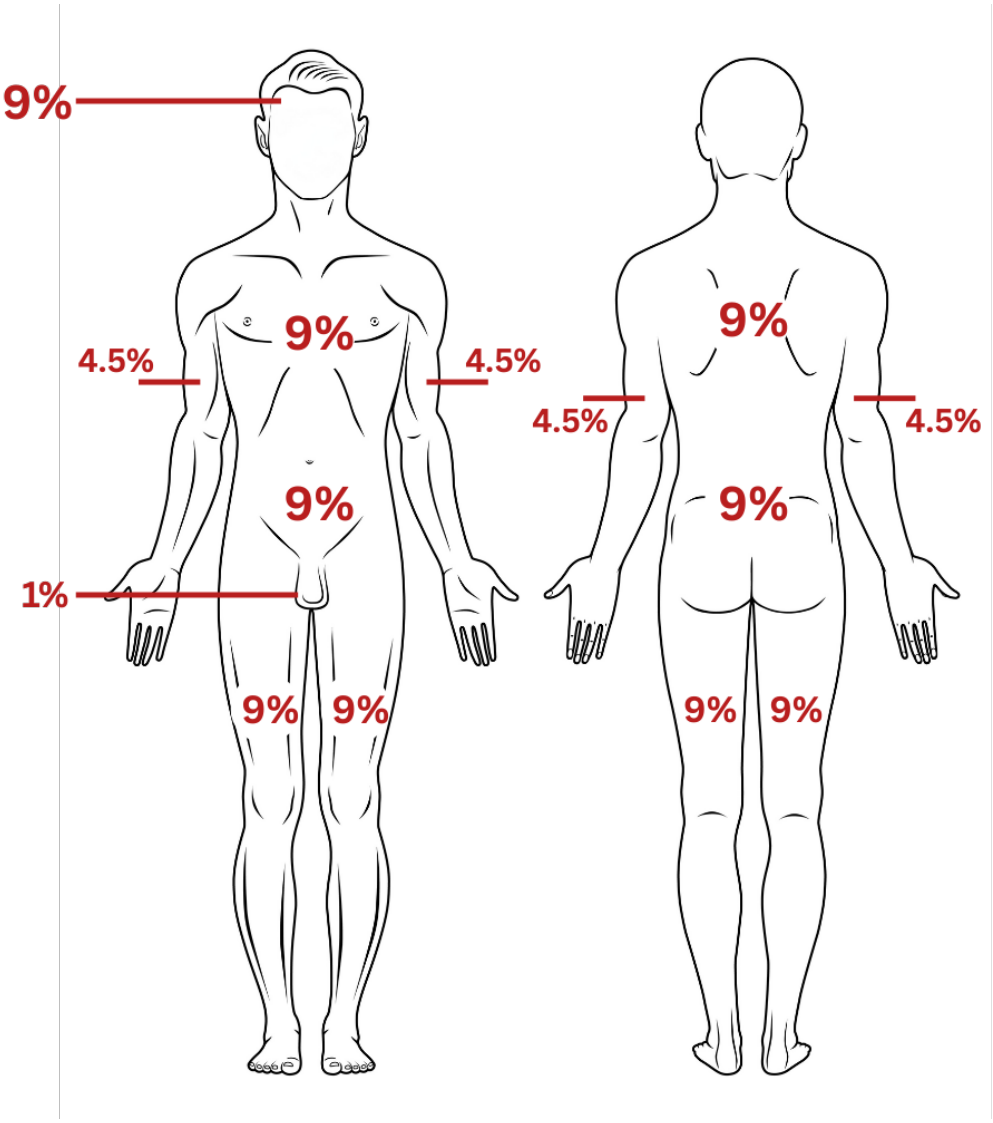
PBW Females = 45.5 + 2.3 [height (inches) – 60]

