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1 GENERAL CONSIDERATIONS

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1.1 GENERAL CONSIDERATIONS

1.1.1 Goal:

To maintain the most clinically adept team for critical, high risk, or problem prone patients who must be transferred after careful consideration of the risks and benefits.

1.1.2 Objectives:

Optimize pre-departure interventions to diminish the potential for enroute deterioration.
Respond aggressively to enroute deterioration with interventions guided by the protocols, and communication with On-Line Medical Direction (OLMD) if necessary.
Seek to achieve application of tertiary care perspective and technology to integrate the care of the patient from the referring source into that of the receiving facility.

1.1.3 Policy:

The Critical Care Transport Team, under the guidance of designated OLMD will follow the outlined protocols and procedures to meet the needs of the patient, their family, and the referring staff. These guidelines apply to both the paramedic and nurse disciplines of the LifeFlight of Maine Critical Care Transport Team.

1.1.4 At the Referring Hospital:

Introduce yourself and the team members.
Unless the patient is in extremis, one crew member may initiate care while the other retrieves report. Remember, the referring hospital may have hours or days of experience with this patient.
Review x-rays, EKG's, lab information, and perform a physical exam with emphasis on the pertinent systems. Collect the pertinent information for the care of the patient during transport and hand-off.
Proceed with stabilization utilizing standing protocols. If the management of the patient is beyond the scope of these protocols, or if you have reason to believe these protocols do not apply, call OLMD for consultation and guidance.
Work with referring staff as much as possible. To the extent possible, explain what you're doing and why.
Before leaving the referring hospital, have the patient and family visit if possible.
Explain the patient's condition and probable course. It is important to have a clear set of expectations for families and providers.

1.1.5 The transport team should give a complete report to the receiving unit and leave documentation of the care provided during the transport. Feedback information must be given as well.

1.1.6 Some medications discussed in these protocols may be obtained from the referring hospital.

1.1.7 All medications listed in these protocols are to be considered IV/IO unless otherwise stated.

1.1.8 **Note: This protocol manual will not suffice as a tutorial or substitute for training, educations, experience, and a commitment by providers to lifelong learning.**

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1.2 ROUTINE STANDARD OF CARE

1.2.1 **Universal Precautions.**

1.2.2 **Vital sign monitoring commensurate with clinical manifestation of the patient, and, at a minimum, every 30 minutes.**

1.2.3 **As patient acuity dictates, interventions include:**

Cardiac monitor.
Pulse oximetry.
Nasal Capnography.
Serial BP monitoring.
Serial 12-lead electrocardiography.
Analgesia and sedations appropriate to the patient's condition.
Appropriate airway management.
Appropriate respiratory assistance.
Oxygen therapy via nasal cannula, NRB, or other device as appropriate for the patient condition.
Appropriate ventilator management, when applicable.
Reliable intravenous access for medication and fluid administration.
Appropriate fluid therapy and bleeding control.
Gastric decompression as indicated for patient condition.
Identify or obtain a thorough history and physical exam.
Identify or obtain diagnostic information necessary to support a working diagnosis and the treatment plan that follows.
Aseptic technique for all invasive procedures.
Unless specified, all medications are to be administered via peripheral IV or IO.
Continuous waveform capnography for ALL patients with advanced airways.
Continuous waveform monitoring if the patient has a PA/Arterial Catheter or ICP monitor.
Documented blood glucose in patients with altered mental status.

1.2.4 **Provide complete verbal report to receiving staff:**

Assure referring assessment, diagnostics, and treatments have been included in transfer of care.

1.2.5 **Paper handoff form, documenting care provided by LOM crew, is REQUIRED**

1.2.6 **Note: Ketamine should not be used as a procedural sedation. Unless being administered for RSI, contact with LOM medical direction MUST be made if intended to be used on a patient without a supraglottic or endotracheal airway in place.**

2 RESPIRATORY

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2.1 AIRWAY MANAGEMENT

2.1.1 Indications:

Any patient who presents with an obstructed airway, apnea, or compromised spontaneous oxygenation and ventilation.

2.1.2 Objectives:

To achieve secure, adequate, protected, and stable exchange of gases, oxygenation, and ventilation of the patient during the entire transfer operation.

2.1.3 Clinical Management:

Maintain cervical spine precautions in all patients suspected of spinal trauma.
Administer $Fi0_2$ appropriate for patient's condition.
Clinical indications and required equipment:
Respiratory distress and hypoxia.
Nasal cannula (NC).
High Flow Nasal Cannula System (HFNC).
Air entrapment mask (Scoop or Venturi Mask).
Oxymizer moustache.
Non-rebreather mask (NRB).
Obstructed airway:
Foreign body: Magill forceps (after appropriate interventions for airway obstruction).
Vomitus: Appropriate transport suction device including yankauer and ducanto suction catheters.
Blood/Saliva: Appropriate transport suction devices.
Tongue: Oral airway, Basic Life Support (BLS) maneuvers including jaw thrust or chin lift as indicated.
Severe facial/neck trauma:
Endotracheal intubation, supraglottic airway device placement or surgical airway.
Apnea:
Bag valve mask ventilation with the use of a PEEP valve used in association with oral airway as temporizing maneuver.
Oral endotracheal intubation is preferred under all circumstances when definitive airway management is required.
Supraglottic airway device: For use when endotracheal intubation has failed.
Surgical airway: This procedure is indicated when all other attempts at airway stabilization have failed.
Ineffective oxygenation, but spontaneous ventilation:
Non-invasive Positive Pressure Ventilation (NIPPV) including Continuous Positive Airway Pressure Ventilation (CPAP) and Bi-Level Positive Airway Pressure (BiPAP) Ventilation.
Rapid sequence intubation (RSI).
Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.

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RESPIRATORY

Anticipated clinical course:
Deterioration; suspected or anticipated.
Transport; safety to crew or patient.
Impending compromise including possible, but not limited to inhalation injuries, and angioedema.

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2.2 ENDOTRACHEAL INTUBATION

2.2.1 **Indications:**

The Critical Care Transport team (LifeFlight of Maine) is directed to place a definitive airway in any patient who has compromised, no spontaneous ventilatory effort, or who has impending loss of airway reflexes.
If the patient has spontaneous ventilations, clenched jaw, or requires medications for placement of an endotracheal tube or a supraglottic device.
Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.

2.2.2 **Relative contraindications:**

An endotracheal tube should be placed if staff are unable to oxygenate and ventilate with bag valve mask technique despite oral and nasal adjuncts.

2.2.3 **Equipment Required:**

Appropriate personal protective equipment.
Bougie.
Endotracheal tubes of appropriate size for patient.
Approved video laryngoscope with other appropriate laryngoscope handles (to include hyperangulated or miller blades as applicable).
Additional various size and type of blades appropriate for patient for the use in direct laryngoscopy.
10 ml syringe.
Tube securing device.
End tidal CO_2 waveform continuous monitoring device or Emergency Backup (i.e. Easy cap End-Tidal Colorimetric Device).
Nasal cannula with or without integrated continuous End Tidal Capnography monitoring system.
Bag valve mask with PEEP valve AND appropriate reservoir.
HEPA filters.
Functioning suction device for the environment in which the airway interventions are taking place (portable vs. fixed) with appropriate suction catheter tips.
Magill forceps or equivalent.
Appropriately sized stylet for the endotracheal tube.
High-flow oxygen.
Stethoscope.
Alternative airway devices (including King LT/S-D and/or appropriately sized Laryngeal Mask Airway).
Continuous ECG monitor with pulse oximetry, NIBP monitor, and Waveform Capnography.

2.2.4 **Clinical Management:**

If this is a pharmacologically assisted intubation, please refer to CCTTP 2.4 Pharmacologically Assisted Airway Management for medication administration.
Assemble and prepare equipment (with back-up devices) and achieve agreement with teammate on action sequence, including rescue maneuvers and contingencies.
Prior to initiation of airway management, visually assess the patient's airway based upon co-morbidities, anatomy, and concurrent injuries (consider the use of a Mallampati score).
Determine the appropriate technique for airway placement and identify potential complications.
The use of the following mnemonics has been proven useful for providers completing definitive airway management:

HEAVEN
Hypoxemia ➔ O_2 saturation of less than 92% at initial airway attempt.
Extremes of size ➔ Peds patient (less than 8 yrs.) or obesity.
Anatomical Challenge ➔ Trauma, FB, structural abnormality.
Vomit / Blood / fluid ➔ Obscured Airway.
Exsanguination ➔ Anemia will cause unstable hemodynamics.
Neck ➔ Limited cervical mobility.

POGO
Percentage of glottic opening seen, defined by the linear span from the anterior commisure to the interarytenoid notch.
100% is a full view of the glottis.
0% view means that even the interayrtenoid notch is not seen.

MOANS: Potential causes of BVM ventilation difficulty.
Mask seal, male or Mallampati score.
Obesity or obstruction.
Age.
No teeth or neck.
Stiff or snoring.

LEMON: Airway assessment method.
Look externally.
Evaluate the 3-3-2 rule.
Mallampati score.
Obstruction score.
Neck mobility

RODS: SGA/ LMA placement.
Restricted mouth.
Obstruction.
Disrupted or distorted airway.
Stiff lungs or spinal precautions.
SHORT: Surgical airway placement.
Surgery.
Hematoma.
Obesity.
Radiation.
Tumor.
Check integrity of endotracheal tube balloon.
Select appropriate size endotracheal tubes and blades. Refer to section CCTTP 2.2.5 Endotracheal Tube Sizing Guide.
The use of a bougie is encouraged for airway management on the first pass attempt. However, if a stylet is used, insert appropriately sized stylet if desired. (Note: The end of the stylet should not go past the "Murphy's Eye," approximately 1 cm from distal end of tube).

Preoxygenation (Denitrogenation): If the patient is not pre-oxygenated, an attempt should be made to pre-oxygenate with 100% oxygen via non-rebreather for three minutes or 180 seconds prior to any intubation attempt, or if possible, several (8) vital capacity breaths in order to facilitate nitrogen washout. These breaths should be ideally provided in a patient with spontaneous ventilations. In some cases, bag valve mask ventilations can be used to augment ineffective ventilation. Consider aborting intubation attempt if oxygen saturations are less than 10% of starting saturation.
Apneic Oxygenation: Place nasal cannula on patient for passive apneic oxygenation typically in conjunction with bag-valve mask or non-rebreather is in place. Maintain oxygen therapy and if the patient is obtunded, liter flow can be increased up to 15 liters per minute if not contra-indicated.
Oral Endotracheal Intubation:
If unable to ventilate patient and maintain oxygen saturations > 92%, place an oropharyngeal or nasopharyngeal airway adjunct and perform two- person, four-handed ventilating technique. Maintain in-line spine stabilization of all trauma patients. Use head-elevated laryngoscopy position to achieve optimal visualization. Adjust accordingly to maintain anatomical alignment in trauma patients.
Position the patient ideally (maintain cervical spine immobilization where appropriate) at a comfortable height and in the "sniffing" position.
Remove any obstructing materials (i.e. front of cervical collar, head immobilizers, helmets if appropriate.)

- *If front of c-collar and/or head immobilization device is removed, manual inline c-spine stabilization is REQUIRED to be maintained throughout procedure.

Remove foreign bodies and/or dentures from mouth if obstructing view.
Suction airway as needed.
While holding laryngoscope in left hand, insert blade into right side of mouth, sweeping tongue to the left.
Place the Mac blade (curved) in vallecula or the Miller blade (straight) under the epiglottis.
With an upward motion, raise the epiglottis to visualize the vocal cords.

- NEVER use prying motion against the upper gums or teeth.
- LifeFlight of Maine utilizes a video laryngoscope for all intubations. This should be the first option used.

Apply external laryngeal manipulation (ELM) at the request of the provider who is performing the intubation.
Have a bougie open and ready to use for each intubation.
While visualizing the vocal cords, pass the bougie or endotracheal tube through the cords approximately 0.5 cm beyond the cuff.
Average adult female tube depth usually 21-22 cm.
Average adult male tube depth usually 23-24 cm.
Pediatric tube depth usually *three times* the size of the ETT appropriate for that size child.
If unable to visualize the cords, consider maneuvers such as External Laryngeal Manipulation (ELM) to manipulate the anatomy into view.
While securely holding the endotracheal tube, remove the laryngoscope and stylet.
Inflate the balloon with 5-10 ml of air and remove the syringe. Use appropriate manometer to identify cuff pressures. Refer to CCTTP 10.20 Endotracheal tube cuff pressures.
Attach End Tidal CO_2 detection device (preferably Continuous Waveform Capnography). It is appropriate to use a quantitative monitoring device. (Note: In cardiac arrest, lack of CO_2 production may make $ETCO_2$
Inaccurate requiring the use of alternative devices or direct laryngoscopy, to adequately verify endotracheal tube placement.)
Ventilate patient with BVM at 100% FiO_2 until placed on appropriate ventilator. Refer to CCTTP 10.8 Mechanical Ventilation.

2.2.5 Endotracheal Tube Sizing Guide

Age	Birth	6 mos	1 year	2 year	3 year	4 year	5 year	6 year	8 year	10 year	12 year	14 year	Adult
Average Weight (kg)	3.5	7	10	12	14	16	18	20	25	30	40	50	70
Endotracheal Tube Size (mm)	3-3.5	3.5-4	4	4.5	4.5	5	5	5.5	6	6.5	7	7.5	8
Insertion Depth (cm)	9	11	12	13	14	14	15	15	16	17	18	20	22

2.2.6 Notes:

Pediatrics: Cuffed ETT in the pediatric population is the standard. However, this should not be cause for changing an otherwise functioning uncuffed ETT tube, which has been previously placed.

Endotracheal tube sizes:

Cuffed ETT (mm) = (age/4) + 3.5

Uncuffed ETT (mm) = (age/4) + 4

Approximate Tube Depth (cm) = ETT size (mm) x 3

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2.3 CONFIRMATION AND CONTINUOUS MONITORING OF ADVANCED AIRWAYS

2.3.1 Confirmation

Once the endotracheal tube is placed, verification of tube placement will be accomplished using at least **three** of the following methods, one of which must be an $ETCO_2$ detector device or laryngoscopy by the second provider.
Additional methods of confirmation include:
$ETCO_2$ Waveform Capnography.
Colorimetric $ETCO_2$ Device (i.e. Easy Cap) if #1 is not available. This is far less preferable but can be used in emergent situations.
Direct visualization.
Observation of chest rise and fall.
Auscultation of bilateral breath sounds.
Absence of epigastric sounds with respirations.
ETT condensation with exhalation.
Confirmation of ETT placement is a dynamic process, requiring ongoing monitoring during transport.
While x-ray is a useful tool for confirmation of depth, it is not mandatory to evaluate placement.
Secure tube with appropriate ties and devices.
In patients without any concern for spine trauma, the head of the bed should be elevated by 30° and gastric decompression with NG /OG tube should be accomplished whenever possible to prevent gastric regurgitation.
If ETT placement is confirmed, continue to ventilate patient at an age/size appropriate rate and volume. Refer to CCTTP 10.8 Mechanical Ventilation for LifeFlight of Maine ventilation guidelines.
If ETT placement is unable to be confirmed, or there exists any doubt as to correct ETT placement, immediately remove ETT and oxygenate patient with a BVM and 100% oxygen.
Reattempt placement of endotracheal tube placement when feasible.

2.3.2 Additional notes:

Observe for chest rise and fall and presence of End Tidal CO_2 ($ETCO_2$) waveform monitor.
Attention: Patients must be ventilated with a minimum of six (6) breaths before this before $ETCO_2$ detector devices are deemed accurate
The standard is that ALL patients who are intubated have continuous end tidal capnography and it must be documented in the patient's record.
If right main stem intubation is suspected (decreased or absent left-sided breath sounds), Reposition ETT by deflating balloon and move ETT cephalad (1-2 cm) and recheck.
When ETT position is confirmed, note cm marking at the gums and secure the endotracheal tube with an ETT securing device.
There can be excessive swelling of the oral soft tissues which can complicate measuring the exact depth of the endotracheal tube and edentulous patients exist.

Consider placing a cervical collar to prevent excessive head movement and subsequent ETT displacement.
If utilizing an Easy Cap for initial placement identification (emergent situation ONLY), switching to quantitative waveform $ETCO_2$ monitoring should be done as soon as practical, and should be maintained throughout transport.
Continuous assessment of the waveform for morphology should be noted with appropriate intervention as needed. $ETCO_2$ must be numerically documented with vital signs, and a printed strip at relinquishment must be attached to chart.
Throughout transport, the position of the endotracheal tube must be continually monitored. Reassessment must occur after every patient move.
Endotracheal tube cuff pressures should be measured after intubation. Adjustments may be required in both rotor and fixed wing transport to compensate for change in surrounding ambient pressures. Refer to CCTTP 10.20 Endotracheal tube cuff pressures.

2.3.3 **Documentation Pearls:**

Indication for procedure.
Vital signs (including pulse oximetry) before, during and after procedure including printed $ETCO_2$ waveforms and values.
Medications, routes, and doses.
ETT size and depth.
Verification of proper placement of ETT.
ETT pressure measured (CCTTP 10.20 Endotracheal tube cuff pressures.)

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2.4 PHARMACOLOGICALLY ASSISTED AIRWAY MANAGEMENT

2.4.1 **Indications:**

It may be necessary on occasion to sedate and utilize neuromuscular blockade before or during transport to facilitate intubation of the patient with a compromised airway when standard methods have failed and would delay care. Indications for pharmacologically assisted intubation include:

Failure to protect or maintain the airway (i.e. GCS< 9, partial / full airway obstruction).
Can the patient phonate with a clear and unobstructed voice?
Can the patient swallow spontaneously and handle normal oropharyngeal secretions?
Failure to oxygenate or ventilate (i.e. laryngospasms, ARDS, or status asthmaticus).
Anticipated clinical course.
Deterioration - suspected or anticipated clinical deterioration.
Transport - protection of patient and/or flight crew during transport due to combativeness, agitation, or altered mentation. Please refer to LifeFlight of Maine Policy 7.11 Transport of Combative Patients. In certain cases, patients in police custody may require airway stabilization for safety. Please refer to LifeFlight of Maine Policy 7.10 Transport of Prisoners in Protective Custody
Impending airway compromise (i.e. inhalation injuries, angioedema).

2.4.2 **Equipment as outlined in** CCTTP 2.2.3 Endotracheal intubation.

2.4.3 **Pharmacologically Assisted Intubation (RSI) Summary:**

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1. PREPARATION

Denitrogenation:
Monitor oxygen saturations and provide 100% oxygen by non-rebreather mask for three (3) minutes at a minimum at “flush-flow rate” (approximately 40-60 Liters per minute).
Coach patient to take eight (8) vital capacity breaths, if possible.
If patient is obtunded or if the respiratory effort is inadequate and the patient is hypoxic with oxygen saturations of less than 92% consider BVM with PEEP valve at FiO_2 of 100%.
Apneic Oxygenation:
Place nasal cannula on patient in preparation for passive apneic oxygenation.
While the patient is awake, the liter flow can range from 6 to 15 Liters per minute as the patient can tolerate.
Once the patient has been sedated adequately, the nasal cannula liter flow should be turned up to a minimum of 15 liters per minute for apneic oxygenation.
Monitor vital signs (ECG, heart rate, blood pressure, pulse oximetry, and end tidal wave form capnography).
Position spine/stabilization/airway anatomy.
HELP Position in morbidly obese patients. Refer to CCTTP 2.2.3 Endotracheal intubation.
IV Access/Meds
Ensure appropriate IV access. Preferably separate two sites.
Calculate ideal body weight versus actual body weight for medication dosing:

Etomidate dosing: Based upon **Ideal Body Weight**

- **In morbidly obese patients Lean Body Weight should be used.**

Ketamine dosing: Based upon **Ideal Body Weight**

- **In morbidly obese patients Lean Body Weight should be used.**

Rocuronium Dosing: Based upon **Total Body Weight**
Succinylcholine Dosing: Based upon **Total Body Weight**
Bougie on every attempt as this is the preferred device with which to achieve intubation.
Equipment/backup options.
Have backup devices (King Airway and other airway devices) at the bedside.

2. PREMEDICATION
Atropine can be used as a drying agent and to minimize bradycardia caused by laryngeal stimulation in pediatric patients. It is also used in setting of a second dose of succinylcholine for a bradycardia seen with repeated dosing of this neuromuscular agent (different mechanism for bradycardia).
For all patients < 1 year of age and to be considered for patients < 5 years of age:
Atropine 0.02 mg/kg IV.
Minimum dose: 0.1 mg IV.
Maximum dose 0.5 mg IV.
Onset: Immediate peak at 2-4 minutes for bradycardia and up to 15 mins for drying effects to become apparent.
Duration variable.
NOTE: There is little evidence demonstrating that **Fentanyl** is clinically beneficial and should NOT be administered as a neuro protective pre-medication in RSI, empirically.

3. INDUCTION (Use one agent only)
Etomidate 0.3 mg/kg IBW IV push
Commonly used sedative/induction agent in RSI with widest range of applications.
Maximum dose: 40 mg single dose.
Onset: 15 to 45 seconds.
Duration: 3-12 minutes.
Ketamine 2 mg/kg Slow IV/IM IBW to MAX 250mg IV, MAX 500mg IM
Ketamine is CONTRAindicated in patients < 3 months of age.
Can be considered for hypotensive, bronchospastic patients as well as those patients with severe sepsis. It can also be used for patient in imminent arrest due to its beta-adrenergic effects.
Maximum dose: 250 mg IV.
Onset: Less than 30 seconds.
Duration: 5-15 minutes.

Induction Notes:
If time allows for correction of hypotension (**SBP < 100 mmHg**) and/or predicted to be < 100 mmHg, initiate plan to address peri-RSI hypotension (i.e. the development of a 'hypotension plan.'
In patients who are potentially hemodynamically unstable, consider calculating the Shock Index to determine whether the patient is at risk for peri-intubation hemodynamic compromise or collapse
The Shock Index is calculated heart rate over systolic BP (HR/SBP)
A value greater than or equal to 0.8 is concerning for inadequate tissue perfusion (i.e. shock).
Thus, in this population of patients, complete the following:

- Insure adequate fluid resuscitation.
- Consideration of a reduced dose of the induction agent.
- Consider initiation of bolus or infusion vasoactive medications as per CCTTP 4.9 Refractory Shock and Hypotension.

During airway procedure, if anticipated or actual SBP < 100 mmHg, use **Epinephrine or Phenylephrine** per CCTTP 4.9.9 every 2-5 minutes until airway patency is achieved and vasoactive infusion is prepared and initiated.

4. PARALYSIS
Rocuronium: 1.5 mg/kg TBW IV.
Maximum dose: 150 mg IV.
Onset: 60 to 120 seconds (maximum peak).
Duration: Dose dependent, but typically 30-60 minutes.

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5. INTUBATION
Please refer to CCTTP 2.2 Endotracheal Intubation for actual procedure.

6. POST-INTUBATION
Add Agents that are needed for ongoing management. If sedation and analgesia are not adequate, patients can be awake clinically, but still be paralyzed.
If at any time following Airway Procedure, SBP < 100 mmHg, refer to CCTTP 4.9 Refractory hypotension and shock. for treatment options of post-intubation hypotension.
See CCTTP 2.4 Pharmacologically Assisted Airway Management for adult patients.
See CCTTP 11.5 Pediatric airway management for pediatric patients.

2.4.4 Delayed Sequence Intubation (DSI)

- **Definition:** Delayed Sequence Intubation (DSI) is defined as utilizing medications to optimally prepare a patient who cannot tolerate standard pre-intubation interventions for endotracheal intubation. It is facilitated by using intravenous or intramuscular Ketamine. This is a rarely used procedure at LifeFlight and should only be attempted in consultation with a LOM Medical Director.

- **Indication:** The patient requires Endotracheal Intubation but is unable to tolerate standard pre-intubation optimization including pre-oxygenation, denitrogenation, and hemodynamic resuscitation.

- **Procedure:**
  - Identify patient requiring emergency intubation and have reviewed the LOM RSI checklist.
  - Identify that the patient will not tolerate standard RSI pre-intubation interventions.
  - Perform as much of the pre-intubation checklist as possible and retrieve all necessary equipment ready before starting DSI.
  - Ensure the patient has a patent airway and spontaneous respirations based upon the LOM Airway assessment techniques.
  - Place standard nasal cannula at 15 L/min prior to placement of the preoxygenation device
  - Position the patient's HOB at 30° with the auditory meatus above the jugular notch. You may keep the patient in the upright position in cases of facial trauma if necessary or appropriate.
  - Pre-medicate with Zofran 4 mg IVP/IM as required.
  - Choose preoxygenation device based on the patient's SpO_2:
    - If $SpO_2 \geq 95\%$ use:
      - Use the bag-valve-mask (BVM) with PEEP valve and a functional seal at flush flow of oxygen, or non-rebreather (NRB) mask at flush flow of oxygen.
    - If $SpO_2 < 95\%$:
      - Use the BVM with PEEP valve with a functional seal.
  - Continue to preoxygenate for at least three (3) minutes or at least eight (8) vital capacity breaths.
  - Administer Ketamine 1mg/kg slow IV push OR 5 mg/kg IM if no IV is available.

    - Note: in the administration of the ketamine, push the medication slowly IV push over 60 seconds to prevent apnea.
  - If further doses of sedation are required, consider an additional dose of ketamine at 0.5mg/kg IV to achieve complete dissociation if required.

- IV/monitoring/Fluids/pressors as needed to achieve optimal pre-intubation conditions as noted in CCTTP 4.9 Refractory Shock and Hypotesion
- Paralyze and intubate the patient using the LOM intubation guidelines. Refer to CCTTP 2.2.3 Endotracheal Intubation

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2.5 POST-INTUBATION SEDATION, PAIN CONTROL AND MUSCLE RELAXANTS

2.5.1 Indications:

To optimize the post-intubation treatment of critically ill patients in terms of adequate analgesia, on-going paralysis, and appropriate sedation. To differentiate the intubated patient from the non-intubated patient as regards aggressive pain control and sedation.

2.5.2 Pearls, Pitfall, and Considerations:

Intubated patients require aggressive pain and anxiety management.
Enhanced consideration must be given to vital signs and non-verbal communication to adequately assess pain, anxiety, and seizure activity in the intubated and paralyzed patient.
Some analgesic and/or sedative agents may cause or exacerbate hypotension.
Non-depolarizing agents should be used if ongoing paralysis is necessary after intubation (i.e. Rocuronium).
Remember that patients can be awake under muscle relaxants (i.e. paralytics). Ongoing sedation and analgesia should be done on an empiric dosing schedule.
Consider the effects of post-intubation sedation. Anticipate hypotension and ensure treatment prior to the medication effects occur. Refer to CCTTP 4.9 Refractory Shock and Hypotension.
For longer transports of greater than 30 minutes, consider infusions of sedation, analgesia (and neuromuscular blockade as applicable) for steady state maintenance during the transfer.

2.5.3 Analgesia (choose one or a combination of the following depending on patient needs):

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Fentanyl Bolus: 0.5-2 mcg/kg IV bolus PRN.
Minimum dose: None.
Maximum dose: 150 mcg IV.
Onset: 1-3 min. Peak 3-20 min.
Duration: 15-30 min.
Fentanyl Infusion: 0.25-2.5 mcg/kg/hr IV titrated continuously.
Morphine Bolus: 0.05-0.1 mg/kg IV PRN. Titrate to adequate pain control.
Minimum dose: None.
Maximum dose: 8 mg.
Onset: 1-3 min. Peak: 3-20 min.
Duration: 15-30 min.
Morphine Infusion: 0.01-0.1 mg/kg/hr IV titrated continuously
Maximum dose: 10 mg/hr.
Ketamine Bolus/Infusion: See below.
Dilaudid Bolus: 0.2-1mg every 1-3 hours PRN
Minimum dose: None
Maximum dose: 1mg/hr
Onset: 5 min. Peak 10-20 min
Duration: 3-4 hours

2.5.4 **Sedation (Choose one or a combination of the following depending on patient needs):**

Midazolam Bolus: 0.01-0.1 mg/kg IV every 5 minutes.
Minimum dose: None.
Maximum dose: 5 mg IV.
Onset: 1-3 min Peak: 3-20 min.
Duration: 15-30 min.
Midazolam Infusion: 0.04-0.2 mg/kg/hr titrated continuously.
Lorazepam Bolus: 0.01-0.05 mg/kg IV every 15 minutes.
Minimum dose: None.
Maximum dose: 4 mg IV in single dose bolus.
Onset: 5-20 min. Peak: 3-20 min.
Duration: 15-30 min.
Lorazepam Infusion: 0.01-0.1 mg/kg/hr titrated continuously.
Propofol Bolus: 0.1 to 1 mg/kg IV.
Minimum dose: None.
Maximum dose: None.
Onset: 1-3 min. Peak: 3-20 min.
Duration: 15-30 min.
Propofol Infusion: 5-200 mcg/kg/min titrated continuously.
Titrate in increments of 10-25 mcg/kg/min if MAP > 65.
Usual maintenance is 50-80 mcg/kg/min in transport.
Ketamine Bolus: 1 mg/kg IV.
CONTRAindicated in patients < 3 months of age.
Ketamine has dose dependent analgesic and dissociative properties.
In patients with physiologic stress leading to concern for catecholamine depletion, consider lower dose (0.25-0.5 mg/kg).
May repeat 0.25-0.5 mg/kg PRN or continue infusion dosing.
Minimum dose: None.
Maximum dose: 250 mg IV.
Onset: 1-3 min. Peak: 3-20 min.
Duration: 15-30 min.
Ketamine Infusion: 0.5-2 mg/kg/hr.

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2.5.5 **Paralysis:**

If patient's minute ventilation is above the ventilator setting, prior to medication, correct ventilator setting as needed and appropriate.

If staff feel that they are not able to manage the patient effectively without the use of muscle relaxants (i.e. paralytics) medical direction supports the use of these medications. It is imperative to have a detailed neurological exam recorded.

Long Acting: Use when sedative agents alone are insufficient for safe transport.

Rocuronium: 0.6 to 1.5 mg/kg every 30 min PRN. Onset: 1-2 min. Duration: dose dependent.
Minimum dose: None.
Maximum dose: 150 mg IV.
Onset: 1-3 min. Peak: 3-20 min.
Duration: 15-30 min.

Vecuronium: 0.1 mg/kg IV/IO PRN.
Minimum dose: None.
Maximum dose: 10 mg IV.
Onset: 60 to 75 seconds.
Peak: 3-20 min.
Duration: 15-30 min.

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2.6 ACUTE BRONCHOSPASM

2.6.1 Indications:

Acute bronchospasm occurs in a variety of disease processes. These include chronic disease states including chronic obstructive pulmonary disorder (COPD), emphysema, bronchitis, and congestive heart failure. Other reversible disorders include asthma. It is important for the provider to differentiate the diagnosis through a thorough history and precipitating factors. Determining a patient's usual status of disease will enable the provider to assess the current presentation and allow for an appropriate level of treatment.

2.6.2 Pearls, Pitfalls, and Considerations:

Indications for aggressive treatment include evidence of hypercarbia, hypoxia, fatigue (to include nebulizer and other adjunctive therapies). Controlled hypercarbia is preferable to inducing barotrauma in these patients. All that wheezes is not asthma.

2.6.3 Clinical Management:

Assess and maintain an adequate airway. Additionally, assess the patient's respiratory and circulatory status. Watch for increasing ventilatory fatigue, which will culminate in hypoventilation and the need for intubation and ventilatory support.
Position of comfort (usually most comfortable sitting upright).
If the patient has spontaneous respirations, administer supplemental oxygen 6-15 L/minute via NC or NRB to maintain oxygen saturations of greater than 92%. If the patient has severe respiratory distress, consider high flow oxygen. Prepare for advanced airway management.
Monitor cardiac rhythm, oxygen saturation, end tidal CO_2, and hemodynamic status.
Establish IV and maintain KVO rate.
If patient intubated or there are concerns regarding nebulization as it pertains to aerosol generation, **Albuterol** 8 puffs via MDI.
Duo-Neb (**Albuterol** 2.5 mg/ **Ipratropium** 0.5 mg) mixed in nebulizer and given over 5-15 min. (Flow rate 6-8 LPM air/oxygen) inhaled. After two doses of Duo-Neb, administer continuous albuterol nebulizers PRN.
Do not use ipratropium in patients with known peanut allergies.
If not otherwise given, administer **Methylprednisolone Sodium Succinate** (Solu-Medrol) at 2 mg/kg to MAX dose 125 mg IV.
Consider the administration of **Magnesium Sulfate** 25-75 mg/kg to MAX dose of 2g IV over 30 minutes in patients with known history of asthma. Monitor for cardiorespiratory depression.
If above ineffective, administer **Epinephrine 1:1000** (1mg/1mL) 0.3 mg IM every 5-10 min. in patients with life threatening respiratory distress or refractory shock. Use with caution in patients with cardiovascular disease or over age 55.
PEDIATRIC dosing (< 30 kg) **Epinephrine** 1:1000 (1mg/1mL) 0.01mg/kg IM q 5-10 min. x 2 doses (MAX dose 0.3 mg).
After two doses of Epinephrine IM, initiate **Epinephrine Infusion**: 0.05 mcg/kg/min to max dose of 0.5 mcg/kg/min Start at 0.05 mcg/kg/min. (3.5-35 mcg/min for a 70kg patient). Titrate by 0.02 mcg/min as indicated.

Dose range: 0.05-0.5 mcg/kg/min (3.5-35 mcg/min for a 70kg patient).
There is no true maximum dose but consider additional agent once titration has reached 0.3 mcg/kg/min (or 21 mcg/min for a 70kg patient).
In adult patients, if the patient's respiratory status continues to deteriorate, consider trial of Bi-Pap at initial settings of 10/5 with a $Fi0_2$ of 100%. Titrate accordingly.
If the patient's mental status continues to wane, prepare for emergent intubation. Induction medication of choice is **ketamine** for asthma.
Reassess respiratory status and associated vital signs.
In intubated patients, for **Albuterol**, use Metered Dose Inhaler (MDI). Install a spacer in the ventilator circuit and extend it fully. If an HEPA filter is being used, ensure that the MDI is proximal to the filter. Insert the MDI at the top of the spacer and depress medication just prior to the inspiratory phase. Allow the patient to take several breaths and subsequently repeat. Collapse the spacer after treatment to minimize dead space.

2.6.4 SPECIAL CASES: Partial Airway Obstructions

Croup
Assess the adequacy of the airway, breathing and circulation, and intervene as appropriate.
Provide ventilatory support as needed. If there is concern for the patient to maintain a patent airway, consider endotracheal intubation by most experienced provider (including anesthesiology in operating room environment).
Monitor and record vital signs including RR, SPO_2, HR, $ETCO_2$, and BP.
Administer high-flow, high-concentration oxygen.
Dexamethasone (Discuss with sending clinician).
0.6 mg/kg PO/IV. MAXimum dose 15 mg PO/IV.
Prepare the nebulizer with **racemic epinephrine** (0.05 ml/kg of a 2.25% solution to a max single dose of 0.5 ml.) May not administer more frequently than every one to two (1-2) hours as needed for severe stridor.
Connect the nebulizer to an oxygen source at six (6) liters per minute.
Reassess and monitor for desired effect and side effects.
Epiglottitis or Undifferentiated Stridor.
Assess the adequacy of the airway, breathing, and circulation. Intervene as appropriate.
Provide ventilatory support as needed. If there is concern for the patient to maintain a patent airway, consider endotracheal intubation by most experienced provider (anesthesiology in operating room environment), especially in adult or pediatric patients presenting with signs and symptoms of upper airway compromise.
Monitor and record vital signs including RR, SPO_2, HR, ECG, BP, and $ETCO_2$.
Administer high-flow, high-concentration oxygen.
If there is concern for an infectious etiology of the airway obstruction (epiglottitis, retropharyngeal abscess, etc.) the patient should have appropriate antibiotic coverage prior to transfer.
Contact on-line medical control including receiving physician or LOM medical director for additional options of further interventions as necessary.

RESPIRATORY

Reassess and monitor patient during course of patient care for any changes, signs, and symptoms.

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2.7 CARDIOGENIC PULMONARY EDEMA

2.7.1 Indications:

Any patient with signs and symptoms of acute pulmonary edema.

2.7.2 Pearls, Pitfalls, and Considerations:

Clinical evaluation should be primarily to assess for perfusion adequacy. In the initial evaluation, assess airway, breathing and circulation. Obtain history from providers and patient if possible. Obtain lab values, EKG, and echocardiogram reports.
If the patient has undergone recent hemodynamic monitoring, record the following: CO, PA, PCWP, CVP, and SVR.

2.7.3 Clinical Management:

Assess respiratory and circulatory status with special attention to respiratory fatigue, worsening dyspnea, and alterations in mental status.
Precipitating factors should be identified and corrected if possible. These include, but are not limited to the following:
Dysrhythmias.
Alterations in blood pressure, including hyper and hypotension.
On-going cardiac ischemia.
Establish and maintain adequate airway and ventilation status.
Initiate oxygen therapy to maintain oxygen saturations of greater than 93%.
Place patient in position of comfort.
Consider trial of Bi-Pap ventilation. Refer to CCTTP 10.9 Non-invasive mechanical ventilation.
If patient is in respiratory failure, consider intubation. See protocol CCTTP 2.3 Rapid Sequence Intubation
With confirmed diagnosis of pulmonary edema (based upon history, clinical exam, chest x-ray, and laboratory evaluation), medication administration can include:
If MAP below 60, refer to CCTTP 4.9 Refractory hypotension and shock.
In the setting of acute pulmonary edema and the MAP above 60, consider the following:
NTG 0.4 mg SL once per minute for continuous CVP/SVR reduction if symptoms are severe. Repeated dosing can occur as a bridge to infusion.
NTG infusion 50-200 mcg/min IV.
Furosemide 20-80 mg IV. Titrate administration based upon prior exposure to medication and hemodynamics.
Prior to transport, consider inserting an indwelling urinary catheter to monitor urine output (If available at the sending facility and procedure does not unnecessarily delay transport).

2.8 ACUTE PULMONARY EMBOLISM

2.8.1 **Indications:**

Any patient with signs and symptoms of an acute pulmonary embolism (APE).
Staff must be able to recognize patients with history commensurate with APE and provide safe and efficacious care and transport to the appropriate destination.

2.8.2 **Pearls, Pitfalls, and Considerations:**

Patient with PE can present with a wide variety of signs and symptoms. These can include everything from dyspnea and chest pain to profound hypotension and refractory shock.

2.8.3 **Clinical Management:**

Assess patient's airway, breathing and circulation.
Assess patient's oxygenation and hemodynamic status.
Provide supplemental oxygen as needed to maintain oxygen saturations greater than 92% in patients with spontaneous respirations.
In patients with acute respiratory distress, consider endotracheal intubation. Refer to CCTTP 2.2 Endotracheal Intubation.
In patients with refractory hypotension, refer to CCTTP 4.9 Refractory hypotension and shock.
In patients with confirmed pulmonary emboli, anticoagulation therapy should be considered.
Consider involving LOM medical director to assist in this decision.
Consider facilitating transport to embolectomy-capable facility.
Administration of heparin can occur if no ABSOLUTE contraindications are present. These include:
Recent surgery
Hemorrhagic CVA
Active bleeding (other than menstruation or epistaxis)
Aortic dissection
Intracranial or spinal cord tumors.

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Heparin
In patients with a BMI > 30, discuss dosing with sending provider as adjusted body weight must be used.
Bolus of 80 units/kg (MAX 10,000 units)
Followed by a continuous infusion of 18 units/kg/hr (MAX 2,000 units/hr)
For persistent hypotension despite management with the preceding measures, initiation of thrombolytic therapy (per sending physician) may be considered prior to departing the referring facility.

2.8.4 **If a thrombolytic is given to a patient with pulmonary embolism, refer to** CCTTP 4.11 Thrombolytic Therapy Monitoring.

3 CARDIAC

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3.1 ACUTE CORONARY SYNDROMES: MANAGEMENT FOR PERCUTANEOUS CORONARY INTERVENTION (PCI)

3.1.1 Indications:

Patient presenting with signs and symptoms compatible with acute myocardial ischemia. This can encompass patients who have angina symptoms to those patients experiencing STEMI or Non-ST elevation myocardial infarctions (NSTEMI).

3.1.2 Pearls, Pitfalls, and Special Considerations:

Identify patient as candidate for primary percutaneous coronary intervention.
Refer to CCTTP 3.2 ACS / STEMI fibrinolytic therapy checklist.
Refer to CCTTP 3.3 ACS / STEMI cardiac catheterization lab activation checklist.
Inclusion Criteria (Criteria adopted from healthcare systems including, but limited to Northern Lights Eastern Maine Medical Center, Central Maine Healthcare, and Maine Health):

- 12 hours or less from onset of symptoms.
- ST elevations must be greater than 1mm and two or more anatomically contiguous leads with reciprocal changes.
- For leads V2-V3, the criteria for a STEMI are:
  2mm - Males 40 years and older.
  2.5mm - Males younger than 40 years.
  1.5mm. - Females independent of age.

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Regional ECG Criteria are the following:

- Septal (V1, V2).
- Anterior (V2-V5).
- Inferior (II, III, aVF.
- Lateral (High: I and aVL, Low: V5, V6).
- Posterior (ST depression greater than 1mm in V1, V2 and possibly V3 with and R/S ratio > or = to 1. Evaluate for ST segment elevation in Leads V7-9).
- Other STEMI equivalents or ACS syndromes that have been identified by involved providers (including Sgarbossa, Wellens and Brugada Syndromes).

Exclusion Criteria (**Absolute**):

- Active or recent internal bleeding (< 10 days).
- History of stroke within the last six months or any hemorrhagic stroke.
- Intracranial or interspinous surgery/trauma within the last two months.
- Recent trauma or surgery at non-compressible site within the last 10 days.
- Suspected aortic dissection or pericarditis.
- Known allergy to specific thrombolytic agent.

Exclusion Criteria (**Relative**):

- Age.
- Known bleeding disorders.
- Pregnancy.

- Severe uncontrollable hypertension (SBP >200 or DBP > 120) or otherwise unstable hemodynamics.
- Inability to lie supine.
- Altered mental status (confusion, obtundation, or agitation).
- CPR > 10 minutes.
- Current Coumadin therapy with INR > 2.
- Hemorrhagic ophthalmic conditions.
- Ischemic stroke in the last six months.
- Recent puncture or procedure to non-compressible blood vessel.
- Significant trauma in the last two weeks or major surgery within the last two months.
- DNR/DNI.
- Known contrast allergy.
- Prior to transport, distinguish location of myocardial infarction with basic EKG interpretation. Anticipate added fluid requirements and bradydysrhythmias for proximal RCA lesions (including inferior wall myocardial infarctions).

Additional notes:

Beta blockers should be used with caution in ACS patient during the *acute* phase of the myocardial infarction. It should only be used in patients who are having cardiac symptoms and are truly hyperdynamic with elevated blood pressure and heart rate. The administration of any type of beta blocker would be after the discussion with the receiving physician.
NTG administration is NOT contraindicated, but judicious clinical use is advised in all types of myocardial infarctions.
Deferring treatment and diagnostic procedures for transport, with the intent of shortening the time interval spent at the scene or sending facility, may be the best practice for these patients. The goal bedside time is 10 minutes or less.

3.1.3 Clinical Management:

Assess and manage airway, breathing, and circulation.
Only initiate oxygen therapy if patient hypoxic with persistent oxygen saturations less than 92%
Initiate cardiac monitoring, pulse oximetry, and serial vital signs.
Obtain or review a 12-lead EKG and interpret the findings. Assess for dysrhythmias and treat per appropriate protocol. Complete right-sided EKG if indicated.
Establish IV access (consider **two** sites) and infuse at a maintenance rate if blood pressure is stable, bolus fluids if hypotensive persistently (SBP < 90 mmHg).
Avoid placing intravenous line in region of right wrist if possible.
Consider utilizing ultrasound to assess global cardiac function and estimate stroke volume and cardiac output as applicable. Additionally, consider the use of ultrasound to evaluate for pericardial tamponade.
Consider placing defibrillation pads prior to transport. External pacer on standby if indicated.
Position patient on semi-fowler's position, unless hypotensive.

Treat arrhythmias per Advanced Cardiac Life Support (ACLS) guidelines.
Treatment sequence, (continue sequence if already initiated by referring facility).
NTG 0.4 mg tablet SL every 3 min x 3 for chest pain as tolerated by BP.
Check BP after each dose, maintain SBP > 100 mmHg.
Use with caution in the presence of right-sided MI.
If the patient has received a dose of Viagra within the past 24 hours or a dose of Cialis or Levitra within the past 72 hours, NTG is contraindicated.
Aspirin 81-324 mg PO unless contraindicated by a true allergy (Chew and swallow if possible).
Note: Dosage goal is 324 mg during the cardiac event for patients with suspected acute coronary syndrome.
If pain is not relieved, consider **NTG infusion** via IV.
Initiate at 20 mcg/minute. Max 200 mcg/min. Titrate NTG in increments of 5 mcg/min increments every 3-5 minutes for relief of pain.
Note: Nitroglycerin is used to treat symptoms of acute coronary syndrome, but has no effect on the actual lesion itself.
If pain is still not relieved, treat pain per CCTTP 4.12 ANALGESIA for the patient without an advanced airway.

Heparin IV bolus of 60 units/kg IV.
Max dose 4000 units.
Heparin infusion is a maximum of 12u/kg/hr for protracted transports of over 1 hour.
Max dose 1000 units/hr on initiation of therapy.
There may be instances when the heparin infusion may be higher based upon a suboptimal ptt (partial thrombo…time).