ARDSnet, NIH NHLBI ARDS Clinical Network Mechanical Ventilation V_T card

Appendix J: Medication Drip Chart

DRUG burn rates (80kg)	Bolus Low Dose	Bolus High Dose	Infusion Low Dose	Infusion High Dose
ANALGESIA				
KETAMINE	0.5 mg/kg	2 mg/kg	0.2 mg/kg/hr	4 mg/kg/hr
80 kg	40 mg	160 mg	16 mg/hr	320 mg/hr
conc: 100 mg/ml	0.4 ml	1.6 ml	0.16 ml/hr	3.2 ml/hr
500mg in 500ml bag	40 ml	160 ml	16 ml/hr	320 ml/hr
500mg vial will last:	12.5 doses	3.1 doses	31 hours	1.5 hours
Compatible w/:	**D5W and NS for 24 hours, LR for 4 hours**			
FENTANYL	50 mcg	100 mcg	25 mcg/hr	200 mcg/hr
80 kg	50 mcg	100 mcg	25 mcg/hr	200 mcg/hr
conc: 50 mcg/ml	1ml	2 ml	0.5 ml/hr	4 ml/hr
250mcg in 500ml bag	100 ml	200 ml	50 ml/hr	400 ml/hr
250mcg vial will last:	5 doses	2.5 doses	10 hours	1.25 hours
Compatible w/:	**D5W and NS**			
SEDATION **= Controlled Substance				
MIDAZOLAM	**2 mg**	**5 mg**	**1 mg/hr**	**8 mg/hr**
80 kg	2 mg	5 mg	1 mg/hr	8 mg/hr
conc: 1 mg/ml	2 ml	5 ml	1 ml/hr	8 ml/hr
conc: 5 mg/ml	0.4 ml	1 ml	0.2 ml/hr	1.6 ml/hr
5mg in 500ml bag	40 ml	100 ml	20 ml/hr	160 ml/hr
5mg vial will last:	2.5 doses	1 dose	5 hours	37.5 minutes
Compatible w/:	**D5W and NS for 24 hours, LR for 4 hours**			
PROPOFOL (10mg/mL)	**0.5 mg/kg**	**1 mg/kg**	**5 mcg/kg/min**	**80 mcg/kg/min**
80 kg	40 mg	80 mg	0.4 mg/min	6.4 mg/min
conc: 10mg/ml	4 ml	8 ml	0.04 ml/min	0.128 ml/min
200mg bottle will last:	5 doses	2.5 doses	8.3 hours	0.5 hours
1000mg bottle will last:	25 doses	12.5 doses	41.6 hours	2.6 hours
Compatible w/:	**D5W, NS, and LR**			
PARALYTICS				
ROCURONIUM	0.8 mg/kg	1 mg/kg	5 mcg/kg/min	16 mcg/kg/min
80 kg	64 mg	80 mg	0.4 mg/min	1.28 mg/min
conc: 10 mg/ml (10 ml vial)	6.4 ml	8 ml	0.04 ml/min	0.128 ml/min
100mg in 500ml bag	320 ml	400 ml	2 ml/min	6.4 ml/min
100mg vial will last:	1.5 doses	1.25 doses	4.1 hours	1.3 hours
Compatible w/:	**D5W, NS, and LR**			
VECURONIUM	0.08 mg/kg	0.1 mg/kg	0.05 mg/kg/hr	0.1 mg/kg/hr
80 kg	6.4 mg	8 mg	4 mg/hr	8 mg/hr
10 mg in 1ml	0.64 ml	0.8 ml	0.4 ml/hr	0.8 ml/hr
10mg in 500ml bag	320 ml	400 ml	200 ml/hr	400 ml/hr
10mg will last	1.5 doses	1.25 doses	2.5 hours	1.25 hours
Compatible w/:	**D5W, NS, and LR (max dilution of 1mg/ml)**			
VASOPRESSORS				
NOREPINEPHRINE	**10 mcg**	**100 mcg**	**0.1 mcg/kg/min**	**1 mcg/kg/min**
80 kg	10 mcg	100 mcg	8 mcg/min	80 mcg/min
1 mg in 10ml	0.1 ml	1 ml	0.08 ml/min	0.8 mcg/min
1mg in 500ml bag	5 ml	50 ml	4 ml/min	40 ml/min
1mg will last	100 doses	10 doses	2 hours	12 minutes
Compatible w/:	**D5W, NS, and LR**			
NOREPINEPHRINE	10 mcg	100 mcg	0.1 mcg/kg/min	1 mcg/kg/min
80 kg	10 mcg	100 mcg	8 mcg/min	80 mcg/min
4 mg in 4ml	0.01 ml	0.1 ml	0.008 ml/min	0.08 mcg/min
4mg in 500ml bag	1.25 ml	12.5 ml	1 ml/min	10 ml/min
4mg will last	400 doses	40 doses	8 hours	50 minutes
Compatible w/:	**D5W, NS, and LR**			
PHENYLEPHRINE	100mcg	500 mcg	0.4 mcg/kg/min	2 mcg/kg/min
80 kg	100mcg	500 mcg	32 mcg/min	160 mcg/min
0.5mg/5ml (100mcg/ml)	1 ml	5 ml	0.32 ml/min	1.6 ml/min
10mg in 500ml bag	5 ml	25 ml	1.6 ml/min	8 ml/min
10mg will last	100 doses	20 doses	5.2 hours	1 hour
Compatible w/:	**D5W, NS, and LR**			