Verify that the patient has received any type of anti-platelet therapy (EITHER Ticagrelor **OR** Clopidogrel). Based upon the receiving hospital's antiplatelet drug of choice, and dosing. Discuss with either sending or receiving physician the administration of the appropriate drug and dosage for the patient with a confirmed ST elevation myocardial infarction or acute coronary syndrome (ACS).

Note: There may be circumstances when the receiving interventional cardiologist does **not** want any anti-platelet therapy initiated.

Communicate with receiving provider if the anti-platelet therapy was NOT given or was vomited during transport.

3.1.4 Special Considerations:

Continuous infusions of medications, including NTG and Heparin can be held during transition from bedside to transport vehicle to expedite scene time. Use clinical judgment as necessary.

There is NO indication to routinely complete ECG at the bedside, unless there is a change in patient's clinical status (i.e. change in pain, hemodynamic changes or dysrhythmias) that may change treatment or destination unit.

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3.2 ACS/STEMI FIBRINOLYTIC THERAPY CHECKLIST

In the setting of an acute coronary syndrome or ST elevation myocardial infarction, fibrinolytic therapy may be indicated as a first line therapy or if the patient will potentially experience a significant delay to percutaneous coronary intervention.

Use this checklist or the local equivalent to determine if a specific patient is eligible for **fibrinolytic therapy for ACS or STEMI**.

EXCLUSION CRITERIA: POTENTIAL ABSOLUTE CONTRAINDICATIONS	YES	NO
Active internal bleeding.		
History of bleeding or clotting disorders OR any history of anti-coagulant use.		
History of intracranial hemorrhage		
Intracranial or intraspinal surgery or trauma in the last two (2) months		
Intracranial neoplasm, arteriovenous malformation, or aneurysm		
Pregnancy		
Uncontrolled hypertension with systolic BP > 180mm Hg and diastolic BP > 100mm Hg		
EXCLUSION CRITERIA: POTENTIAL RELATIVE CONTRAINDICATIONS	**YES**	**NO**
Diabetic hemorrhagic retinopathy or other hemorrhagic ophthalmic conditions.		
Prolonged CPR (longer than 10 minutes)		
Major surgery at non-compressible site (i.e., CABG) within 10 days.		
Documented cerebrovascular disease.		
Gastrointestinal or genitourinary bleeding within last 7 days.		
Significant liver dysfunction.		
PHYSICALLY advanced age (>75 years with multiple disease states beyond AMI).		
Patients currently receiving oral anticoagulants.		
Previous thrombolytic therapy within last two (2) months.		
Trauma to the head in the last two weeks.		
Any trauma in the last two weeks.		
Surgery in the last two weeks.		

Note: This checklist has been adopted from the Department of Cardiology at Maine Health.

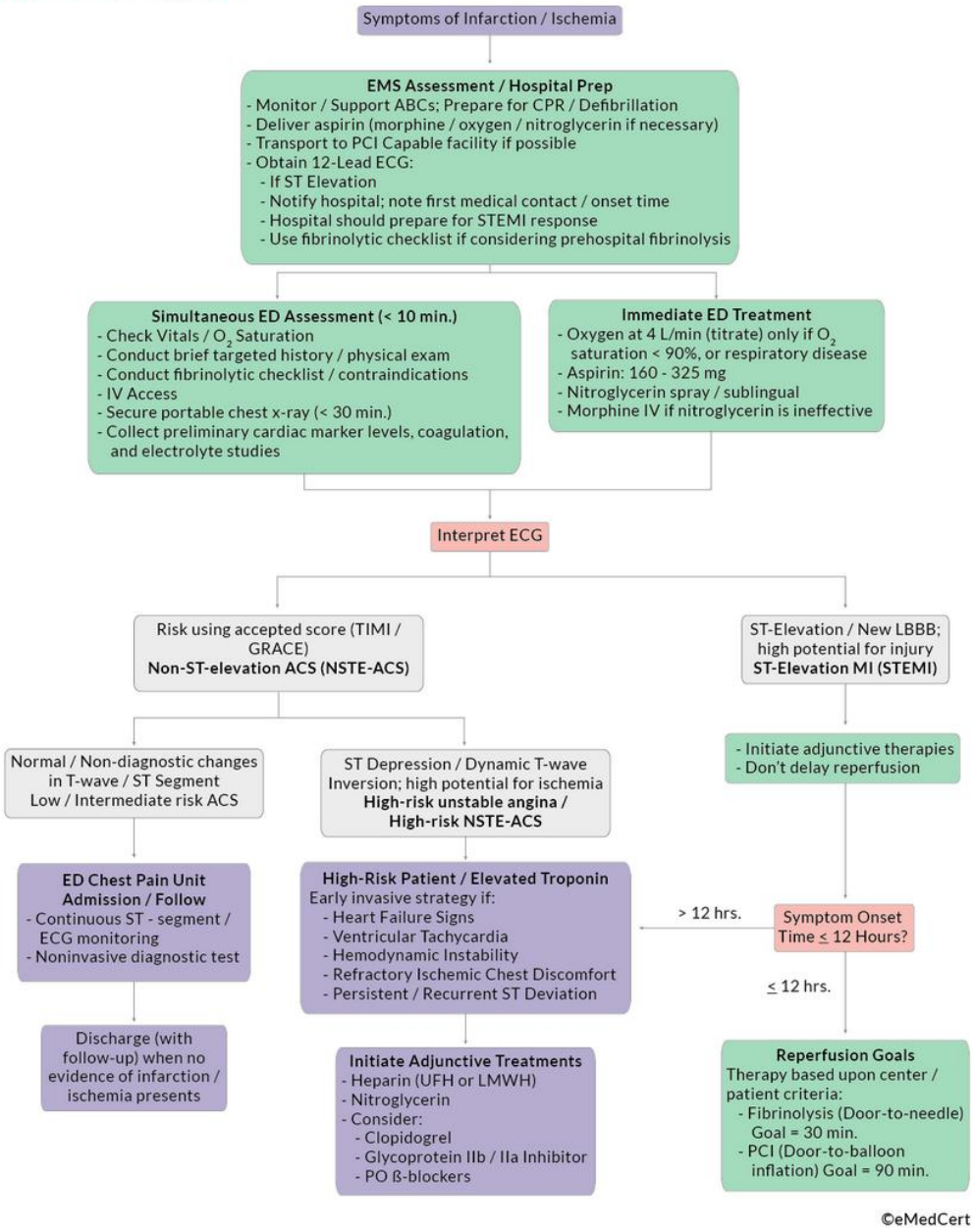
3.3 ACS/STEMI CATHETERIZATION LAB ACTIVATION CHECKLIST

3.3.1 **The following information should be communicated via MEDCOMM 1-888-421-4227.**

Satellite phone utilization may be required.

Patient information	Name
	DOB
	Weight
Medical History	Current Pain / Discomfort Level
	Duration of Symptoms
	Contrast Allergy?
	Code Status?
Clinical Findings	Evidence of concurrent CVA or GI Bleed?
	Hemodynamics (Vitals) / Airway Status.
	Location of MI on ECG.
Mentation and ability to cooperate with acute procedure.	Able to cooperate for procedure (is there an anesthesia requirement).
Treatment	IV Access.
	Treatment provided.
Hemodynamics	Blood pressure and heart rate assessment.
Estimated time of arrival.	Arrival at receiving facility.

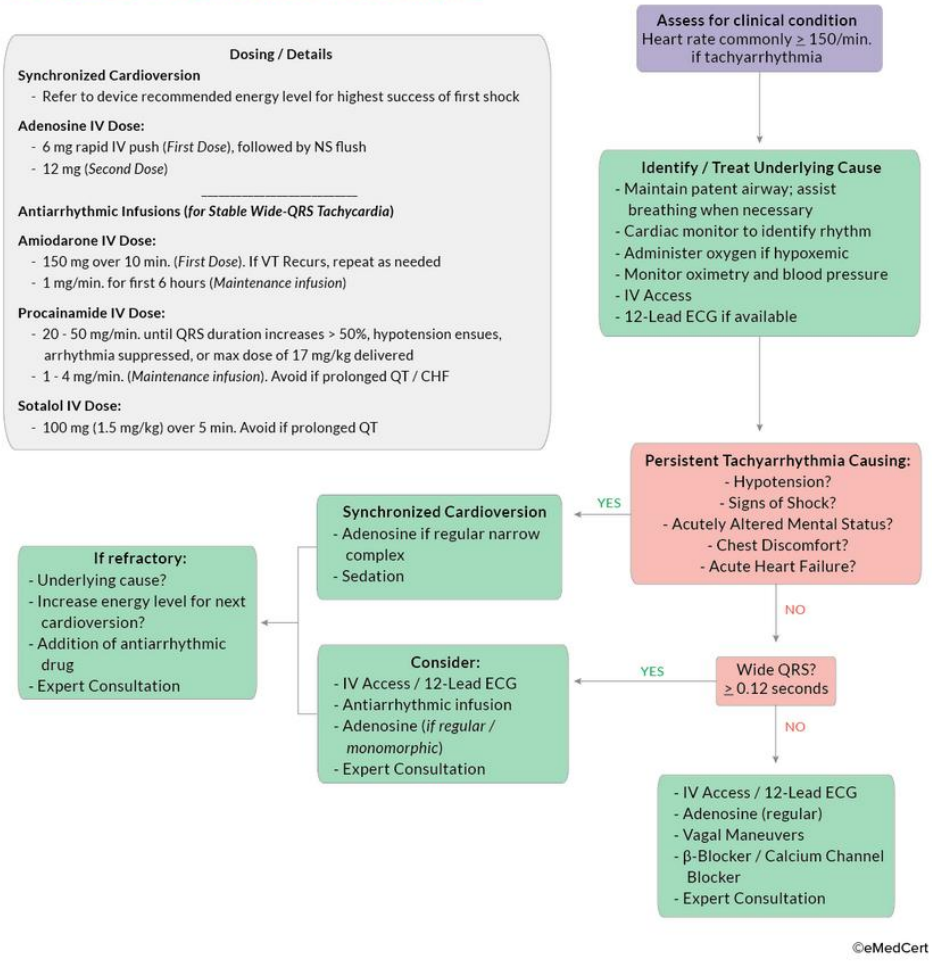
ACS Algorithm



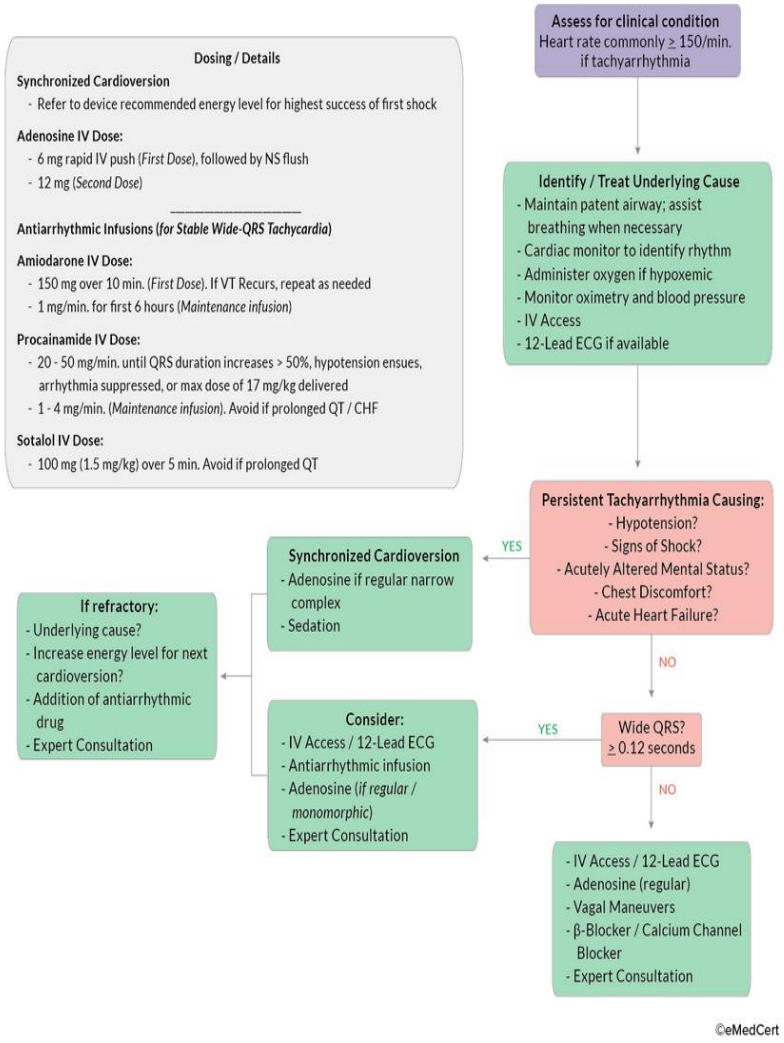
3.4 CARDIAC DYSRHYTHMIAS

3.4.1 Tachycardia - Refer to ACLS

UNSTABLE TACHYCARDIA ALGORITHM

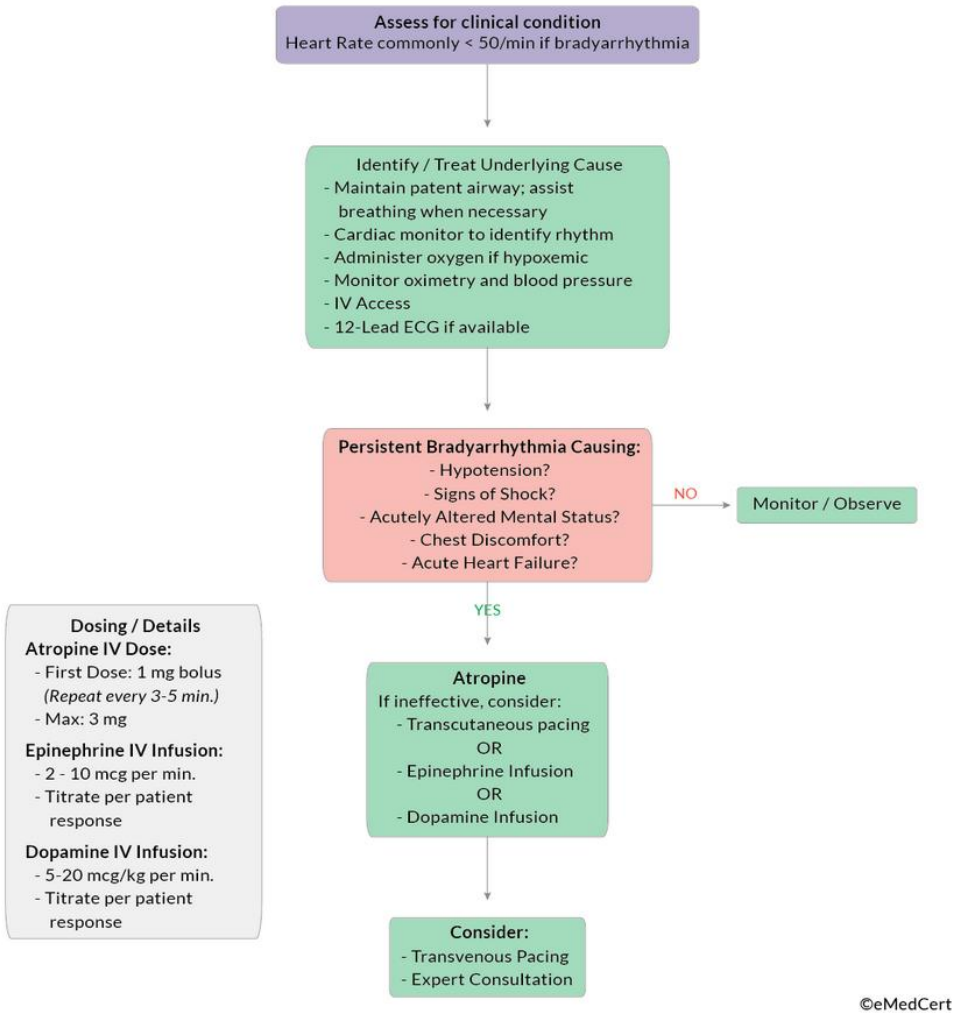


STABLE TACHYCARDIA ALGORITHM



3.4.2 Bradycardia - Refer to ACLS

BRADYCARDIA ALGORITHM



3.5 CARDIAC ARREST

3.5.1 **Refer to Maine EMS Protocol (Red 7 – 11).**

3.5.2 **With ROSC and compromised neurological function, consider** CCTTP 3.7 Targeted temperature Management.

3.5.3 **Termination of Resuscitation**

- Maine EMS (Termination of Resuscitation: Red 13-14)
- Maine EMS (Termination of Resuscitation for Traumatic Cardiac Arrest: Green 22)
- Refer to CCTTP 14.1 Termination of Resuscitation

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CARE IN THE IMMEDIATE POST–ARREST PHASE

IMMEDIATE POST–CARDIAC CARE ALGORITHM

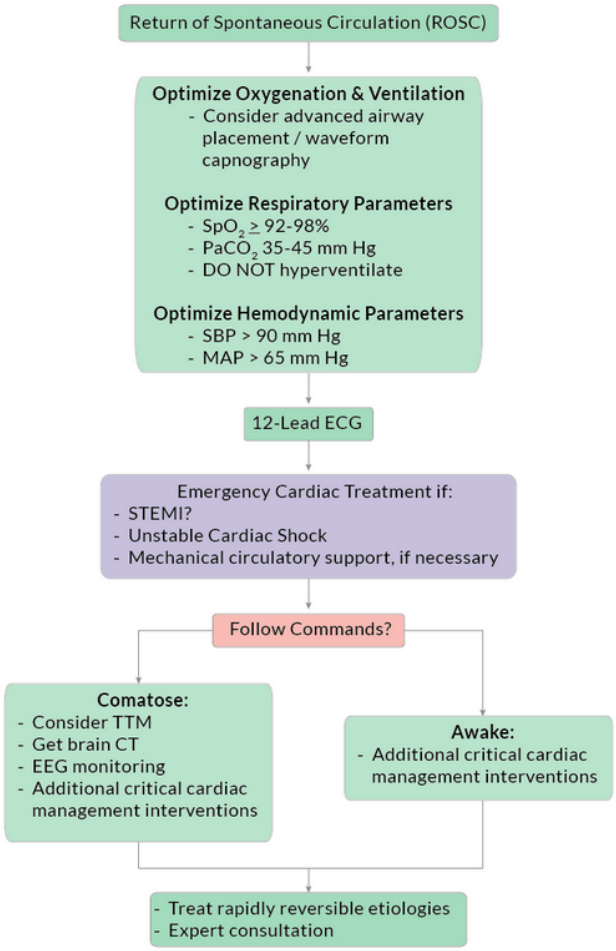
Initial Stabilization Phase
- Begin at 10 - 12 breaths/min, titrate to target $PaCO_2$ (*35 - 45 mm Hg*)
- Titrate FIO_2 to minimum needed to achieve SpO_2 92% - 98%
- Avoid excessive ventilation

Emergent Cardiac Interventions
- 12-Lead ECG
- Consider hemodynamics

TTM
- TTM decisions receive high priority as cardiac interventions
- Begin TTM asap if victim is not following commands
- Start at 32° - 36° C for 24 hours

Ongoing Critical Care Management
- Ongoing monitoring of core temperature
- Maintain normoxia, normocapnia, euglycemia
- Deliver lung-protective ventilation
- Continuous / intermittent EEG monitoring

Reversible Causes
- Hypoxia
- Hypovolemia
- Hydrogen Ions (*Acidosis*)
- Hyper- / Hypokalemia
- Hypothermia
- Toxins
- Tamponade (*Cardiac*)
- Thrombosis (*Pulmonary Embolus*)
- Tension Pneumothorax
- Thrombosis (*Acute Coronary Syndrome*)



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If arrest is suspected to be ONLY traumatic in nature, refer to CCTTP 6.10 Acute resuscitation of the unstable trauma patient

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CARDIAC

Adult Cardiac Arrest Algorithm

For VF / Pulseless VT cases, providers should utilize the right side of the Cardiac Arrest Algorithm *(above)*, and should proceed through the VF / pVT steps *(Steps B – K)*.

CPR Quality
- Push hard (≥ 2 in.) and fast (≥ 100 - 120 per min.)
- Allow complete chest recoil, and reduce interruptions between compressions
- Avoid over-ventilation
- If no advanced airway, 30:2 compression - to - ventilation ratio
- Quantitative Waveform Capnography
  - If $PETCO_2$ < 10 mm Hg, try to improve CPR Quality

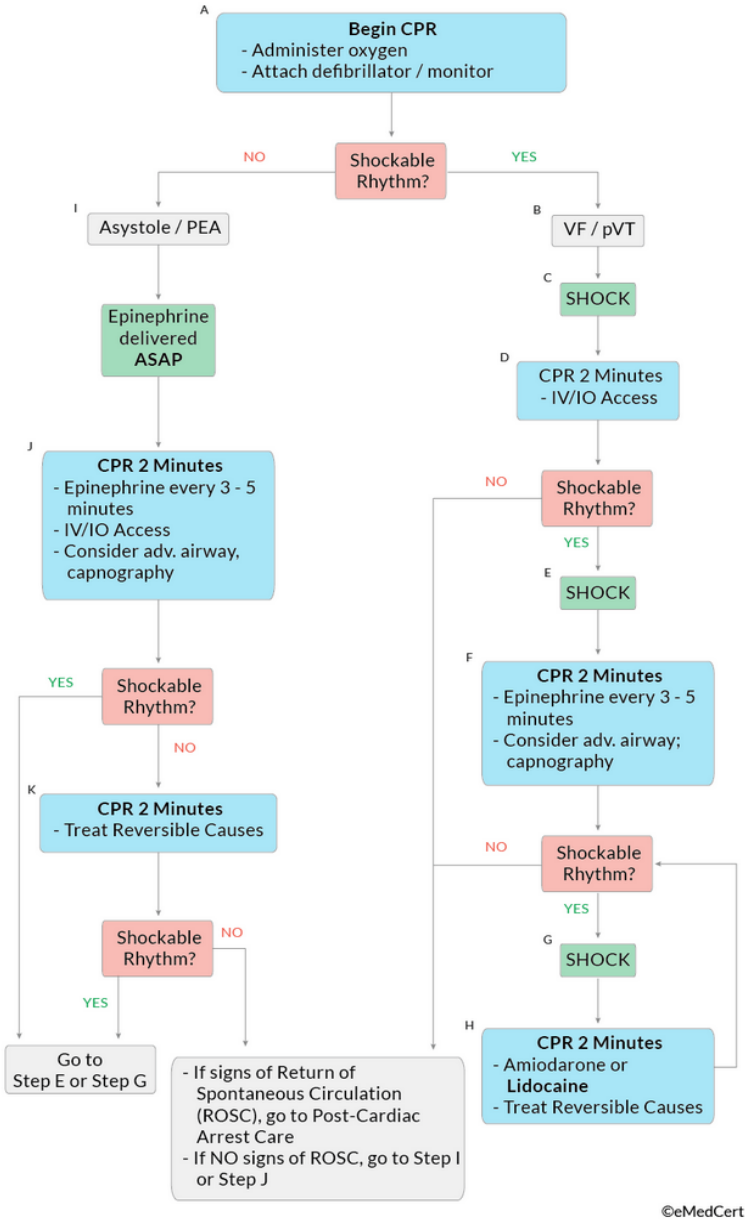
Advanced Airway
- Endotracheal intubation or Supraglottic Advanced Airway
- Waveform capnography to confirm / monitor ET Tube placement
- 10 breaths/min. with continuous chest compressions

Shock Energy
- **Biphasic:** Use manufacturer recommendation (i.e. 100 - 200 J initial dose); If unknown, use max accessible. Second / subsequent doses should be equivalent, higher doses may be considered.
- **Monophasic:** 360 J

CPR Drug Therapy
- **Amiodarone IV/IO Dose:** First dose: 300 mg bolus Second dose: 150 mg
- **Epinephrine IV/IO Dose:** 1 mg every 3 - 5 mins.

ROSC
- Blood pressure (BP) and pulse
- Spontaneous arterial pressure waves with intra-arterial monitoring
- Sudden continuous increase in $PETCO_2$ (commonly ≥ 40 mm Hg)

Reversible Causes
- Hypoxia
- Hypovolemia
- Hydrogen Ions (Acidosis)
- Hyper- / Hypokalemia
- Hypothermia
- Toxins
- Tamponade (Cardiac)
- Thrombosis (Pulmonary Embolus)
- Tension Pneumothorax
- Thrombosis (Acute Coronary Syndrome)



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3.6 ATRIAL FIBRILLATION AND ATRIAL FLUTTER

3.6.1 Indications:

Successful treatment of the rapid heart rate by stabilizing the abnormal heart rhythm through therapeutic interventions.

3.6.2 Pearls and Pitfalls:

Obtain a 12-lead EKG to confirm the presence of atrial fibrillation or atrial flutter and document ventricular rate (and if applicable, atrial rate if indicated).
Obtain past pertinent medical history (Atrial fibrillation, atrial flutter, Wolff-Parkinson-White Syndrome, COPD, or CHF).
The rapid heart rate is considered "unstable" when it is accompanied with chest pain, dyspnea, diaphoresis, nausea and vomiting, or hemodynamically compromised vital signs.
Consider and evaluate for the clinical pathology causing the abnormal rhythm (i.e. cardiac, sepsis, or trauma) **PRIOR** to slowing the heart rate with medications.

3.6.3 Clinical Management:

Manage airway, breathing, and circulation.
Administer supplemental oxygen to maintain SpO_2 > 95%.
Begin cardiac, pulse oximetry, and blood pressure monitoring. Consider hands-free, multi-function pads to patient's chest. There may indication to proceed directly to cardioversion if patient becomes unstable.
Establish IV access of NS or LR at KVO rate.
If patient is symptomatic with stable hemodynamics (SBP > 110), choose **one** of the following:

Diltiazem

Caution in patients with history of known or suspected Wolff-Parkinson-White (WPW Syndrome) and in patients with congestive heart failure (CHF).
0.25 mg/kg to a MAXimum of 20 mg IV/IO push over 2 minutes.
If not effective in 15 minutes, give a second dose of 0.35 mg/kg MAX of 25 mg) IV/IO.
If still NOT effective, begin **Diltiazem infusion** at 5-15 mg/hr
Add **Diltiazem** 125 mg (25 mL) to 100 mL NS, final concentration 1mg/mL

Metoprolol

Caution / avoid with patients in CHF, COPD / Asthma, heart block, valvular failure, cocaine use, or with HR < 50 or systolic BP < 90 mmHg.
5 mg IV/IO push over 2 minutes.
May repeat x 2 every 5 minutes for a total of 15 mg; goal is to obtain an optimal heart rate of 50-60 BPM.

Amiodarone

Consider if QRS duration is greater than 0.12 Sec.
Mix 150mg in 50 mL NS and administer IV over 10 minutes.
If conversion successful, initiate **Amiodarone infusion**.

Mix for concentration of 1.8 mg/mL (90 mg/50 mL, 180 mg/100 mL, etc.) and initiate infusion at 1 mg/min with inline 0.2 Micron filter, noting exact time and report total dose to receiving facility staff.

Note: If there is concern around the etiology of the atrial fibrillation or atrial flutter, consider discussing with involved providers.

If patient is unstable (systolic BP < 90 mmHg, altered LOC, severe chest pain, pulmonary edema):
Perform synchronized cardioversion per CCTTP 3.4.1 and AHA Guidelines
Consider sedation or analgesia per CCTTP 4.12 ANALGESIA for the patient without an advanced airway or CCTTP 4.13 Sedation and anxiolysis for the patient without an advanced airway.

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3.7 FTARGETED TEMPERATURE MANAGEMENT (TTM)

3.7.1 **Indications:**

Increased brain temperature contributes to ischemic brain damage in patients post cardiac arrest. Studies have shown that preventing a fever after return or circulation (ROSC) minimizes ischemic damage rather than aggressive therapeutic hypothermia.
TTM protocols have contributed to improved neurological outcomes. There is new data demonstrating improved outcomes with early initiation of targeted temperature management, but there is no evidence that improved outcomes occur with out-of-hospital initiation.

3.7.2 **Patient Inclusion Criteria:**

Age 18+ (less than 18, consult Pediatric Intensivist).
Cardiac arrest from any malignant arrhythmia and ROSC.
Has *persistent* altered mentation and is unable to follow commands.
Due to persistent AMS or other mitigating factors, these patients are intubated with mechanical ventilation.
SBP can be maintained at 90 mmHg or greater, spontaneously or with fluids, vasopressors, and/or inotropes.
Less than six (6) hours since ROSC and less than or equal to one hour of resuscitation time.
Less than 15 minutes from collapse to CPR. (If time unknown, err on starting therapeutic hypothermia).

3.7.3 **Relative Patient Exclusion Criteria:**

Continuing significant cardiac arrhythmia or hemodynamic instability.
Evidence of sepsis.
Active severe bleeding.
Coma unrelated to arrest. (i.e. drug overdose).
Recent major surgery or trauma.
DNR or any condition precluding treatment in the opinion of the transferring physician or flight crew.
Pregnancy is NOT an exclusion criterion.

3.7.4 **Clinical Management:**

There is no evidence to support utilization of TTM in the out-of-hospital cardiac arrest patient.
The overriding goal of out-of-hospital transport of cardiac arrest patients is to avoid temperatures more than 37° Celsius.
Discuss with accepting providers and institution about the initiation of therapeutic cooling.
Evaluate and record neurologic status prior to initiation of sedatives and paralytics if possible.
If a provider is unavailable, initiate cooling as early as possible. Temp goal is 33-36° Celsius.
Sedate and paralyze the patient as per CCTTP 2.5 Post Intubation Sedation, Pain Control & Muscle Relaxants. Suppress shivering with neuromuscular blockade.
If the team can continue the initiation of hypothermia treatment or the patient is febrile, apply ice packs to patients' neck, axilla and inguinal area after patient is sedated and paralyzed.
If patient is shivering, increase sedative and/or analgesia dose prior to increasing paralytic.

Monitor temperature via esophageal, rectal, or Foley temperature probe as time and mission allow.
During care, if the patient's temperature becomes less than 33° Celsius, remove ice packs and cover patient to reduce further drop in temperature.
Consider turning on aircraft AC to assist with cooling en route.
Report to receiving tertiary center.

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3.8 NON-TRAUMATIC AORTIC DISSECTION

3.8.1 Indications:

Aortic dissection begins with the formation of a tear in the aortic intima that directly exposes an underlying medial layer to the driving force (pulse pressure) of the intraluminal blood. There are two types of aortic dissections:

Stanford Type A:

Involves the ascending aorta and/or aortic arch, and possibly the descending aorta. The tear can originate in the ascending aorta, the aortic arch, or, more rarely, in the descending aorta.

It includes DeBakey types I and II. It requires emergent surgical repair.

Stanford Type B:

Involves the descending aorta or the arch (distal to the left subclavian artery), without involvement of the ascending aorta.

It includes DeBakey type III. It is typically managed medically until surgical complications arise.

3.8.2 Pearls, Pitfalls, and Considerations:

Aortic dissection may present as an acute stroke or AMI.

Clinical Pearl: "Chest pain + 1," or "1 + Chest pain."

Achieve maximal control of luminal flow with initial heart rate control and then subsequent BP management.

3.8.3 Clinical Management:

Rapidly assess and obtain history to include known trauma, infection, congenital condition, hypertension, atherosclerosis, and onset of pain.

Assessment is to include primary and secondary surveys, blood pressure in both upper and lower extremities, and distal pulses must be assessed in all 4 extremities.

Place at least two large bore IV lines. If unable to obtain IV access, consider the placement of an Intraosseous line (I/O) or having a provider place a central line.

Place patient on monitor and have patient on continuous heart, respiratory, pulse oximetry, and end tidal CO_2 monitoring.

Provide appropriate pain and anxiolysis per CCTTP 4.12 Analgesia for the Patient Without an Advanced Airway and 4.13Anxiolysis and Sedation for the Patient Without an Advanced Airway.

Obtain all laboratory and imaging reports from sending facility (Including CD's of diagnostic imaging if the imaging has not been sent electronically).

EKG's should be completed on all dissections as well.

Prior to transport, attempt to view chest x-ray. Note size of mediastinum and evaluate for apical capping.

Identify or consider obtaining INR:

If > 1.4, contact receiving clinician for options of Liquid Plasma, Vitamin K (phytonadione), or K-Centra (4-Factor Prothrombin Complex Concentrate).

Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.

Blood pressures should be completed every five (5) minutes during transport. Decisions around blood pressure management should be based upon the higher blood pressure that is recorded (i.e. treat the higher blood pressure).
Consider placement of arterial line to monitor blood pressure continuously.
Consider utilizing ultrasound to assess great vessels and determine presence of pericardial effusion.
Assess for new heart murmurs.

3.8.4 **Blood Pressure Management:**

Hypotensive patient:
Titrate fluids to keep systolic BP at 90, or that which maintains cerebral perfusion.
Consider Liquid Plasma or PRBC's. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
Consider vasopressors if hypotension has not responded to fluids and colloids.
If HR > 70 and SBP < 90, contact receiving clinician for rate control options.
Hypertensive patient:
Consider aggressive analgesia and anxiolysis prior to progressing to antihypertensives.
Use **Esmolol** to achieve HR 50-70 beats per minute.
If the patient's BP remains elevated, consider **Nicardipine** (or other agent) to achieve target SBP.
Refer to CCTTP 4.10 Hypertensive emergencies.

3.8.5 **Patients with Concurrent Myocardial Infarction Confirmed by EKG analysis:**

Complete EKG.
Initiate appropriate blood pressure management based upon noted vital signs. If patient is hypotensive, refer to CCTTP 4.9 Refractory hypotension and shock.
If patient is hypertensive, refer to CCTTP 4.10 Hypertensive emergencies.
Avoid thrombolytics, NSAIDS, aspirin, heparin as well as platelet inhibitors (i.e. clopidogrel and ticagrelor).
Consult immediately with receiving physician team and transport to appropriate destination.

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3.9 THORACIC AND ABDOMINAL AORTIC ANEURYSMS

3.9.1 Indications:

An aortic aneurysm can develop anywhere in the ascending, descending, arch, or thoraco-abdominal area of the aorta. However, most abdominal aortic aneurysms are commonly located below the renal arteries.

3.9.2 Pearls, Pitfalls, and Considerations:

A distending abdomen, absence of distal pulses, mottled and/or cyanotic distal extremities, accompanies severe hypotension from a ruptured aneurysm.
The patient may have a history of severe abdominal pain without evidence of rupture.
The use of permissive hypotension has benefits in the survival of this complicated disease process during transport to a definitive-care facility.
Unless otherwise specified by the receiving clinician, titrate BP to a systolic of 80 to 90 and/or a MAP of 60.

3.9.3 Clinical Management:

Rapidly assess and obtain history to include known trauma, infection, congenital condition, hypertension, atherosclerosis, known aneurysm, and onset of pain.
Assessment is to include primary and secondary surveys as well as blood pressures and distal pulses in all four extremities.
Avoid aggressive abdominal examinations.
Syncope and back pain are key findings.
Assess airway, breathing, and circulation. Maintain adequate airway and ventilation. If the patient has any alteration in mental status or level of consciousness, consider advanced airway placement per CCTTP 2.1 Airway Management.
Consider utilizing ultrasound to assess great vessels.
If the patient has spontaneous respirations, provide supplemental oxygen to maintain oxygen saturations greater than 93%.
Obtain two large bore peripheral IV's.
Monitor patient's hemodynamic status, including continuous pulse oximetry, heart rate, and respiratory status including end tidal CO_2 monitoring as applicable.
Alert the receiving hospital for imminent surgery.
Titrate fluids to keep systolic blood pressure to approximately 90 mmHg systolic, or a blood pressure that maintains cerebral perfusion based upon GCS and mental status.
Consider need for colloids and resuscitate with PRBC's or Liquid Plasma.
Consider placement of arterial line.
Consider obtaining INR and a Type and Screen prior to leaving sending facility (or at least have it drawn).
If the patient demonstrates evidence of hypovolemic shock, refer to CCTTP 4.9 Refractory hypotension and shock.
Initial resuscitation should focus on fluid and blood administration with goal blood pressure as noted above.

If providing packed red blood cells, refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
If the patient remains hypotensive despite fluid and blood administration, refer to CCTTP 4.9 Refractory hypotension and shock. If the patient is anti-coagulated and/or has an INR > 1.4, consider emergent anti-coagulation reversal in consultation with accepting physician. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
Provide appropriate pain and anxiolysis per protocols. Refer to CCTTP 4.12 Analgesia for the Patient Without an Advanced Airway and CCTTP 4.13 Anxiolysis and Sedation for the Patient Without an Advanced Airway.
If the patient is hypertensive:
Consider aggressive analgesia and anxiolysis prior to progressing to anti-hypertensives.
Priority should be focused on systolic blood pressure control over that of the HR.
Use Nicardipine to achieve target SBP 90-100 and/or a MAP of 60.
If hypertension persists, contact receiving clinician for other options. Refer to CCTTP 4.10 Hypertensive emergencies.

3.9.4 **Overall Management and Communication with Receiving Physician:**

A ruptured abdominal aortic aneurysm is a time-critical diagnosis requiring immediate operative repair. The flight team is to ensure that scene times are minimized. Provide effective communication to ensure receiving facility is aware of diagnosis.
Determination for the need for direct admission to the operating room must be made and communicated with Medical Control as soon as possible.

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3.10 MECHANICAL CIRCULATORY SUPPORT CHECKLIST

3.10.1 **Note: This guideline is not designed to determine the appropriate use of ECMO, IABP, LVAD, Tandem Heart or Impella devices, rather its function is to aid the critical care transport team to ensure all logistics have been addressed prior to transport.**

3.10.2 **Critical Care Transport Equipment**

Mechanical ventilator with appropriate tubing.
Cardiac monitor with adjuncts to continuously monitor venous and arterial pressures.
Designated equipment bag that holds components for cardiac and hemodynamic monitoring (i.e., transducers, cables, and O-rings, etc.).
Medication bag as well as narcotic pouch with sufficient amount of medications for the entire trip.
Appropriate number of pumps (with appropriate number of supplies) or functioning alternative for use in transport environment.
Power strip.
Securing straps as indicated depending on mode of transport.
Extra O-rings.
As applicable:
Pacemaker.
Intra-aortic balloon pump with adequate supply of helium (note tank level prior to departure).
Ambulance should have its own generator in order to power the appropriate equipment.
Prepared Blood Products in cooler
One to two units of packed red blood cells and plasma as per standard protocol. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
Cross-matched PRBC (appropriate for distance of transport) packed in cooler (minimum of one unit) if there is concern for ongoing bleeding.
Platelets in cooler if count <100 or evidence ongoing bleeding.
Liquid plasma (LP) if INR >1.4 or evidence of ongoing bleeding.
Cryoprecipitate if fibrinogen <150 or evidence of ongoing bleeding.

3.10.3 **Access**

Functional arterial line (radial or femoral access) that is ideally placed in the right upper extremity.
Central Venous Access (Three lumen central line minimum).
Cordis as needed.

Equipment/medication specific to ECMO or other supplemental hemodynamic or ventilatory support.
Identify and have specific familiarity with the device used by the sending hospital.
Protek Duel (RVAD)
Tandem Heart (LVAD)
Tandem Life (ECMO)
If patient is being transported with perfusion from your facility, ensure that the perfusionist has addressed any ECMO circuit incompatibilities with receiving center prior to transport.
Suitable blood pump, centrifugal or roller.
Membrane oxygenator, appropriate for the patient size.
Device(s) for heating and regulating circuit blood temperature (less critical for adult transports).
Medical gas tanks, regulators, hoses, connectors, flow meters, and blenders for provision and adjustment of blended sweep gas to the oxygenator.
I-Stat or other suitable Point of Care anticoagulation monitoring equipment to assess blood gases, electrolytes, hemoglobin, glucose and anticoagulation (e.g., Activated Clotting Time).
Emergency pump or manual control mechanism in the event of primary pump failure or power failure.
Uninterruptable power source(s) capable of meeting the electrical power needs of all equipment during transfer between vehicles and in the event of vehicle power source failure.
If Tandem heart, consult sending team prior to transfer.
If intravenous vasoactive medications – new bag of each medication (appropriate for minimum two to three times transport distance).
If continuous sedation/analgesia/NMB – new bag of each medication (appropriate for minimum two to three times transport distance).
If there are other specific medications that are not outlined in the LFOM specific protocols (i.e. inhaled epoprostenol), ensure that enough of these medications are brought for the length of the transport (appropriate for minimum two to three times transport distance).

3.10.4 **Personnel**

Perfusionist – confirm from sending/receiving. If from sending hospital, confirm will require plan for return if applicable.
Surgeon/ECMO specialist – if accompanying from sending hospital, confirm will require plan for return if applicable.
On arrival of transport team, expectation for conference call with sending attending physician, receiving attending physician, transport team.
Flight team consisting of critical care paramedic and flight nurse.

3.10.5 **Preparation**

Pre/post membrane and systemic blood gas within 30 minutes of initialization of transport.
CBC, PT/ INR, Fibrinogen, CMP within four hours of initialization of transport.
Lactate within two hours of initialization of transport.

3.10.6 Prior to departure

Ensure that all arterial lines, including Swan, are being transduced.
Ensure that all lines, cords, etc. are well secured, will not catch on anything, and have enough slack for loading and securing into the vehicle.
All power cords that need to be plugged in during transport are accessible.
Temperature is being monitored continuously or there is a plan for intermittent checks.
Liter of crystalloid is attached and accessible (for volume/IV push medications).
Impella: spare purge cassette and tubing.
VAD: extra batteries and controller.
IABP: all connections are secure, printer is set to auto, have both batteries and power cord.
ECMO: hand crank, clamps, extra disposables per the direction of the perfusionist.

3.10.7 Logistics of Transport

Face Sheet.
Imaging copied and placed in chart (include CD's if applicable).
ED note, History and Physical, Discharge Summary or other appropriate clinical notes included.
Laboratory Results.
EMTALA form and provider certification form signed.
Completion of Physician Report as well as Nurse-to-Nurse Report.
Appropriate transport notifications (Ground Teams, Ambulance Logistics and Rotor / Fixed Wing details addressed).
Obtain appropriate phone numbers including cell phones to ensure contact if issues arise.
If going by ground: ensure MEDCOMM reminds transporting service to fill ambulance oxygen and to bring a pack rack.
If there is a ground leg prior to receiving hospital: ensure MEDCOMM stresses that a box truck, not a van, be waiting at time of arrival to receiving airport / helipad.
Notify pilot of possibility for a perfusionist/surgeon that will need a return flight.

3.10.8 Assessment and documentation

Swan: depth, PA systolic, PA diastolic, cardiac index, and SVR.
Impella: depth, P-level, flow, RPM, power draw, heparin/dextrose purge rate, and perfusion of insertion limb.
VAD: flow, RPM, power draw, and extra controller has same settings.
IABP: ratio, timing, and perfusion of insertion limb.
ECMO: depth of each cannula, flow, RPM, sweep gas flow, perfusion of insertion limb.
Anticoagulation: medications, lab results, and trends.
Blood sugar: most recent result, trends, and assess for possibility of stopping insulin infusion for transport.
Chest tube: patient tolerance of water seal between room and vehicle, output, air leak
Pacemaker: backup or actively paced, chamber(s) being paced, rate, output, sensitivity

3.10.9 Pearls of Transport of the patient with a MCSD device.

Movement should be co-coordinated by the person in charge of the lines coming from the MCSD, instead of just the person in charge of the ETT.
The ECMO circuit and machine should never rise above the level of the patient.
Keep any MCSD plugged in whenever possible.
Be aware of total power draw during transport in an ambulance.
Patients may have an open chest, where the sternum was not reclosed following cardiac surgery. Care must be taken with straps, and with movement, as the sides of the sternum could lacerate a ventricle or other important anatomy in addition to dislodging the implanted equipment. These patients should never be rolled.
Place the SpO_2 monitor on the right hand for ECMO and the left hand for an IABP.
These patients are often very volume overloaded, so it is common for pharmacy to mix non-standard extra concentrated infusions. Double and triple check your medications.
Don't be alarmed by seemingly insufficient ventilator settings in the setting of ECMO. The role of the oxygenator is to be the primary source of oxygen.

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4 MEDICAL

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4.1 ANAPHYLAXIS AND ALLERGIC REACTIONS

4.1.1 Indications:

Symptoms ranging from urticarial, flushing, itching, and facial edema to respiratory distress, laryngeal edema, hypotension, and irreversible shock occurring in a patient who, within the previous few hours, was exposed to a precipitating medication, insect bite or food.
Attempt to identify cause of reaction (consider blood products, medications or latex) and prevent or eliminate further exposure.
Be prepared for recurrence of allergic signs and symptoms despite initial interventions.

4.1.2 Pearls, Pitfalls and Considerations:

Early, rather than late airway intervention may be required if swelling is rapid.

4.1.3 Clinical Management:

Attempt to identify etiology of antigen exposure.
Assess and maintain adequate airway, breathing, and circulation.
Provide supplemental oxygen to maintain oxygen saturations greater than 92%. Proceed to advanced airway management and intubation if there is potential for airway obstruction or the patient has severe dyspnea.
If there is concern for progression of the allergic reaction, consider establishing intravenous access with two large bore needles (18 gauge or larger) with NS at initial KVO rate.
Mild reaction:
Diphenhydramine (Benadryl) 25-50 mg IV/IM.
Consider **Epinephrine** 0.3mg IM (Concentration1:1000 at 1mg/1ml) in the anterolateral thigh.
In patient with risk of cardiovascular disease, note that there is risk for cardiovascular sequelae with the use of **Epinephrine**.
Methylprednisolone (Solu-Medrol) 125 mg IV/IM every eight (8) hours.
Consider **Albuterol** nebulizer.
Premix of 2.5 mg in 3 mL of NS, repeat as tolerated.
Staff may consider continuous nebulizer of **Albuterol** 7.5 mg/9mL inhaled for severe bronchospasm. Refer to CCTTP 2.8 Acute Bronchospasm.
If patient intubated or there are concerns regarding nebulization as it pertains to aerosol generation, **Albuterol** 8 puffs via MDI.
Consider **Famotidine** 20 mg IV.
Moderate to severe reaction:
In addition to the above medication, continue to monitor for worsening upper airway edema and bronchospasm.
May consider repeating IM **Epinephrine** 0.3mg (Concentration1:1000 at 1mg/1ml) IM every five minutes for two doses and then consider epinephrine infusion as noted if clinical status is worsening.