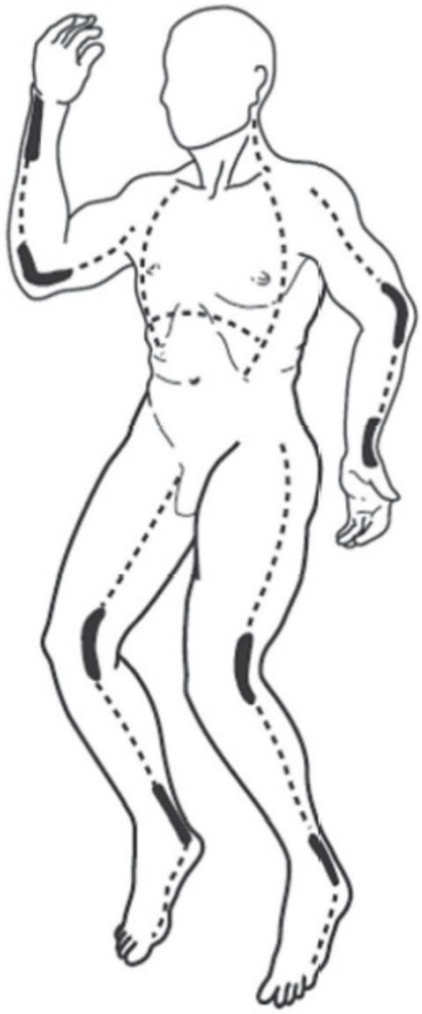
Appendix K: Rule of 9's

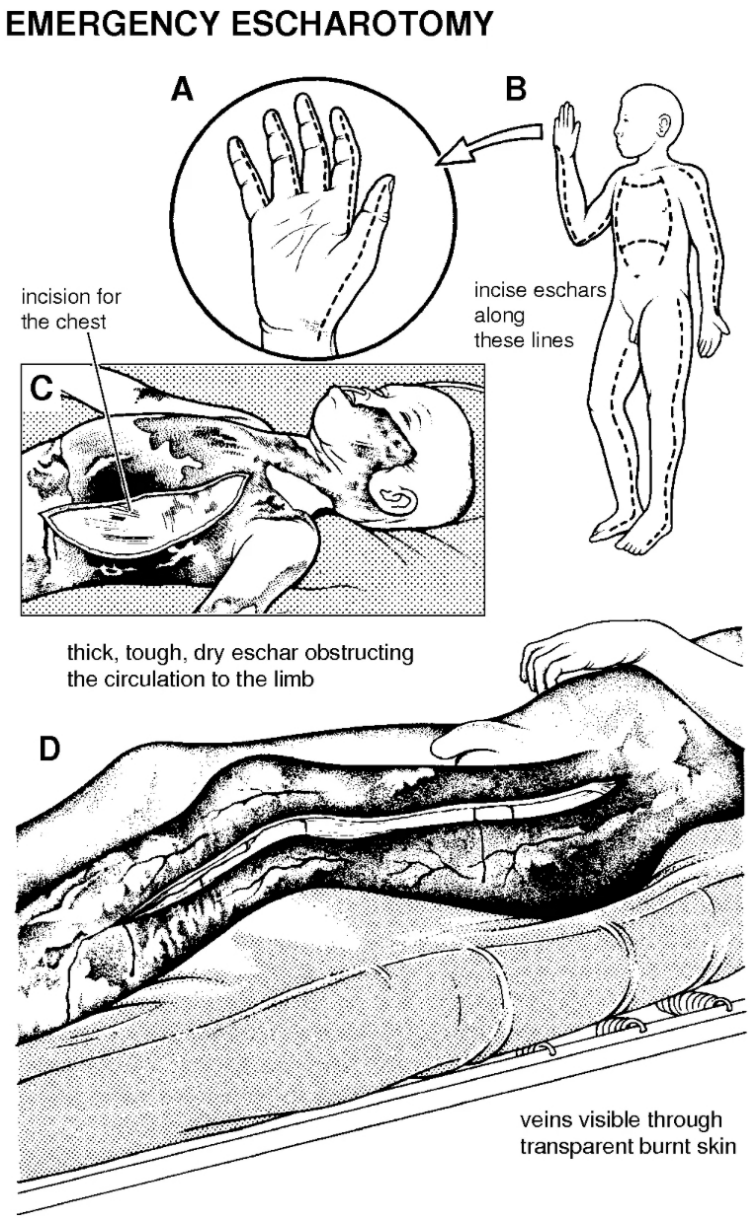


Appendix L: Rule of 10's Quick Reference Chart

Total % Burned (2nd and 3rd Degree)	Pt Weight (kg)						
	40 - 80kg	90kg	100kg	110kg	120kg	130kg	140kg
20%	200	300	400	500	600	700	800
30%	300	400	500	600	700	800	900
40%	400	500	600	700	800	900	1000
50%	500	600	700	800	900	1000	1100
60%	600	700	800	900	1000	1100	1200
70%	600	800	900	1000	1100	1200	1300
80%	800	900	1000	1100	1200	1300	1400
90%	900	1000	1100	1200	1300	1400	1500
100%	1000	1100	1200	1300	1400	1500	1600
	{---------- mL/Hr ----------}						

Appendix M: Escharotomy Reference





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Glossary of Acronyms

AE	Aeromedical evacuation
CASEVAC	Casualty evacuation
CoERCCC	Committee on En Route Combat Casualty Care
CoTCCC	Committee on Tactical Combat Casualty Care
ERC	En route care
FWB	Fresh Whole Blood
IAW	In accordance with
JTS	Joint Trauma System
LTOWB	Low titer O whole blood
MARCH	Massive Hemorrhage, Airway, Respirations, Circulation, and Head/Hypothermia
MEDEVAC	Medical Evacuation
MTF	Medical Treatment Facility
TACEVAC	Tactical Evacuation
TBSA	Total Burn Surface Area
TCCC	Tactical Combat Casualty Care
TXA	Tranexamic Acid
OTFC	Oral transmucosal fentanyl citrate
PCD	Pelvic compression device
POI	Point of injury
UOP	Urine output