If there is evidence for worsening respiratory distress or respiratory failure, consider Rapid Sequence Intubation.
Endotracheal Intubation: Pharmacologically assisted or Rapid Sequence Intubation. Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management
If the patient develops worsening hypotension, provide intravenous fluid resuscitation with crystalloids to maintain SBP > 90 mmHg systolic.
If the patient remains hypotensive despite a **total** of 30ml/kg of IV fluid, refer to CCTTP 4.9 Refractory hypotension and shock.
Monitor for signs of pulmonary edema and fluid overload.
Consider Epinephrine infusion.
Start at 0.05 mcg/kg/min. (3.5 mcg/min in a 70kg patient)
Titrate by 0.02-0.05 mcg/kg/min as indicated.
Dose range: Up to 0.5 mcg/kg/min. (35 mcg/min in a 70kg patient) There is no true maximum dose but consider additional agent if the patient is unresponsive to higher doses.
In cases of refractory shock due to severe anaphylaxis, epinephrine infusion is the vasopressor of choice. Doses noted in refractory shock protocol. CCTTP 4.9 Refractory hypotension and shock.

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4.2 DIABETIC EMERGENCIES

4.2.1 Indications:

This protocol addresses patients with complications from diabetes mellitus, including those patients' experiencing hypoglycemia, hyperglycemia, or diabetic ketoacidosis (DKA) as indicated.

4.2.2 Pearls, Pitfalls, and Considerations:

DKA represents a state of disordered metabolism in which the level of hyperglycemia may not fully describe or comport with the other metabolic changes, such as potassium depletion or ketoacidosis.
Repletion of potassium, fluids, and correction of the acidotic state must proceed deliberately and with due regard for the time interval in which this patient has been experiencing this condition.
Overly aggressive administration of insulin, fluids, potassium, and sodium bicarbonate will produce untoward outcomes.
Hyperglycemia from other etiologies other than that of DKA should be ruled out before applying this protocol.
Do not initiate insulin infusion until potassium is 3.3 mEq/L or greater.

4.2.3 Hypoglycemia

Determine serum glucose level with point of care device (I-STAT or Accu-check finger stick).
Obtain adequate IV access with large bore IV (18-gauge or greater) in anticipation of aggressive fluid resuscitation.
Initiate IV fluids with 0.9% Normal Saline initially at TKO rate.
Maintain appropriate hemodynamic status blood pressure with fluid resuscitation as indicated.
Treatment of known diabetic with decreased LOC or patient with altered mental status with hypoglycemia:
Dextrose 25g (50ml of D_{50} or 250ml of D_{10})
If suspected or known ETOH abuse, consider co-administration:
Thiamine 100 mg IV over 5 minutes during the course of treatment.
If unable to obtain access:
Glucagon 1 mg IM.
For pediatric hypoglycemia, refer to CCTTP 11.14 Pediatric Diabetic Emergencies

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4.2.4 Hyperglycemia

If measured glucose level is high or diabetic ketoacidosis is suspected, it is imperative to review lab values (if already obtained, document for chart and receiving facility):
CBC
CMP, Mg, and Phosphorous.
Serum B-hydroxybutyrate (serum ketones).
Venous blood gas.
UA.
Calculate anion gap = (NA-(C1+CO2).
If labs are unavailable, complete VBG and BMP on I-STAT.
If following criteria are met, proceed to CCTTP 4.2.6 Diabetic Ketoacidosis (DKA)
Analyze data:
Identify if whole blood glucose is greater than 200 mg/dl.
Venous pH < 7.3.
Bicarbonate (HCO_3) < 15 mmol/L.
UA demonstrates ketones.
Anion gap greater than 12.
If labs are unobtainable, do not initiate insulin therapy. Consult medical control for additional options.

4.2.5 Hyperglycemia Therapy

If above criteria are not met for DKA or all data has not been obtained as outlined above, discuss with OLMC necessity of therapy.
Normal Saline maintenance therapy can be initiated. In discussion with OLMC, rate can be adjusted based upon diagnosis and hemodynamic stability.

4.2.6 Diabetic Ketoacidosis (DKA Adult Patients)

Meets all criteria as outlined above.
Patient to remain NPO.
Stop insulin pump or other exogenous insulin source.
Intravenous fluids
0.9% Normal Saline (NS)
1000 ml/h x 1h, then 500 ml/h x 2h
After initial infusion of 0.9% NS, repeat BMP to assess for hyponatremia. If Sodium is between 135 and 145, fluid should be changed to 0.45% NS.
500 ml/hr for 2 hours and then maintenance at 200 ml/hr.
IVF should be changed to **D5W 0.45% NS** at 200 ml/hr when serum glucose < 250 mg/dl.
If the patient has a history of heart failure or an alternative diagnosis where fluid overload is a concern, consult OLMC or receiving physician.
Do NOT bolus Insulin intravenous unless ordered by the appropriate provider.
Initiate **Insulin infusion** and adjust rate based upon table below.
Regular Insulin (100 units/ 100 ml 0.9% NS) infusion at 0.1 unit/kg/hr (typically between 6-10 units per hour).

Adjust per DKA protocol as outlined in Table below.
If K < 3.3 mEq/L, MUST initiate potassium replacement before insulin infusion may be started. Refer to CCTTP 4.5.1 Hypokalemia.

Current FSBG (Finger stick blood glucose)	**Change in FSBG (Finger stick blood glucose) from previous value**	**Action**
250mg/dl and above	Increased by 50mg/dl or more	Verify **insulin** infusion is running at prescribed rate and contact prescriber.
250mg/dl and above	Increased by 1-49mg/dl or Decreased by any amount	No change
Below 250mg/dl	Decreased by 100mg/dl or more	Change IV fluid to **D5W/0.45NS** and Decrease **insulin** infusion rate by 50% (1/2) and recheck WBG in 30min. Notify prescriber if FSBG still decreasing
Below 250mg/dl	Decreased by 1-99mg/dl or Increased by any amount	Change IV fluid to **D5W/0.45NS** and No change in **Insulin** drip rate
Below 200mg/dl	Decreased by 60mg/dl or more over the previous TWO hours	Change IV fluid to **D5W/0.45NS** and Decrease **Insulin** infusion rate by 50% (1/2) and call prescriber for changes to insulin rate/IV fluids
Below 200mg/dl	Decreased by 1-59mg/dl over the previous TWO hours Or Increased by any amount	Change IV fluid to **D5/0.45NS** and No change in **Insulin** drip rate
Below 100mg/dl	N/A	Decrease **Insulin** infusion rate by 50% (1/2) and change IV fluid to **D10 / 0.45NS** at current rate. Call prescriber to re-evaluate **insulin/IV** fluids.

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Do NOT stop **Insulin infusion** UNTIL all 3 criteria met:
Anion gap is < 12.
Serum CO_2 (Bicarbonate) is greater than or equal to 20.
Long-acting insulin has been administered.
Potassium replacement for patients in Diabetic Ketoacidosis (DKA).
Patients experiencing hypokalemia without concurrent diagnosis of DKA, refer to CCTTP 4.5.1 Hypokalemia.
Infuse potassium replacement CONCURRENTLY with insulin. However, before an insulin infusion can be started, the potassium must be at least 3.3 mEq or above

Potassium Replacement in Diabetic Ketoacidosis.

Serum Potassium	**Treatment**
K+ > 5	Add **Insulin**
K+ between 4 and 5	Infuse **KCl** at 10mEq/h IV x 2 (over an hour each)
K+ between 3 and 4	Infuse **KCl** at 10mEq/h IV x 3 (over an hour each)
K+ < 3.0	Infuse **KCl** at 10mEq/h IV x 4 (over an hour each)

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Sodium Bicarbonate 8.4%:
The administration of intravenous sodium bicarbonate remains controversial.
Consider contacting receiving physician for any of the following for direction:
pH is < 7.1.
HCO_3 < 5.
K+ > 6.5
ECG changes
Decreased MAP refractory to fluid administration and vasopressor use.
Consideration of IV bolus dosing will be completed under advisement from on-line medical control or receiving clinician.
Contact receiving clinician for any of the following:
Euglycemia is achieved.
Anion gap < 12.
Potassium has normalized.

Typically, the administration of sodium bicarbonate is a bolus followed by an infusion.

4.3 GASTROINTESTINAL BLEEDING

4.3.1 Indications:

Patients who present with the loss of blood in either the upper or lower tract.
Patient may present with mild anemia to severe hypovolemic shock.

4.3.2 Pearls, Pitfalls, and Considerations:

"Coffee ground" emesis or hematemesis suggests a proximal lesion, and hematochezia or melena suggests a distal lesion.
History of medication, alcohol use, and anticoagulants should be elicited.
Octreotide has been shown to be an effective bridge to endoscopy in patients suffering from upper GI bleeding (variceal or otherwise) and in those patients with known suspected or known liver disease. Octreotide is also appropriate in patients suffering from GI hemorrhage of unknown origin.
Pantoprazole bolus has been identified as equivalent in treatment when compared to continuous infusion.

4.3.3 Clinical Management:

Assess and monitor airway, breathing, and circulation.
If patient has adequate spontaneous respirations, administer supplemental oxygen to maintain saturation greater than 92%.
Monitor cardiac functions (EKG, B/P, Pulse and RR) and O_2 saturations.
Establish TWO large bore IV's of Normal Saline at a TKO rate.
Treat for hypovolemic shock as appropriate.
Use permissive hypotension strategy.
Maintain MAP of 60-65.
Initiate resuscitation with blood products prior to using vasopressor therapy or large amounts of crystalloid infusion. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
If patient has continued hypotension, refer to CCTTP 4.9 Refractory hypotension and shock.
Consider taking additional uncrossmatched packed red blood cells and Liquid Plasma from Northern Light or CMMC prior to launching, if patient has sustained major blood loss.
Identify a completed INR, type and screen, and hematocrit **prior** to transport. If these values have not been completed, consider obtaining I-STAT hemoglobin/hematocrit with every patient.
If patient has supratherapeutic INR, consider discussion of anticoagulation reversal with accepting physician, including **Vitamin K**, **Liquid Plasma** or **Prothrombin Complex Concentrate** (CCTTP 10.4 Rapid reversal of coagulopathy and CCTTP 10.1 Packed red blood cells and liquid plasma).
NG tubes are NOT contraindicated in patients vomiting bright red blood or with confirmed esophageal/gastric varices that have recently bled. Avoid over-vigorous suction to avoid mucosal irritation.
Currently, the literature does not support the use of Tranexamic Acid (TXA) in the setting of GI hemorrhage since the time of injury cannot typically be ascertained with certainty.

Consider initiation of somatostatin analogues in patients with uncontrolled upper GI hemorrhage or in patients in whom the source of gastrointestinal bleeding cannot be identified.
Octreotide dosing:
IV bolus: 50 mcg in 100 ml over 20 minutes. May repeat bolus in first hour if hemorrhage is not controlled.
After bolus, initiate continuous IV fusion of 25-50 mcg/hour (specifically indicated in end-stage liver disease with esophageal varices, but should be used for all significant bleeds).
Consider Proton Pump Inhibitor (PPI) administration for undifferentiated gastrointestinal bleeding:
Pantoprazole 80 mg IV bolus every 12 hours.
If balloon tamponade (i.e. Blakemore tube) is necessary, endotracheal intubation should be completed prior to its placement to prevent airway obstruction during transport. Discuss the option with providers directly involved in patient care.

Patients with a history of liver cirrhosis and esophageal varices:
Consider the use of **Vasopressin**:
Contact the receiving clinician for the initiation of 0.2 to 0.4 units per minute (12-24 units/hr)

- Note: This dose is higher than that for refractory shock dose and there is controversy around its use.

Consider the use of 1g of ceftriaxone IV every 24 hoiurs.

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4.4 SEPSIS

4.4.1 **Indications:**

To identify those patients with septic shock.
Septic shock is defined as a clinical diagnosis of sepsis with profound compromise at the cellular and circulatory system level leading to a higher risk of morbidity and mortality.
Patients with septic shock are defined by having:
A vasopressor requirement to maintain a mean arterial pressure (MAP) of 65mm Hg or greater.
AND
A serum lactate of greater than 2.0 mmol/L.
The "surviving sepsis" campaign of 2012 has focused on early aggressive therapy to combat the sequelae associated with severe septic shock. This campaign has evolved and updated as literature and research results have improved.
Once identified, blood cultures and appropriate antibiotic therapy and resuscitation MUST occur within 60 minutes of presentation. Refer to Reference Guide for antibiotic therapy choice guidelines.

4.4.2 **Pearls, Pitfalls, and Considerations:**

Once identified, septic shock must be treated with aggressive crystalloid infusion to maintain urine output of greater than 0.5 ml/kg/hr, a lactate less than 2.0 mmol/L and a CVP of 12-15 if available. Blood cultures and antibiotic therapy MUST occur prior to transport.

4.4.3 **Clinical Management:**

Assess airway, breathing, and circulation. Maintain adequate airway and ventilation. If the patient has any alteration in mental status, consider advanced airway placement per CCTTP 2.2 Endotracheal Intubation.
Given the debate of the use of **Etomidate** in the setting of sepsis due to adrenal suppression, Ketamine should be considered as an **equivalent** induction agent in the setting of rapid sequence intubation.
If the patient has spontaneous respirations, provide supplemental oxygen to maintain oxygen saturations greater than 92%.
Obtain at least two large bore peripheral IV's. If IV access is not possible, proceed to an I/O or request sending providers to place central line catheter.
Place patient on cardiac monitor.
Continue to monitor patient's hemodynamic status, including continuous pulse oximetry, heart rate, and respiratory status.
Obtain core temperature (rectally, if possible). If a foley catheter is to be placed, please use temperature sensing equipment.
If central venous access is available, monitor Central Venous Pressure (CVP).
Prior to departure from sending facility:
Obtain blood cultures prior to the administration of antibiotics.
Ensure that the administration of broad-spectrum antibiotics has occurred prior to transfer.

Fluid bolus of 30 ml/kg of Lactated Ringers for hypotension and/or lactate greater than or equal to 2.0 mmol/L.
There is a small subset of patients who may require additional fluid boluses prior to vasopressor administration.
Clinical judgment must be utilized, including the use of ultrasound (RUSH exam), urine output and other markers of resuscitation. Additionally, if there are comorbid factors that prevent standard IV Fluid resuscitation, these should be documented as well.

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Vasopressor therapy in Sepsis:
If the patient's hemodynamic status does not improve with crystalloid infusion, or the patient's lactate remains greater than 4.0 mmol/L, refer to CCTTP 4.9 Refractory hypotension and shock.
Vasopressor therapy initially to target a mean arterial pressure (MAP) of 65mmHg, refer to CCTTP 4.9 Refractory hypotension and shock.
Norepinephrine is the vasopressor of choice.
Epinephrine can be substituted or potentially be used as an additional agent if needed to maintain adequate blood pressure.
Vasopressin 0.03 units/minute (1.8 units/hr) can be added to **norepinephrine** (NE) with intent of either raising MAP or decreasing norepinephrine use. (**Vasopressin** is a fixed dose medication and is typically not titrated). It should not be used as a single agent.
Dopamine should only be used as a second line vasopressor agent to **norepinephrine** only in highly selected patients. (i.e. patients with low risk of tachyarrhythmia's and absolute or relative bradycardia).
Phenylephrine is not recommended in the treatment of septic shock.
Cardiac output is known to be high and blood pressure persistently compromised.
As salvage therapy when combined inotrope/vasopressor drugs and low-dose vasopressin have failed to achieve MAP target, a trial of **Dobutamine** infusion can be administered or added to vasopressor (if in use) in the presence of:
Myocardial dysfunction as suggested by elevated cardiac filling pressures and low cardiac output.
Ongoing signs of hypoperfusion, despite achieving adequate intravascular volume and low adequate MAP.
If using vasopressor therapy, it is recommended that an arterial line be placed as soon as feasible.
If the patient remains hypotensive despite aggressive fluid resuscitation and vasopressor use, consider the administration of **Hydrocortisone (Solu-Cortef)** 100mg IV (from sending hospital).
If the patient is noted to have a hemoglobin of less than or equal to 7.0, initiate packed red blood cell infusion. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma for target levels of 7.0 to 9.0g/dl.
Monitor blood glucose q 12 hours.
If glucose is greater than 180 mg/dl, refer to CCTTP 4.2 Diabetic Emergencies for aggressive control of hyperglycemia
Contact receiving physician for option of **Sodium Bicarbonate 8.4% 50mEq over 3-5 minutes** if pH is less than 7.1. There is very limited indication for its use.

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4.5 ELECTROLYTE DERANGEMENTS: HYPOKALEMIA

4.5.1 **Indications:**

Any patient with serum Potassium ≤ 3.2 with suspicion that electrolyte abnormality is contributory to patient's clinical condition.

4.5.2 **Potassium Administration Procedure:**

There is limited efficacy of oral potassium in the setting of critical illness.
Verify that the patient meets criteria for urine output and serum creatinine level.
Generally, the patient's urine output should be more than 20 ml/hr for at least two (2) hours before using this protocol.
The patient's serum creatinine level should be ≤ 2.0 before using this protocol, unless otherwise ordered by the physician.
Consider obtaining a concurrent magnesium level in the setting of hypokalemia.
If a serum K+ is ≤ 3.5, infuse KCL in concentrations no greater than:
20 mEq/50 ml D5W (or NS if indicated) for central lines.
10 mEq/100 ml D5W (or NS if indicated) for peripheral lines according to the following scale per hour.
NEVER ADMINISTER KCL IV PUSH: It could cause BRADYCARDIA, VENTRICULAR FIBRILLATION and ARREST.

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4.5.3 **For Central Lines:**

SERUM K+	**KCL DOSE**	**TOTAL**
≤ 2.5 mEq/L	20mEq KCL q1hr x 5	100mEq
2.6 – 3.0 mEq/L	20mEq KCL q1hr x 4	80mEq
3.1 – 3.5 mEq/L	20mEq KCL q1hr x 3	60mEq

4.5.4 **For Peripheral Lines:**

SERUM K+	**KCL DOSE**	TOTAL
≤ 2.5 mEq/L	10mEq KCL q 1hr x 10	100mEq
2.6-3.0 mEq/L	10mEq KCL q 1hr x 8	80mEq
3.1-3.5 mEq/L	10mEq KCL q1hr x 6	60 mEq

4.6 ELECTROLYTE DERANGEMENTS: HYPERKALEMIA

4.6.1 Indications:

To emergently treat hyperkalemia which can be due to:
Decreased or impaired potassium excretion (i.e. acute or chronic renal failure).
Addition of potassium into extracellular space, (i.e. meds, rhabdomyolysis and hemolysis).
Transmembrane shifts (i.e. acidosis and medication effects).
Factitious hyperkalemia (i.e. improper blood collection or lab error).

4.6.2 Pearls, Pitfalls, and Considerations:

The presence of typical EKG changes or any rapid rise in serum potassium indicates that hyperkalemia is potentially life threatening and warrants immediate treatment.
Succinylcholine should be avoided in patients exhibiting a serum potassium above 5.5 mEq/L.
Substitute magnesium sulfate in place of calcium in the presence of digoxin-toxic cardiac arrhythmias as noted below.

4.6.3 Hyperkalemia is defined as a potassium level greater than 5.5mEq/L. Ranges are as follows:

5.5-6.0mEq/L – mild condition.
6.1-7.0mEq/L – moderate condition.
7.1mEq/L and greater – severe condition.

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4.6.4 Possible EKG Findings:

Serum potassium	Typical ECG appearance	Possible ECG abnormalities
Mild (5.5–6.5 mEq/L)		Peaked T waves Prolonged PR segment
Moderate (6.5–8.0 mEq/L)		Loss of P wave Prolonged QRS complex ST-segment elevation Ectopic beats and escape rhythms
Severe (>8.0 mEq/L)		Progressive widening of QRS complex Sine wave Ventricular fibrillation Asystole Axis deviations Bundle branch blocks Fascicular blocks

4.6.5 **Clinical Management:**

Repeat any potassium level ≥ 5.5 mEq/L prior to treatment unless patient is hemodynamically unstable.
If IFT, request sending facility to confirm prior to LOM arrival; otherwise use ISTAT device.
Monitor serum potassium by ISTAT every 20-30 minutes after starting treatment for hyperkalemia.
Perform continuous EKG monitoring with vital signs documented every five (5) minutes or appropriate interval.
If the hyperkalemia is severe (potassium > 7.0mEq/L) or the patient is symptomatic, begin treatment before investigation of the underlying cause.
Avoid **Calcium** if digoxin toxicity is suspected.
Magnesium Sulfate (2gm IV over 5 min) may be used alternatively, for digoxin-toxic cardiac arrhythmias.
Individualized treatment to the patient (i.e. if the hyperkalemia is not severe, the patient may only need furosemide to enhance elimination).

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Summary of treatment of hyperkalemia.

Therapy	Dosing	Onset of Effect	Duration of Effect
Calcium Gluconate	2.0 grams over 10 mins IV Peds – 100 mg /kg over two mins	1 to 3 mins	30 to 60 mins
Sodium Bicarbonate	1 mEq/kg IV Bolus Peds – 1-2 mEq/kg/dose Max Dose is 100 mEq IV	5 to 10 mins	60 to 120 mins
Insulin plus Dextrose Ratio: 1 unit of regular insulin to 2.5g of IV dextrose.	10 units of regular insulin IV Peds: 0.1 unit per kg to a max of 10 units IV Plus 25g of Dextrose in 50 ml IV Peds: 0.5 to 1.0 g/kg IV to a max of 25g	30 minutes	4 to 6 hours May defer additional dextrose if BG > 250mg/dl
Albuterol	Nebulized: 10 to 20mg over 15 mins. Peds: 2.5mg nebulized if less than 25kg. 5.0mg nebulized if greater than 25kg.	15 minutes	15 to 90 minutes
Furosemide (with physician direction only)	20 to 80mg IV bolus	With onset of diuresis.	Until diuretic effect ends.

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4.6.6 **Treatment:**

Mild (5.5-6.0 mEq/L)
Cardiac monitor and repeat K+ enroute.
If patient is HYPERVOLEMIC, hypertensive, and has normal renal function, contact receiving physician or medical director for option of **furosemide.**
Moderate (6.0-7.0 mEq/L) without EKG changes:
The above treatments (dosages noted above) and administer **Insulin and Dextrose** IV (may defer Dextrose if glucose > 250)
Severe (> 7.0 mEq/L) or Moderate (6.0-7.0 mEq/L) with EKG changes:
The above treatments (dosages noted above):
Administer nebulized **Albuterol** 10-20 mg over an hour (60 mins.).
If patient intubated or there are concerns regarding nebulization as it pertains to aerosol generation, **Albuterol** 8 puffs via MDI.
Administer **Sodium Bicarbonate**, 50 mEq IVP for a single dose.
Administer **Calcium Gluconate**, 2.0 grams over 10 minutes IV.
If there is a central line, (not I/O) 1.0 grams (an amp) of Calcium Chloride (CaCl) can be given alternatively IV.
Consider the use of Furosemide 20 to 80mg IV with consultation with provider.
Special Situations:
If the patient progresses to ***cardiac arrest***, give the following early in your resuscitation efforts.
Calcium Gluconate: 60mg/kg IV to max single dose of 3g over 1 minute, may repeat in 10 minutes.
Sodium Bicarbonate: 1-2 mEq/kg IV to max single dose of 50mEq over 1-2 minutes. May repeat in 10 minutes.
Acute renal failure:
Arrange for dialysis.
Patients with chronic renal failure on dialysis tolerate higher than normal potassium levels.
Communicate with receiving facility to expedite process.

4.7 ELECTROLYTE DERANGEMENTS: HYPOCALCEMIA

4.7.1 **Indications:**

Any symptomatic patient presenting with an iCal value below 1.0.
Normal iCal is 1.19 to 1.29.
Be watchful for neurologic changes (Tetany, Chvostek's sign, etc.)
Patients with elevated K+ CCTTP 4.6 Patients with electrolyte derangements: Hyperkalemia.
Symptomatic magnesium overdose.

4.7.2 **Pearls, Pitfalls and Considerations:**

Monitoring of iCal levels are of increased importance in patients receiving blood transfusions due to the citric acid preservative used in banked blood binding to calcium.
Low calcium levels can exacerbate bleeding.

4.7.3 **Clinical Management**

In patients receiving large amounts of banked blood products, venous of arterial ionized calcium levels will be monitored via iStat.

If indicated, administer **Calcium Gluconate 1 Gram over 10 minutes.**

Monitor for dysrhythmias and hypotension.

Recheck ionized calcium every 30 min during infusion.

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4.8 ELECTROLYTE DERANGEMENTS: MAGNESIUM DERANGEMENTS

4.8.1 **Indications:**

Any patients for whom electrolyte replacement therapy have been initiated by the referring institution.

4.8.2 **Magnesium Administration Procedure:**

The patient's urine output should be ≥ 20 ml/hr for at least two (2) hours before using this protocol, unless otherwise ordered by the physician.
Cardiac monitoring is required during administration of IV magnesium to digitalized patients due to the risk of heart block.
IV magnesium mixture is not to be concentrated more than 1 gm/100 ml.
Administer the magnesium at a rate no greater than 500 mg/hr in patients who use digoxin, due to the risk of heart block.
Hypotension can occur from rapid administration. During administration of IV magnesium, monitor BP at least every 15 minutes for the duration of the infusion.
Magnesium sulfate is available in varying strengths for parenteral administration. Solutions should be carefully checked to verify that correct dosage is being administered.
To make a 10% solution from a 50% solution:
Take 4 ml 50% magnesium and dilute with 16 ml D_5W or 0.9%NS. The resulting concentration is 2 grams magnesium/20 ml (or 100 mg/ml).
Serum magnesium repletion:
Magnesium should not be administered intravenously at rates greater than 125 mg/min except when administering for pre-eclampsia or for prevention of pre-term labor.
Magnesium is contraindicated in patients with myocardial infarction or heart block as it may slow cardiac conduction.
Because of the CNS effects of magnesium, there may be interactions between magnesium and barbiturates, narcotics, hypnotics, or system anesthetics.
Treatment of hypomagnesaemia depends on the degree of deficiency and the clinical effects. Oral replacement is appropriate for mild symptoms, while IV replacement is indicated for severe clinical effects.
Most patients with symptomatic hypomagnesaemia and normal renal function, with an estimated deficit of 1-2mEq/kg should receive 1mEq/kg of magnesium sulfate for the first 24 hours as a continuous IV infusion.
If cardiac dysrhythmias or seizures are present, infuse 1-2g magnesium sulfate IV infusion over 15 minutes for loading dose. Contact provider for continuous infusion.

4.9 REFRACTORY SHOCK AND HYPOTENSION

4.9.1 Indications:

The LOM Provider will institute measures necessary for the stabilization and maintenance of ventilation and circulation in patients exhibiting signs and symptoms of shock.

4.9.2 Pearls, Pitfalls and Considerations:

If available, a Swan-Ganz catheter has been useful in the past for evaluating shock. If in place, document that the balloon wedges and the position of the catheter. Always transduce the PA pressure to ensure proper catheter position. Occasionally, a PA diastolic pressure can be used to approximate CVP.

Vasopressin and **Epinephrine** can cause constriction of coronary vasculature which may lead to cardiac ischemia.

It is hypothesized that vasopressin can be used with a pH below 7.15 and may work in the late stages of shock secondary to the depletion of the body's intrinsic chemical.

Phenylephrine raises SVR/Afterload without any beta stimulus which may contribute to left ventricular workload.

A vasopressor/inotrope strategy that has been initiated prior to LOM arrival, which is proving effective and is physiologically appropriate, may be continued or modified at the discretion of the LOM team (in consultation with involved providers).

4.9.3 Clinical Management:

Consider placing a radial arterial line as soon as practicable. Titrate vasopressors and inotropes to MAP of 65.

Assess airway, breathing, and circulation.

Administer high-flow oxygen and begin continuous hemodynamic monitoring with cardiac monitor, non-invasive blood pressure monitoring, oxygen and end-tidal CO2 monitoring.

Establish two large bore IV's. In the setting of an inter-facility flight, if the patient has a central line, establish if the line is in the appropriate location and is patent.

If possible, determine shock etiology.

Ascertain patient's hydration status.

PCWP below 6.0.

Urine output.

CVP of 8.

Respirophasic pulse pressure variation via arterial line.

Consider RUSH ultrasound exam for IVC collapse if trained.

If the patient is not hydrated adequately, consider aggressive, but appropriate, fluid rehydration.

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4.9.4 **Shock and Other Altered Hemodynamic States:**

Phenylephrine infusions are designed to be continued after the initiation of vasopressor therapy by a sending institution but can be used as additional pressor therapy when other pressors are contraindicated (i.e. uncontrolled tachycardia or dysrhythmias). Please refer to the notes from the protocols as outlined below.

4.9.5 **Distributive Shock (Septic, Neurogenic, Anaphylactic: SVR Below 800)**

Initiate rapid crystalloid fluid administration up to 30 ml/kg. Monitor for respiratory distress. Treat with appropriate protocol that addresses specific etiology of shock in conjunction with this protocol.

Therapies can include the following:

If transient hypotension is suspected, or a bridge to definitive therapy or infusion is required, consider push-dose Epinephrine or Phenylephrine described below in CCTTP 4.9.9. Transient Hypotension "Push-Dose Epinephrine or Phenylephrine"

Norepinephrine: If above not effective.

0.05-0.6 mcg/kg/min as indicated.

There is no true maximum dose, but consider additional agent one titration has reached 0.3 mcg/kg/min.

Vasopressin: If above not effective

0.03 units/min (1.8 units/hr).

It is important to note that typically Vasopressin is held at a fixed rate and is not titrated but can be seen at doses ranging from 0.01-0.04 units/min.

Epinephrine: If no response to any of the above, **Epinephrine**

0.05-0.5 mcg/kg/min titrated for effect.

Phenylephrine: Consider for uncontrolled tachycardia or dysrhythmias

10-180 mcg/min

4.9.6 **Cardiogenic Shock: (CO below 3.5/CI below 2.0):**

Treat any rate/arrhythmia issue with appropriate LOM protocol. Refer to Section 3 Cardiovascular protocols.

CCTTP 3.4 Cardiac dysrhythmias.

If known volume issue or in case of RVMI, aggressively fluid-hydrate patient.

Therapies can include:

If transient hypotension is suspected, or a bridge to definitive therapy or infusion is required, consider push-dose Epinephrine or Phenylephrine described below in CCTTP 4.9.9. Transient Hypotension "Push-Dose Epinephrine or Phenylephrine."

Norepinephrine:

0.05-0.6 mcg/kg/min as indicated.

There is no true maximum dose, but consider additional agent one titration has reached 0.3 mcg/kg/min.

Dobutamine: If above not effective

5-20 mcg/kg/min to further increase CO/CI without reducing filling time and increasing tachycardia.

Epinephrine: If no response to any of the above, **Epinephrine**
0.05-0.5 mcg/kg/min titrated for effect.
Phenylephrine: Consider for uncontrolled tachycardia or dysrhythmias
10-180 mcg/min titrated for effect.
Dopamine is the last adjunctive therapy that should be used for both chronotropy and inotropy.
2-20 mcg/kg/min IV.

4.9.7 **Hypovolemic Shock:**

Stop bleeding. Utilize direct pressure and deploy tourniquet as needed.
It is reasonable to defer crystalloids and initiate colloids if obvious or suspected blood loss exists.
Initiate judicious fluid challenge with NS up to 30 ml/kg. Target MAP of 60-65 and SBP of 80-90mmHg.
Refer to CCTTP 10.1 Packed red blood cells and liquid plasma for blood product administration considerations.
If clinically indicated, consider Tranexamic acid (TXA), refer to CCTTP 10.2 Tranexamic acid.
If no response to above and treatments in CCTTP 6.10 Acute resuscitation of the unstable trauma patient are being completed simultaneously, or if transient hypotension is suspected, or if a bridge to definitive therapy or infusion is required, consider push-dose Epinephrine or Phenylephrine described below in CCTTP 4.9.9. Transient Hypotension "Push-Dose Epinephrine or Phenylephrine."
Norepinephrine:
0.05-0.6 mcg/kg/min as indicated.
There is no true maximum dose, but consider additional agent one titration has reached 0.3 mcg/kg/min.

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4.9.8 **Shock of Indeterminate Etiology (Hypotensive without a clear etiology)**

Rapid administration of isotonic fluid at 30 ml/kg.
Vasopressor therapy can include:
If transient hypotension is suspected, or a bridge to definitive therapy or infusion is required, consider push-dose Epinephrine or Phenylephrine described below in CCTTP 4.9.9. Transient Hypotension "Push-Dose Epinephrine or Phenylephrine."
Norepinephrine:
0.05-0.6 mcg/kg/min as indicated.
There is no true maximum dose, but consider additional agent one titration has reached 0.3 mcg/kg/min.
Vasopressin: If above not effective
0.03 units/min (1.8 units/hr).
It is important to note that typically Vasopressin is held at a fixed rate and is not titrated but can be seen at doses ranging from 0.01-0.04 units/min.
Epinephrine: If no response to any of the above, **Epinephrine**
0.05-0.5 mcg/kg/min titrated for effect
Phenylephrine: Consider for uncontrolled tachycardia or dysrhythmias.

10-180 mcg/min titrated for effect.

4.9.9 **Transient Hypotension "Push-Dose Epinephrine or Phenylephrine":**

There are two types of Push-Dose Vasopressor Therapy from which a provider can choose:
Phenylephrine (Pre-filled syringe).
Epinephrine (mixed in a syringe by provider at bedside).
Utilize pre-filled syringe, if available, or see mixing guide below.
Adults: "**Push-dose Neosynephrine.**"
50-200mcg IV q 2-5 mins to goal BP.
Ideally, limit use to up to 2 administrations while concurrent titratable vasopressor is prepared.
"**Push-dose Neosynephrine**" **mixing guide** if pre-filled syringe not available
Add 10mg of Neosynephrine to 100mL NS for concentration of 100 mcg/mL.
Adults: "**Push-dose Epinephrine**"
5-10 mcg q 2-5 mins to goal BP.
Ideally, limit use to up to 2 administrations while concurrent titratable vasopressor is prepared.
"**Push-dose Epinephrine**" **mixing guide.**
Utilizing 10 ml saline syringe, eject 1 ml (total of 9 ml of saline remaining in syringe).
Utilizing the saline syringe, with 9 ml remaining, and a three-way stopcock, withdraw 1 ml of the 0.1 mg/ml (1:10,000). "Cardiac" epinephrine into the syringe (total of 10 ml of volume in syringe).
This will make a solution of 0.01 mg/ml (10 mcg/ml) in the syringe. The syringe should be labeled prior to utilization.
Preparation of the syringe should only be performed after patient contact and recognition of need. Once prepared, the syringe may only be utilized for that one patient and may not be saved.

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4.10 HYPERTENSIVE EMERGENCIES

4.10.1 Indications:

The LOM provider will institute measures necessary for the stabilization and maintenance of ventilation and circulation in patients exhibiting signs and symptoms of hypertensive crisis.

4.10.2 Pearls, Pitfalls and Considerations:

A hypertensive emergency occurs as a result of either an acute or chronic elevation in blood pressure resulting in significant end organ dysfunction.
Critical systems affected include central, cardiac, neurologic, and renal.
It is imperative that the provider elicit a complete history; including history of the current complaint, past medical history, and suspected or confirmed current diagnosis.
Evaluate for other etiologies of hypertension including pain and anxiety.
Refer to CCTTP 4.12 and 4.13 for Analgesia and Anxiolysis or Sedation.

4.10.3 Clinical Management:

Assess and monitor airway, breathing and circulation.
If patient has adequate spontaneous respirations, administer supplemental oxygen to maintain saturation greater than 92%.
Monitor cardiac functions (EKG, BP, Pulse, and RR) and O_2 saturations.
Establish two large bore IV's of Normal Saline TKO.
Titrate medications below to targets outlined in individual protocols for non-traumatic CVA, Non-traumatic subarachnoid hemorrhage aortic dissection or aneurysm.

4.10.4 Appropriate protocols:

CCTTP: 5.1 Ischemic cerebrovascular accidents and transient ischemic attacks.
CCTTP: 5.2 Non-traumatic subarachnoid hemorrhage.
CCTTP: 3.8 Aortic emergencies.
CCTTP: 3.9 Aortic aneurysms.

4.10.5 Medications Commonly Used and Encountered Include (In Alphabetical Order):

If HR > 60 and preferentially for aortic dissection
Esmolol (Brevibloc) Premixed 2500 mg/250 ml (10,000 mcg/ml).
Loading dose 1 mg/kg to MAX of 80 mg over 30 seconds.
Initiate infusion at 150 mcg/kg/min.
Titrate by 50 mcg/kg/min to desired HR of 60-70 and a MAX of 300 mcg/kg/min.
If HR drops below 60, reduce **Esmolol** infusion.
If hypertension persists, add additional antihypertensive (**Nicardipine** infusion as below).
Use extreme caution in asthmatics, diabetics, impaired renal function, or patients with a history of hypotension and CAD.
May cause arrhythmia, angina, MI, or death if stopped abruptly. May cause hypoglycemia and mask the symptoms.
If HR < 60 and preferentially for aortic aneurysms and CVA's

Nicardipine (Cardene) Mix 25 mg/250 ml.
Initiate infusion 2.5 mg/hr.
Consider increasing infusion at 5–10 minute intervals.
Increase infusion 2.5 mg/hr.
MAX dose 15 mg/hr.
Once desired BP is achieved, consider incremental dose reduction to lowest rate possible while still achieving desired SBP parameters. Typically, this can be achieved at 3 mg/hr.
If hypertension persists, contact receiving clinician for other options.
Others you may encounter:
Clevidipine.
No loading dose.
Initial infusion at 1-2 mg/hr. Titrate 1-2 mg/hr q 5-10 minutes for desired therapeutic effect.
Typical dose range is 4-6 mg/hr.
Max dose 16 mg/hr.
May be given through peripheral intravenous access.
Hydralazine 10-20 mg slow IV push
May be given through peripheral intravenous access.
Labetalol 10 mg slow IV push.
May repeat 10-20 mg IV q 10 minutes up to 200 mg until adequate BP is reached.
May be given through peripheral intravenous access.
Nitroprusside Start infusion at 0.5 mcg/kg/min.
The infusion can be increased by 0.5 mcg/kg/min every 5 minutes until desired BP is reached or max dose of 10 mcg/kg/min.
Do NOT use in the setting of intracranial pathology.
Nitroprusside must be covered because sunlight will break down this medication into cyanide.
Check for blue discoloration in liquid prior to initiation of therapy. If there is significant color change, discard product.

4.11 THROMBOLYTIC THERAPY MONITORING

4.11.1 ******Note: These guidelines are obtained directly from the American Heart Association/American Stroke Association (AHA/ASA) and the manufacturer.**

4.11.2 **Activase (alteplase or tPA).**

General Indications for Therapy: Ischemic Cerebral Vascular Accident
Part 1 During tPA therapy infusion:
Perform neurologic assessment.
The use of a stroke rating scale, preferably the NIHS Score, is recommended.
Repeat every 15 minutes during the 1-hour infusion to monitor for neurologic deterioration.
Check for major and/or minor bleeding.
All body secretions should be monitored for occult blood.
Major bleeding: intracranial, retroperitoneal, gastrointestinal, or genitourinary hemorrhages
Minor bleeding: gums, venipuncture sites, hematuria, hemoptysis, skin hematomas, or ecchymosis.
Arterial and venous punctures should be minimized and checked frequently.
Monitor blood pressure every 15 minutes during the 1-hour infusion.
Blood pressure should be monitored frequently and controlled during and after tPA administration (systolic blood pressure < 180mmHg and diastolic blood pressure < 110mmHg)
Administer antihypertensive medications to maintain blood pressure at or below these levels as described in CCTTP 4.10 Hypertensive emergencies.
Maintain patient's head at 30°.
Maintain NPO (nothing by mouth) during transfer.
Discontinue infusion and notify receiving facility if the patient develops severe headache, acute hypertension, nausea or vomiting, or has worsening of neurologic examination.
Monitor of signs of orolingual angioedema
If angioedema is noted, promptly institute appropriate therapy.
Refer to CCTTP 4.1 Anaphylaxis and Allergic Reactions.
Consider discontinuing tPA infusion with consultation with receiving service.
Part 2. Post tPA therapy:
Continue to monitor for neurologic deterioration.
Complete neurological exam every 15 minutes for the first hour after the infusion is stopped.
Complete exam every 30 minutes for the next six (6) hours.
If the patient is still in the care of the transporting team, a neurological exam should be completed hourly from the eighth post infusion hour until 24 hours after the infusion is stopped.
Continue to check for major and/or minor bleeding.
Continue to monitor and control blood pressure.
Every 15 minutes for the first hour after the infusion is stopped.
Continue to monitor for signs of orolingual angioedema.

4.11.3**Tenecteplase (TNK) Therapy.**

Indications for therapy:
ST-Elevation Myocardial Infarction (STEMI).
Massive pulmonary embolism with hemodynamic instability.
Acute Ischemic Cerebral Vascular Accident (CVA).
Post fibrinolysis reassessment and monitoring.
Vital signs: Completed every 15 minutes for the first hours and then every 30 minutes for the next four hours thereafter.
A concurrent neurological assessment hourly should be completed at the same time frame as hemodynamic monitoring.
Continuous cardiac monitoring until transfer is completed at the acute care hospital as reperfusion arrhythmias may occur.
Defibrillator and treatments should be immediately available. Transcutaneous pads should be always in place for those patients experiencing a myocardial infarction.
Repeat a 12-lead EKG at 60 and 90 minutes post-TNK administration to assess reperfusion. If the patient reports worsening pain, palpitations, or resolution, a 12-lead EKG should be immediately completed.

- Note: A routine EKG for follow up should not delay transfer unless the patient is experiencing new signs or symptoms.

Patient should be on bed rest.
Avoid IM injections or unnecessary disturbance of the patient (e.g. automatic blood pressure cuff).

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4.12 ANALGESIA IN THE PATIENT WITHOUT AN ADVANCED AIRWAY

4.12.1 Indications:

Any patient with pain due to injury or illness.
Pain is a subjective symptom in which the patient exhibits a feeling of distress and discomfort caused by stimulation of certain nerve endings related to their illness/injury.

4.12.2 Clinical Management:

Manage pain aggressively.
Titration over brief time periods is preferable to hourly, interval dosing as a means of achieving patient comfort.
Remain alert to complications and side effects.
Maintain adequate airway, breathing and circulation.
Administer O_2 as indicated to maintain oxygen saturations greater than 92%.
Monitor hemodynamics including pulse, blood pressure, respiratory rate, end-tidal CO_2 and oxygen saturation.
Assess and document a patient's level of pain.
Upon patient contact.
At least every 10 minutes to coincide with the assessment and documentation of patient vital signs.
After any intervention that is performed to relieve pain. Pain shall be documented in the patient chart where the numerical pain value is to be charted.
Assess patient for reports of pain using an objective scale:
Numerical scale such as 1 to 10.
Wong-Baker FACES scale as developmentally appropriate.
In cases where a patient is unable to verbalize their pain, a pain assessment tool such as the Adult nonverbal pain scale should be used.

4.12.3 Consider non-opioid analgesia option

Acetaminophen IV: 12.5 mg/kg to MAX dose of 1000mg over 15 minutes
Doses less than 1000mg (80kg) require infusion pump and should also be administered over 15 minutes.

4.12.4 For Pain NOT relieved by Other Interventions:

Fentanyl Bolus:
Adult 0.5 to 2mcg/kg for MAX 150mcg/dose IV PRN. Titrate to pain control, wakefulness, and airway protection.
Morphine Sulfate Bolus:
Adult: 0.05 mg/kg to 0.1 mg/kg IV to MAX 8mg/dose PRN pain. Titrate to pain control, wakefulness, and airway protection.
Dilaudid Bolus: 0.2-1mg every 1-3 hours PRN
Minimum dose: None
Maximum dose: 1mg/hr

Onset: 5 min. Peak 10-20 min
Duration: 3-4 hours
Have **Naloxone** 0.4 to 2mg IV available to treat respiratory depression (RR < 10 minute) or signs of narcotic overdose.
If patient has been successfully medicated at referring hospital, continue medication enroute.
Nausea
Ondansetron (Zofran) 4 mg IV push. For persistent nausea/vomiting may repeat every 20-30 minutes PRN up to 8 mg IV.
Alternative therapy: Ketamine IV Bolus or Infusion (Dissociative medication)
Contact LOM Medical Direction early for treatment options and subsequent analgesic dosing of Ketamine.
Use with caution in patients with coronary artery disease, hypertension, tachycardia, psychosis, and elevated ICP.
Side effects are not common with low dose **Ketamine** infusions.
Adverse effects that have been reported, typically at higher doses include: hypertension, tachycardia, tremors, tonic-clonic movements, fasciculation, increased intracranial pressure, hypersalivation, vomiting, increased skeletal tone, diplopia, nystagmus, increased intraocular pressure, increased airway resistance, and depression of cough reflex.
Reassure patients (especially non-communicative patients) that they may experience a dream-like feeling.
Infuse through dedicated IV line (when possible) or via the most proximal port of a carrier solution.
Ondansetron 0.1 mg/kg if NOT given within previous 30 minutes
MAX dose 4mg IV.
Ketamine BOLUS
Mix desired dose in 10 ml syringe and administer over 1-2 minutes.
If possible, administer over 1-2 minutes as rapid administration can cause apnea and laryngospasm.
Advise patient to mentally model a pleasant thought.
BOLUS: 0.2mg/kg IV
MAX dose: 25mg IV
May also initiate **Ketamine Infusion** after bolus dose:
INFUSION: 0.05-0.2 mg/kg/hr.
MAX dose: 20mg/hr.
Note: Dissociative doses are usually in excess of 0.5 mg/kg
Emergence Syndrome
If patient does not require any airway management, but becomes agitated during emergence from effects, consider:
Midazolam (Versed)**:** 0.01 mg/kg IV.
MAX dose: 1 mg IV.

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4.13 ANXIOLYSIS AND SEDATION FOR THE PATIENT WITHOUT AN ADVANCED AIRWAY

4.13.1 Indications:

Any non-intubated patient with anxiety or otherwise in need of sedation.

4.13.2 Clinical Management:

Manage sedation needs aggressively.
Titration over brief periods is preferable to hourly interval dosing as a means of reducing anxiety.
Remain alert to complications and side effects.
Evaluate for any underlying medical cause that can be causing the anxiety (i.e. hypoxia, hypoglycemia, toxic ingestion, closed head injury, etc).
Identify changes in vital signs that may indicate that the patient is experiencing anxiety or agitation before significant sequelae occur.
Monitor airway, breathing, and circulation.
Administer O_2 as indicated to maintain oxygen saturations greater than 92%.
Monitor hemodynamics including EKG, pulse, blood pressure, end-tidal CO_2 and O_2 saturation.
Assess and treat pain. Refer to CCTTP 4.12 ANALGESIA for the patient without an advanced airway.

4.13.3 For Anxiety or Agitation Unrelieved by other Interventions, Administer the Following Medications:

For agitation causing acute deterioration or safety hazard, administer:
Midazolam: 0.1 mg/kg to MAX 2mg IV every 5 minutes as needed.
Lorazepam: 0.15 mg/kg to MAX 2mg IV every 15 minutes as needed.
For anxiety unrelieved by benzodiazepines, hemodynamic instability, or concerns for depressing respiratory drive with benzodiazepines.
Contact medical control early for treatment options and subsequent sedative dosing of **Ketamine.**
Ketamine IM: 0.5 mg/kg to MAX 50mg.
Ketamine IV: 0.2mg/kg to MAX 25mg.
If possible, administer over 1-2 minutes as rapid administration can cause apnea and laryngospasm.
Although dissociative doses are usually in excess of 0.5 mg/kg, if patient does not require airway management, but becomes agitated during emergence from effects, consider **Versed:** 0.01mg/kg to MAX 1mg.
If patient has been successfully sedated at referring hospital, continue medication enroute.

4.13.4 If patient is deemed a risk to flight safety and air transport is imperative, they should be sedated, paralyzed, and intubated. Refer to CCTTP 2.2 Endotracheal Intubation.

5 NEUROLOGICAL

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5.1 ISCHEMIC STROKE AND TRANSIENT ISCHEMIC ATTACKS (TIA's)

5.1.1 Indications:

- To identify those patients with ischemic brain dysfunction. Once identified, management should be tailored to blood pressure management and rapid transport to the appropriate receiving center.
- Use either the NIH Stroke Score **OR** the FAST ED stroke score for assessment.

5.1.2 Pearls, Pitfalls, and Considerations:

- Initial evaluation should include the differentiation between stroke and stroke mimics (hypoglycemia, seizures, etc.).
- Subsequent management of intracranial pathology is tailored to the diagnosis. Emergent transport to the most appropriate facility should be completed efficiently.
- In the setting of ischemic stroke without reperfusion, consideration for neurosurgical consultation may be indicated.
- Acute thrombolytic therapy (tPa or TNK) can be initiated in eligible patients who present up to 4.5 hours after the onset of signs and symptoms.
- It is imperative to identify the time "last known well." The time last know well is the time the patient was last seen to be at their baseline neurological functioning and should not be confused with the time patient was found with deficits. This time should be confirmed with a witness and that witnesses information including name and phone number should be provided to the receiving facility to confirm this critical information.

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5.1.3 Clinical Management:

- Assess airway, breathing, and circulation. Maintain adequate airway and ventilation.
- If the patient has spontaneous respirations, provide supplemental oxygen to maintain oxygen saturations 94-99% without persistent hyperoxia.
- For patients ≤ 40 kg, refer to CCTTP 11.14 Pediatric diabetic emergencies. If patient's weight is ≥ 40kg) and the patient's measured glucose level is low (FSBG < 60 mg/dl), provide the following:
  - **Dextrose 50%** 25g IV (50ml of a 50% solution)
    or
  - **Dextrose 10%** 250ml of $D_{10}W$
- If unable to start IV, administer:
  - **Glucagon** 1 mg IM.
- Obtain IV access with two peripheral IV of 0.9% Normal Saline at a TKO rate.
- Obtain vital signs and place patient on monitor, including pulse oximetry and end tidal carbon dioxide as indicated. Complete a neurologic exam, including appropriate stroke score (NIHSS or Cincinnati).

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- If the patient has significant alteration in mental status and cannot adequately protect the airway, consider advanced airway management with rapid sequence intubation. Refer to CCTTP 2.4 Pharmacologically Assisted Endotracheal Intubation.
    - With airway placement, avoid hypotension (SBP of less than or equal to 90 mmHg) and hypoxia ($SP0_2$ of less than 93% and PaO_2 of less than 60). Refer to CCTTP 2.1 Airway Management.
- Elevate head of bed 30°. Minimize noxious stimuli and treat pain aggressively.
- IV fluids:
    - 0.9% Normal Saline at a TKO rate.
    - Consider IV fluid bolus of 500ml of 0.9% NS if patient is hypotensive with a systolic blood pressure of less than 100mmHg OR if the patients stroke signs and symptoms worsen with relative hypotension from the patient's initial baseline.
- If there is suspicion that the patient is anticoagulated, it is imperative to identify the name of the medication and the date/time that the medication was last taken or administered.
    - Obtain INR value in all patients with possible ischemic stroke or TIA.
- If the INR is elevated greater than 1.8, discuss with sending provider and / or receiving center staff to determine appropriate management steps.
    - CCTTP 10.4 Rapid reversal of coagulopathy in non-traumatic ICH.
- Identify nearest appropriate facility and contact stroke team personnel with early activation if possible.
- For scene transports, ONLY manage hypertension if SBP > 220 or DBP > 110 mmHg.
    - **Transport the patient to the nearest hospital with confirmed and available CT imaging.**
    - **Always provide advanced notification.**
    - If there is concern for elevated BP as noted above, contact receiving to discuss management of systolic BP prior to imaging completion.
        - Refer to CCTTP 4.10 Hypertensive Emergencies.
- For inter-facility transports with a confirmed diagnosis of ischemic stroke by CT or MRI imaging, maintain following parameters:
    - **Ischemic stroke not treated with thrombolysis:**
      SBP < 220 and DBP < 110 mmHg unless otherwise directed.
    - **Ischemic stroke post-thrombolysis:**
      SBP <180 and DBP <105 must be strictly maintained.

        - If the patient is hypertensive, refer to CCTTP 4.10 Hypertensive Emergencies.
        - Initial choice of antihypertensive medication includes IV Nicardipine infusion as first line agent. Second line agent is labetalol intravenously.
        - The use of nitroprusside in the setting of intracerebral bleeding or ischemia is contraindicated.

  - Hydralazine is not preferred due to its propensity to cause rapid drops in blood pressure which is known to worsen stroke outcome.
  - Do not drop SBP more than 15% from patient's baseline.
- If the patient is hypotensive with a MAP < 65 mmHg with associated mental status changes, refer to CCTTP 4.9 Refractory Shock and Hypotension.
- Prophylactic anti-epileptics drugs (AED's) are not indicated in ischemic strokes, TIA's or intracerebral bleeding. They may be considered in the setting of SAH. Please consult the accepting attending for option of Levetiracetam (Keppra) or other anti-epileptic (AED) medication.
- If seizures occur, refer to CCTTP 5.3 Seizure Management.
- If the patient received tissue plasminogen activator (tPA) or Tenecteplase (TNK), document time of bolus and time of infusion, physician ordering, and any noted complications. Refer to CCTTP 4.11 Thrombolytic Therapy Monitoring.
- Consider placing arterial line for continuous monitoring of blood pressure.
- If patient has intracranial pressure monitor in place, maintain CPP between 70-100 mmHg.
- If needed, administer sedation per CCTTP 2.5 Post-Intubation sedation, pain control, and muscle relaxants. In the intubated patient, short acting sedating agents such as Propofol are ideal so that the medication can be weaned rapidly for a neuro exam.
- Consider other medications for treatment of specific target organ failure (May require dialogue with the sending/accepting physician or OLMC.)
- If clinical severe neurological deterioration is occurring with signs and symptoms including altered mental status, obtundation, unequal pupils and Cushing's triad (hypertension, bradycardia and irregular respirations), consideration of medications to manage increasing intracranial pressure should be considered.
  - **Hypertonic 3% NS** may be considered if recommended by the receiving physician, however, the efficacy of early prophylactic hyperosmolar therapy for improving outcomes is not well established.
    - 5 mL/kg to **MAXimum of 500mL** over 15 minutes.
  - **Mannitol** (For SBP > 90 and requested by referring physician)
    - 1 g/kg over 15 minutes.
    - Observe closely for hypotension in patients receiving Mannitol.

Note: If the patient continues to demonstrate evidence of intracranial herniation despite giving the first line medication (i.e. mannitol or hypertonic saline), contact receiving clinician for option of giving additional medications on the LifeFlight formulary.

5.2 INTRACRANIAL HEMORRAGE AND NON-TRAUMATIC SUBARAHNOID HEMORRHAGE

5.2.1 Indications:

- To identify those patients with intracranial hemorrhage and non-traumatic subarachnoid hemorrhage. Once identified, management should be tailored to blood pressure management and rapid transport to the appropriate receiving center.

5.2.2 Pearls, Pitfalls, and Considerations:

- Initial evaluation should include the differentiation between stroke and associated mimics (hypoglycemia, seizures, etc.).
  - NIH Stroke Score **OR**
  - FAST ED Stroke Score
- Subsequent management of intracranial pathology is tailored to the diagnosis. Emergent transport to the most appropriate facility should be completed efficiently and swiftly.
- In the setting of hemorrhagic stroke subarachnoid hemorrhage, neurosurgical consultation is recommended.

5.2.3 Clinical Management:

- Assess airway, breathing, and circulation. Maintain adequate airway and ventilation.
- If the patient has spontaneous respirations, provide supplemental oxygen to maintain oxygen saturations greater than 93%.
- For patients ≤ 40 kg, refer to CCTTP 11.14 Pediatric diabetic emergencies. If patient's weight is ≥ 40kg) and the patient's measured glucose level is low (FSBG < 60 mg/dl), provide the following:
  - **Dextrose 50%** 25g IV (50ml of a 50% solution)
    or
  - **Dextrose 10%** 250ml of $D_{10}W$
- If unable to start IV, administer:
  - **Glucagon** 1 mg IM.
- IV of 0.9% Normal Saline at a TKO rate.
- Obtain vital signs and place patient on monitor, including pulse oximetry, and end tidal carbon dioxide as indicated. Complete a neurologic exam, including appropriate stroke score (NIHSS **OR** FAST ED Stroke Score).
- Determine the exact time of onset of signs and symptoms, if possible.
- If the patient has significant alteration in mental status and cannot adequately protect the airway, consider advanced airway management with rapid sequence intubation. Refer to CCTTP 2.4 Pharmacologically assisted rapid assisted airway management.

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- With airway placement, avoid hypotension (SBP of less than or equal to 90 mmHg) and hypoxia (PaO_2 of less than 60). Refer to CCTTP 2.4 Pharmacologically assisted rapid assisted airway management.
- Elevate head of bed 30°. Minimize noxious stimuli and treat pain aggressively to minimize elevated intracranial pressure (ICP).
- IV fluids:
  - 0.9% Normal Saline at a TKO rate.
- If intracranial bleeding is suspected, consider obtaining INR value.
- If the INR is elevated greater than 2.0, contact receiving center staff for option:
  - **Liquid Plasma, Fresh Frozen Plasma, or Prothrombin Complex Concentrate**; refer to CCTTP 10.4 Rapid reversal of coagulopathy in non-traumatic ICH.
  - **Vitamin K (phytonadione)** 5-10 mg IV mixed in 20-100 ml of 0.9% Normal Saline over 30 minutes.
- Identify nearest appropriate facility and contact stroke team personnel with early activation if possible.
- For inter-facility transports with a confirmed diagnosis of stroke by CT or MRI imaging, maintain following parameters:
  - **Intraparenchymal hemorrhage CVA: SBP < 160 and DBP < 100 mmHg.**
  - **Spontaneous non-traumatic SAH: SBP < 140 and DBP < 90 mmHg.**
- If the patient is hypertensive, refer to CCTTP 4.10 Hypertensive Emergencies.
  - Initial choice of antihypertensive medication includes short-acting Nicardipine as first line agent.
  - The use of nitroprusside in the setting of intracerebral bleeding or ischemia is *contraindicated*.
  - Do not drop SBP more than 25% from patient's baseline.
- If the patient is hypotensive with a MAP < 65 mmHg with associated mental status changes, refer to CCTTP 4.9 Refractory Shock and Hypotension
- There is currently a debate in the use of prophylactic anti-epileptic drugs (AED's) in the setting of spontaneous ischemic strokes, TIA's or intracerebral bleeding except in the setting of SAH.
  - Please consult the accepting attending for option of Levetiracetam (Keppra) or other anti-epileptic medications prior to infusion.
- If seizures occur, refer to CCTTP 5.3 Seizure Management.
- Consider placing arterial line for continuous monitoring of blood pressure.
- If patient has intracranial pressure monitor in place, maintain CPP between 70-100 mmHg (with minimum of 60 mmHg).
- If needed, administer sedation per CCTTP 2.5 Post-intubation sedation, pain control, and muscle relaxants. In the intubated patient, short acting agents such as Propofol are ideal.

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- In the setting of SAH, consider Nimodipine 60 mg PR or per gastric tube can be administered if available from the sending facility if the patient is not receiving IV Nicardipine.
- Consider other medications for treatment of specific target organ failure (May require dialogue with the sending/accepting physician or OLMC).
- If clinical severe neurological deterioration is occurring with signs and symptoms including altered mental status, obtundation, unequal pupils and Cushing's triad (hypertension, bradycardia and irregular respirations), consideration of medications to manage increasing intracranial pressure should be considered.
    - **Hypertonic 3% NS** (preferred choice for all patients unless directed by the receiving physician)
        - 5 mL/kg to **MAXimum of 250 mL** over 15 minutes.
    - **Mannitol** (For SBP > 90 and requested by referring physician)
        - 1 g/kg over 15 minutes
        - Observe closely for hypotension in patients receiving Mannitol

        - **Note**: If the patient continues to demonstrate evidence of intracranial herniation despite giving the first line medication (i.e. mannitol or hypertonic saline), contact receiving clinician for option of giving additional medications on the LifeFlight formulary.

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5.3 Seizure Management

5.3.1 Indications:

- Any patient with seizure activity or reported seizures prior to LifeFlight arrival.

5.3.2 Clinical Management:

- Establish and maintain adequate airway, oxygenation, and ventilation.
- Initiate or maintain IV of 0.9 %NS at TKO.
- For patients ≤ 40 kg, refer to CCTTP 11.14 Pediatric diabetic emergencies. If patient's weight is ≥ 40kg) and the patient's measured glucose level is low (FSBG < 60 mg/dl), provide the following:
  - **Dextrose 50%** 25g IV (50ml of a 50% solution)
    or
  - **Dextrose 10%** 250ml of $D_{10}W$
- If unable to start IV, administer:
  - **Glucagon** 1 mg IM.
- Consider **Thiamine** 100 mg IV if suspicion of ETOH abuse.
- If the patient is actively seizing, consider the use of ONE type of benzodiazepine.
  - **Lorazepam** 0.15 mg/kg to MAX 2.0 mg IV push.
    - Repeat twice as needed. Monitor for respiratory depression.
  - **Midazolam** 0.1 mg/kg to MAX 5.0 mg IV push.
    - Repeat twice as needed. Monitor for respiratory depression.
- If patient is unable to protect the airway, refer to CCTTP 2.1 Airway Management.
- If seizures cannot be controlled, administer:
  - **Fosphenytoin**-20 mg PE/kg IV not to exceed 150 mg PE/min,
    - MAX dose 1500 mg PE IV
    - Monitor for cardiac dysrhythmias and associated hypotension.
- **Phenytoin**- 20 mg/kg IV. Infusion rate should be 25 mg/min.
    - MAX dose 1500 mg IV.
    - Monitor for cardiac dysrhythmias and associated hypotension.
- Consider use of **Keppra** for treatment and/or patient has allergy to **fosphenytoin** or continues to have seizures, administer:
- **Keppra** 20 mg/kg IV over 15 minutes
    - MAX of 1 gram
    - Note: There has been controversy noted in the literature regarding the use of **Keppra** in the setting of subarachnoid hemorrhage (traumatic and spontaneous). Consult accepting physician or OLMC for option of this medication.
  - If intubated and BP allows, consider **Propofol.**
    - Bolus 0.1-1 mg/kg

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    - If MAP > 65, infusion with MAX dose 200 mcg/kg/min
- The administration of **Phenobarbital** or **Propofol** infusions have been shown to effectively suppress seizure activity.
    - Consult OLMC or receiving physician for the administration.
    - If staff is directed to administer these medications, endotracheal intubation is usually mandated.
- Refer to CCTTP 2.4 Pharmacologically assisted rapid assisted airway management. Management of seizures post intubation, especially if long-acting neuromuscular blockade is utilized. Refer to CCTTP 2.5 Post-intubation sedation, pain control, and muscle relaxants.
- Once seizures are terminated, examine patient for trauma and treat accordingly. In particular, examine for shoulder dislocation (usually posterior) and intra-oral injury.
- Avoid systolic blood pressures less than 90 mmHg and PaO_2 less than 60.
- If the blood pressure remains below 90 mmHg, consider aggressive fluid resuscitation of 30 ml/kg or subsequent vasopressor therapy use. Refer to CCTTP 4.9 Refractory shock and hypotension.
- Transfer to tertiary capable of managing status epilepticus.

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6 TRAUMA

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6.1 ABDOMINAL AND PELVIC TRAUMA

6.1.1 **Indications:**

Blunt or penetrating injury to the abdomen and fracture to the pelvis. The major immediate complications include the sequelae of hypovolemia and eventually hypovolemic shock if not corrected.

6.1.2 **Clinical Management:**

Complete primary assessment and manage airway, breathing, and circulation.
If indicated, maintain standard spinal precautions.
Control any sources of bleeding identified during this assessment.
Refer to CCTTP 10.17 Hemostatic gauze.
Refer to CCTTP 10.7 Pelvic Binder.
Titrate oxygen accordingly to maintain oxygen saturations greater than 92%. If the patient is intubated, do not wean $Fi0_2$ unless recent arterial blood gas has been completed.
Monitor and treat for hemorrhagic shock as appropriate. Refer to CCTTP 4.9 Refractory hypotension and shock.
Use permissive hypotension strategy as indicated by diagnosis and underlying pathology.
Establish two large bore peripheral IV's of isotonic crystalloid solution to maintain MAP's of 65 or greater. Unless otherwise indicated, do not instill more than one to two liters of crystalloid before moving to appropriate colloid infusion.
If patient is being transported from a community facility, obtain and administer blood products if available as determined by patient condition.
If the patient has had adequate crystalloid volume resuscitation, consider utilizing packed red blood cells and Liquid Plasma as outlined in CCTTP 10.1 Packed red blood cells and liquid plasma.
If the patient has been receiving colloids from a sending facility, it is reasonable to discuss the use of the sending institution's liquid plasma with sending and receiving providers PROVIDED that it does not delay transport to the receiving facility. Otherwise, use that of LifeFlight of Maine to minimize scene time.
Monitor closely for any changes in mental status, vital signs, and/or impending profound shock. Early detection of signs of hemorrhagic shock and appropriate fluid administration can prevent or reduce the degree of shock.
Keep in mind that intravenous volume administration may result in increased bleeding from intra-abdominal sources.
If the source of bleeding is from a non-compressible site, judicious use of fluids may be wise following the standard traumatic resuscitation guidelines.
Provide appropriate analgesia and/or sedation as indicated. Refer to CCTTP 4.12 Analgesia for the patient without a definitive airway and 4.13 Anxiolysis and sedation for the patient without an advanced airway.
If the patient is intubated, refer to CCTTP 2.5 Post-Intubation sedation, pain control, and muscle relaxants.

Assess for varying degrees of abdominal pain during a rapid, but all-inclusive abdominal examination.
Note Kehr's, Cullen's, or Grey Turner's sign.
Spleen and liver injuries may lead to exsanguination immediately following the injury and therefore, specific treatment should focus on hemodynamic status.
IV fluids and/or blood products along with rapid transport should be considered.
Any trauma resulting in hematoma formation to the male or female genitalia should be treated with ice, cold packs, and pressure dressings.
Avoid placement of Foley catheter in setting of severe perineal swelling or blood at the meatus.
When lacerations are present on male genitalia, place wet saline dressings to area. If bleeding of the penis or scrotum is present, pressure dressings should be applied.
Vaginal bleeding should be observed, and a pressure dressing should be applied to the perineum when bleeding is profuse, and from a compressible source.

6.1.3 **Fluid Replacement Requirements:**

Adults in hemorrhagic shock, judicious use of crystalloid (primarily 0.9% Normal saline due to its compatibility with blood products) to maximum of one to two liters.
Examine the abdomen for obvious wounds.
Stabilize any impaled or penetrating object. Refer to CCTTP 6.5 Impaled objects.
If the object cannot be stabilized appropriately, alternate form of transport must be considered if the patient and impaled object cannot fit safely in aircraft.
If there is evidence of eviscerated abdominal contents, examine closely to ensure lack of torsion.
Reduce torsion if noted.
Apply saline-impregnated gauze directly to the site and dry dressing thereafter.
Consider occult intra-abdominal hemorrhage as part of differential diagnoses, especially in the presence of sustained tachycardia in the trauma patient.
E-FAST ultrasound is an appropriate diagnostic if available and does **NOT** delay transport.
Assess for signs of hemorrhagic shock to include, but not limited to a decreased LOC, pale, cool, clammy, diaphoretic skin, pale mucous membranes, delayed or absent capillary refill, distended rigid abdomen, shortness of breath and/or tachypnea, tachycardia and hypotension, unobtainable BP, or a BP that does not respond to fluid administration.
Consider orogastric tube in patients with a definitive airway in place. Patients being transferred from sending facilities who have suspected intestinal injury, gastric distention, or potential for aspiration should have an OG tube. In particular, patients with diaphragmatic rupture, GI tract injuries, and pregnancy should have an OG tube inserted prior to or in transport. For those patients who are awake and do not have a definitive airway in place, consider nasogastric tube as indicated.
Consider Foley catheter if there is no blood observed at urethral meatus. Do not force if insertion is difficult.

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If the patient requires significant colloid resuscitation and is greater than or equal to age 16 years of age, consider the use of Tranexamic acid (TXA). Refer to CCTTP 10.2 Tranexamic acid.

6.1.4 **Pelvic - inspect perineum and buttock area, including anus, for trauma.**

Refer to CCTTP 10.17 Hemostatic Gauze as indicated for hemorrhage control.
If unstable pelvic fracture is suspected, apply pelvic binder (commercial device or sheet wraps). Refer to CCTTP 10.7 Pelvic Binder.
Identify appropriate position of pelvic binder over trochanteric heads.
Avoid repeated assessments by manual compression of an unstable pelvis.
Any large open fractures
Administer **Ceftriaxone** 75 mg/kg to MAX 2 grams IV.
If the patient being transferred during an inter-facility transport, assess, or obtain readings on abdominal films, chest radiograph for signs of free air or intra-abdominal bleeding. Assess for pelvic fractures on films and during complete examination.
Frequent and continuous monitoring of vital signs for developing signs of increasing shock and/or exsanguination.

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6.2 BURNS—MAJOR

6.2.1 **Indications:**

Any patient with chemical, electrical, or thermal burns. Chemical decontamination MUST occur prior to transport.

6.2.2 **Caution/Special Considerations:**

Patients with concurrent multisystem trauma and burns should be transported to the nearest appropriate trauma center for initial stabilization.
For scene flights with patients. Refer to the American Burn Center Transfer Criteria as noted below. Consider immediate transfer these patients to a burn center with the following criteria:

6.2.3

Thermal Burns

- Full-thickness burns
- Partial thickness ≥10% TBSA*
- All potentially deep burns of any size
- Any deep partial or full-thickness burns involving the face, hands, genitalia, feet, perineum, or over any joints
- Patients with burns and other comorbidities
- Patients with concomitant traumatic injuries
- Circumferential injuries
- Poorly controlled pain

Inhalation injury: All patients with a suspected inhalation injury.

Pediatrics (<14 years or <30kg):

- All pediatric burns may benefit from burn center referral due to pain, dressing change needs, rehabilitation, patient/caregiver needs, or non-accidental trauma.

Chemical Injuries: All chemical injuries.

Electrical Injuries:

- All high-voltage (≥1000V) electrical injuries
- Lightning injuries

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Notes:

- Maine Medical Center should also be consulted prior to diversion to Boston Burn Centers.

Consult OLMD for possible direct transport to out of state hospitals.
Of note, superficial (first degree) burns are not included in burn calculations.

6.2.4 Clinical Management:

Stop the burning process and remove all clothing. Thoroughly rinse chemicals off with water, except for powdered chemicals which should be brushed off.
Conduct primary assessment and ensure adequate ABC's.
Any life-threatening problems identified will be immediately treated.
Thorough assessment of respiratory status of patients with facial, neck, and upper torso burns.
Early intubation is often indicated for:
Severe burns of the face and/or neck or in the oropharynx.
History of confinement in burning environment.
Carbon deposits in the oropharynx or nares in conjunction with hoarseness, stridor, or some other tangible evidence of suspicion for airway injury.
Facial and neck edema. Such injuries require prompt intubation or possible cricothyrotomy.
If intubation is required, it must be performed early during care because it may prove to be impossible with the onset of edema after the initiation of fluid replacement.
If the patient is intubated, refer to CCTTP 2.5 Post-Intubation sedation, pain control, and muscle relaxants.
If patient has adequate spontaneous respirations, administer supplemental oxygen to maintain $SpO_2 \geq 95\%$. Consider providing 100% via NRB due to concerns of carbon monoxide poisoning. Refer to CCTTP 7.4 Carbon Monoxide Poisoning or CCTTP 7.3 Patients with suspected cyanide toxicity.
If bronchospasm is present, consider the administration of Albuterol. Refer to CCTTP 2.8 Acute Bronchospasm.
Assess for mechanism of injury and include any potential concerns for trauma and a thorough history around the circumstances surrounding the burn injury.
Treat for signs and symptoms of concurrent significant blood loss and impending hypovolemic shock.
Consider placement of foley catheter for continued monitoring of urine output.
Assess for area and degree of pain.
Assess for circumferential burn injury and distal pulses, motor and sensation to the injury.
Calculate percentage TBSA burned of superficial, partial, and full thickness burns.
In estimating scattered burns, a fairly accurate approximation can be made utilizing the patient's palm to represent 1% of the total BSA and visualizing palm over the burn area. (Refer to CCTTP 6.2.4 Rule of 9's).
Obtain or estimate weight.
Establish a minimum of two large bore IV's, preferably outside burned area. Avoid over-hydration.

Treat pain and anxiety per Refer to CCTTP 4.12 Analgesia for the patient without a definitive airway and CCTTP 4.13 Anxiolysis and sedation for the patient without an advanced airway.
Note: Burn-injured patients frequently require large doses of pain medications.

Fluid Resuscitation:

Burns greater than 20% TBSA are associated with increased capillary permeability and intravascular volume deficits that are most severe in the first 24 hours post-injury. Optimal fluid resuscitation aims to support organ perfusion with the minimal amount of fluid required. Proper fluid management is critical to the survival of patients with extensive burns.

The goal of resuscitation for all burn patients is maintaining tissue perfusion and organ function while avoiding the complications of inadequate or excessive fluid therapy. An understanding of the local and systemic effects of burn injury facilitates patient management in the early post-burn period. The damaging effects of burn shock may be mitigated or prevented by physiologically based early management of patients with major burn injury.

Resuscitation of burns has evolved in the last several years per the American Burn Association. It now based upon type of burn (thermal, inhalation and electrical), population of burn victim (i.e. Adults and Pediatrics) and response to therapies.

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Overall fluid resuscitation principles in burns:

Just in previous iterations of fluid management in burns, it was estimated that one-half of the calculated total 24-hour volume would be administered within the first 8 hours post-burn, calculated from the time of injury and the remainder in the latter 16 hours post burn.

However, in the latest recommendations from the American Burn Association, resuscitation with Lactated Ringers (LR) will be adjusted based upon urinary output and clinical response.

Resuscitation will be adjusted based upon age and type of burn with which the patient presents. Please refer to the noted recommendations below:

Initial Resuscitation:

- In the pre-hospital and early hospital settings, prior to calculating the percent TBSA burned, the following guidelines based on the patient's age are recommended as the INITIAL FLUID RATE as a STARTING POINT in patients with burns clearly >20% TBSA:
    - ≤ 5 years old: 125ml/hr of LR
    - 6-12 years old: 250ml/hr of LR
    - ≥ 13 years old: 500ml/hr of LR

- Once the patient's weight in kg is obtained and the percent second- and third-degree burns is determined in the secondary survey, the Burn Fluid Resuscitation Calculations are used to calculate the ADJUSTED FLUID RATE.

Adjusted Fluid Rates for Burn Injuries.

Adult and Teenager Thermal and Chemical Burns:

- 2 ml LR × patient's body weight in kg × % second- and third-degree burns, with half of the 24-hour total (in mL) infused of Lactated Ringers over the first 8 hours.

Pediatric Patients (12 years and younger):

- 3 ml LR × child's weight in kg × % TBSA second- and third-degree burns, with half of the 24-hour total (in mL) infused over the first 8 hours as per the adult calculation.
- In addition to the resuscitation fluid noted above, pediatric patients should also receive LR with 5% Dextrose at a maintenance rate.

Adult Patients with High-Voltage Electrical Injuries with Evidence of Myoglobinuria (Dark, Red-Tinged Urine):

- 4 ml LR × patient's weight in kg × % TBSA second- and third-degree burns, with half of the 24-hour total (in mL) infused over the first 8 hours.

Pediatric Patients with High-Voltage Injuries with Evidence of Myoglobinuria (Dark, Red-Tinged Urine):

- Consult a burn center immediately for guidance and start with 4 ml LR × patient's weight in kg × % TBSA second- and third-degree burns, with half of the 24-hour total (in mL) infused over the first 8 hours, plus maintenance fluids with D_5LR.

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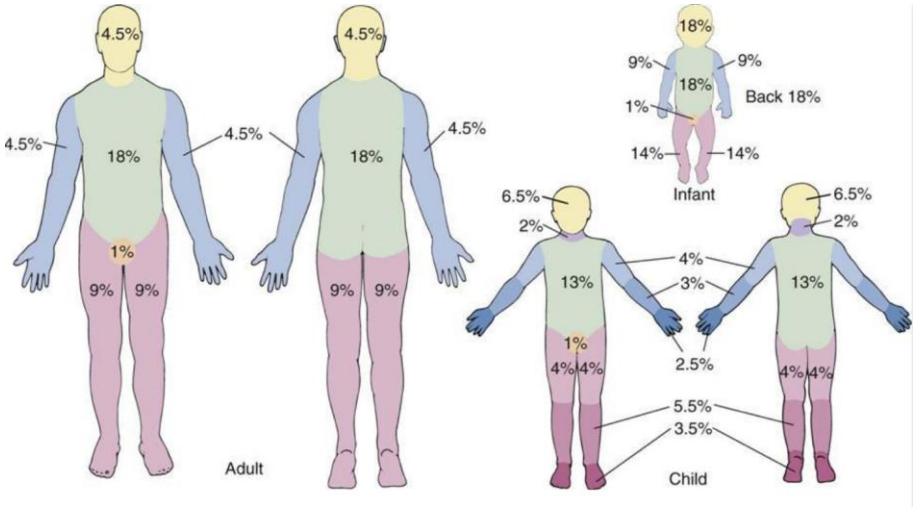
Additional notes:

Check for entrance and exit wounds.
Be aware of mechanism of injury. Toxic products of combustion may induce non-cardiogenic pulmonary edema.
If circumstances indicate closed space exposure, carbon monoxide poisoning may co-exist with other trauma and burns.
High-flow oxygen therapy should be provided.
If patient is unconscious, intubation and administration of 100% FiO_2 should be initiated.
Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.
If there is a concern for patients with concurrent carbon monoxide poisoning, refer to CCTTP 7.4 Carbon monoxide poisoning.

Refer to CCTTP 7.3 Patients with suspected cyanide poisoning if there is suspicion for concurrent cyanide toxicity in the patient who may exhibit concurrent neurologic, respiratory, or cardiovascular compromise, including cardiac arrest.
Assess and treat the burn itself.
If burns are not dressed, cover with clean, dry sheet.
Cover facial burns with dry sterile dressing. Avoid moist dressings.
Eye (corneal) burns are to be irrigated with 500-1000 ml 0.9 % Normal Saline.
Note: There is current no role for antibiotic treatment in the acutely burned patient.
Maintain euthermia. Patients with severe burns are at risk for hypothermia.

6.2.5 **Rule of Nine's:**



http://img.tfd.com/dorland/thumbs/rule_of-nines.jpg

(%)	Head	Chest	Abdomen	Back	Genitals	R Arm	L Arm	R Leg	L Leg
Adult	9	9	9	18	1	9	9	18	18
Child	18	9	9	18	1	9	9	14	14

6.3 CHEST TRAUMA

6.3.1 **Indications:**

Any patient exhibiting signs and symptoms of blunt or penetrating trauma.

6.3.2 **Clinical Management:**

Perform primary assessment and identify critical injuries to the respiratory and circulatory systems. If airway compromise is identified, refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.

Oxygen as indicated by patient condition. Administer supplemental oxygen to maintain $SpO_2 \geq 95\%$.

Identify and stabilize any penetrating objects to the chest.

Control hemorrhage by direct pressure and/or hemostatic gauze. Refer to CCTTP 10.17 Hemostatic Gauze.

Treat for shock as appropriate.

Use permissive hypotension strategy. Maintain MAP of 60-65

Establish two large bore peripheral IV's of isotonic crystalloid solution for a total of one to two liters. If the patient remains hypotensive, consider the administration of colloids. Refer to CCTTP 10.1 Packed Red Blood Cells and Liquid Plasma.

If the team is completing an interfacility transport, assess initial chest radiograph for signs of hemothorax, pneumothorax or other intrathoracic pathology. In addition, complete primary assessment and evaluate respiratory status.

If chest tube is in place with either chest drainage unit or Heimlich valve, confirm position and function of system before departure. When feasible, maintain active suction to the closed system.

Monitor hemodynamic status, including heart rate, blood pressure, oxygen saturations, and end-tidal carbon dioxide.

Consider orogastric tube in intubated patients and nasogastric tube for appropriate patients who are awake and alert.

Observation of clinical signs of an open pneumothorax require immediate placement of a sterile occlusive dressing, large enough to overlap the wound edges, that is taped securely on three sides.

If signs of a tension pneumothorax develop, release occlusive dressing before performing needle thoracostomy or chest tube insertion. Refer to CCTTP 10.12, 10.13, 10.14 Needle, Simple, and Tube thoracostomies as required.

If the patient has evidence of tension pneumothorax, consider finger thoracostomies. Refer to CCTTP 10.13 Simple Thoracostomy.

If a closed pneumothorax is diagnosed, chest tube placement should be strongly considered prior to flight to avoid an increase in size of the pneumothorax at altitude.

Refer to CCTTP 10.14 Tube Thoracostomy as required.

The risk of this delay must be considered in relation to the risk of deterioration of the patient when brought to altitude.

Identify central line position if the line is placed in subclavian or internal jugular positions.
Provide appropriate analgesia and/or sedation. Refer to CCTTP 4.12 Analgesia for the patient without a definitive airway and CCTTP 4.13 Anxiolysis and sedation for the patient without an advanced airway.
If chest tube is inserted prior to transfer, one can consider administration of antibiotic prophylaxis at the time of insertion per sending provider only.
For known or suspected great vessel traumatic injury (aorta, vena cava, and pulmonary artery), provide adequate pain and management.
Recognize that the effects of intubation and positive pressure ventilation can increase intrathoracic pressure.

6.3.3 Thoracic Crush Injury Syndrome:

In the setting of crush syndrome of the thorax (traumatic asphyxiation), staff must be able to identify injuries to the critical systems and be prepared to address these injuries immediately.
Airway management must be addressed with high-flow oxygenation to maintain oxygen saturations greater than 92%.
A thorough respiratory assessment must ensue as described above. Lung decompression may be indicated if there is evidence of hemothorax or pneumothorax.
If the patient is in cardiac arrest, please refer to CCTTP 6.10 Acute resuscitation of the unstable trauma patient for further interventions.
In patients with crush syndromes to the thorax, provide intravenous fluids of 0.9% Normal Saline.
If there is concern for acute decompression secondary to metabolic acidosis (i.e. prolonged compression) after release, consider alkalization:
PRIOR TO EXTRICATION: Consider contacting receiving clinician for option of **Sodium Bicarbonate** bolus and/or infusion.
If hyperkalemia is suspected (onset of PVC's, QRS > 0.12 or peaked T-waves). Refer to CCTTP 4.6 Electrolyte derangement, Hyperkalemia.

6.4 EXTREMITY TRAUMA

6.4.1 **Indications:**

Any patient exhibiting signs and symptoms of trauma to the extremities.

6.4.2 **Clinical Management:**

Assess critical systems first, including airway, breathing, and circulation prior to addressing extremity trauma. Life-threatening problems should be corrected immediately.
Control external hemorrhage with direct pressure, elevation of extremity, and/or hemostatic gauze (CCTTP 10.17 Hemostatic Gauze).
If the provider is unable to control bleeding, consider tourniquet proximal to site of injury.
Assess extremity for pulse, circulation, sensation, and motor function of extremity.
Identify significant swelling, discoloration, deformities or angulation/shortening of the extremity.
Identify if there is evidence of superficial alterations in sensation (neurologic sequelae) or significant areas of pain out of proportion to the exam. (Compartment syndrome or deep muscle injury).
Stabilize impaled objects. Refer to CCTTP 6.5 Impaled objects.
If there is an open fracture, apply moist sterile dressing to wound. Keep the wound as clean as possible. Antibiotics are **NOT** indicated for large lacerations without open fractures.
Open fractures: Administer **Ceftriaxone** 75 mg/kg to a MAX 2 grams IV as long as the patient does not have allergies to penicillin or cephalosporins.

6.4.3 **Fractures:**

Reduce and splint fractures, if possible, by clinician or staff before departure.
Do not reduce fractures if increased pain or resistance is encountered.
Assess tetanus immunization status in all trauma patients.

6.4.4 **Amputation:**

Re-implantation may require resources available only at facilities in Boston. If patient otherwise stable, provide patient report to medical control and request direct flight to one of the facilities.
Complete amputation
Wrap part in saline soaked gauze, place in water-tight Ziploc bag. Place bag in cold water filled container and save for possible re-implantation.
Examine the amputated tissue PRIOR TO DEPARTURE to determine the amount and type of tissue involved.
Ensure that the part is NOT in water directly.
Wrap stump in sterile saline-moistened dressing and pressure dressings.
DO NOT SOAK AMPUTATED PART DIRECTLY IN WATER.

Partial amputation:
Place in anatomical position and splint
Wrap in bulky sterile saline-moistened dressing and keep moist.
Save any avulsed body part.
Treat pain per CCTTP 4.12 Analgesia for the patient without an advanced airway
Pulse oximetry or Doppler may be used to establish status of pulses

6.4.5 **Crush Syndromes-Extremity. Identify Significant Crush Syndromes. These can include:**

One extremity crushed for ≥ 2 hours.
Two extremities crushed for ≥ 1 hour.
Treatment:
Place patient on cardiac monitor and complete 12 lead ECG for evaluation for hyperkalemia or dysrhythmias before and after extrication (release of pressure).
Do not place tourniquet on affected extremity or extremities.
Start two large bore IV's, 0.9 %NS bolus of one liter, then KVO
Repeat boluses of 500 ml as needed to maintain systolic blood pressure > 90 mmHg.
For significant crush injuries or for prolonged entrapment of the extremity as outlined above:
Consider treatment with sodium bicarbonate 1meq/kg IV (MAX 50 meq IV) over 5 minutes
PRIOR TO EXTRICATION:
If hyperkalemia is suspected (onset of PVC's, QRS > 0.12, or peaked T-waves), refer to CCTTP 4.6 Electrolyte derangement, Hyperkalemia.

6.4.6 **Note: The data around alkalinization prior to extrication of a crushed extremity remains controversial. Currently, the protocols at LifeFlight favor the aggressive hydration with isotonic fluids versus bolus of sodium bicarbonate solution UNLESS hyperkalemia is identified.**

6.5 IMPALED OBJECTS

6.5.1 **Indications:**

Patients with impaled object.

6.5.2 **Clinical Management:**

Follow appropriate trauma management for patients with multisystem trauma as noted elsewhere in protocols.
CCTTP 6.1 Abdominal and pelvic trauma.
CCTTP 6.3 Chest trauma.
CCTTP 6.4 Extremity trauma including amputations and crush injuries.
CCTTP 6.6 Facial and neck trauma.
CCTTP 6.10 Acute resuscitation of the unstable trauma patient.

6.5.3 **Special Circumstances:**

If the impaled object is in the cheek and bleeding profusely or object in the airway:
Remove the object if this can be easily done.
Maintain an open airway.
If airway control is required, refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.
Control bleeding and dress wound.
Refer to CCTTP 10.17 Hemostatic Gauze.
If the impaled object is in the eye, refer to CCTTP 6.8 Ocular emergencies.
If the impaled object is in the face, refer to CCTTP 6.6 Facial and neck trauma.

6.5.4 **Additional Notes:**

Do not remove the object unless it includes endangers the airway or prohibits the performance of adequate CPR. If unsure of appropriateness of removing objects, Contact OLMD.
Note: In some cases, OLMD may ask to have object removed judiciously.
Additionally, in some rare circumstances, it may be necessary to use resources to have specially trained personnel to be brought to the scene for removal of the object or other critical interventions.
Control bleeding and place a sterile bulky dressing over the wound and around the object and to stabilize it in place. Use hemostatic gauze as indicated. Refer to CCTTP 10.17 Hemostatic Gauze.
Immobilize injury as indicated.

6.6 FACIAL AND NECK TRAUMA

6.6.1 **Indications:**

Any patient exhibiting signs and symptoms of blunt or penetrating trauma to the face and neck.

6.6.2 **Pearls, Pitfalls and Considerations:**

Be especially attentive to airway management principles, as these patients are at high risk of losing an initially adequate airway. Reassess for airway patency routinely.
Disrupted anatomy may prevent adequate ventilation by bag valve mask ventilation.

6.6.3 **Clinical Management:**

Conduct primary assessment and assure adequate airway, breathing, and circulation. Any life-threatening injury should be treated immediately.
Suspect concurrent cervical spine, head, and ocular trauma. Treat according to specific protocols. Maintain immobilization per clinical presentation.
Control hemorrhage by means of direct pressure, packing or ligation before departure. The use of hemostatic gauze may be indicated (CCTTP 10.17 Hemostatic Gauze).
Establish IV with two large bore intravenous lines and with 0.9% Normal Saline at TKO rate initially should be in place.
Stabilize bone fragments or penetrating objects.
Observe for CSF otorrhea or rhinorrhea.
If there is concern for ocular injury, refer to CCTTP 6.8 Ocular emergencies.
For uncontrolled scalp hemorrhage, refer to CCTTP 10.6 Scalp Wound Stapling for hemorrhage control to staple the wound.
If there is evidence of bleeding on face or neck, use direct pressure to control exsanguination.
Consider the use of hemostatic gauze application (CCTTP 10.17 Hemostatic Gauze).
Assess need for definitive airway placement with endotracheal intubation.
Patients with maxillofacial trauma can be difficult to manage with typical orotracheal intubation.
However, if an airway cannot be maintained with BLS maneuvers, refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.
The use of a paralytic in RSI intubation is indicated with caution in an unstable mid-face fracture due to distortion of the anatomy.
Concurrently, prepare for needle/surgical cricothyrotomy as needed.
Please refer to CCTTP 10.18 Surgical Cricothyrotomy and 10.19 Needle Cricothyrotomy.
Do not insert NG tube if severe facial injury or mid-face fracture. Utilize OG tube for gastric decompression.
Large lacerations alone are NOT an indication for antibiotics.
If facial trauma includes a gunshot wound and open fracture, continue antibiotics as initiated at referring institution.
If not, administer **Ceftriaxone** 75 mg/kg to MAX 2 grams.
Treat pain and nausea per CCTTP 4.12 Analgesia for the patient without an advanced airway.

6.7 HEAD TRAUMA

6.7.1 **Indications:**

Any patient who has sustained a head injury who presents with an altered level of consciousness or has a history of unconsciousness following injury.

6.7.2 **Pearls, Pitfalls and Considerations:**

Consider early intubation because of the risk of deterioration during transport. Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.
Maintain cerebral perfusion pressure.
Patients with multisystem trauma may initially appear hemodynamically stable only because of the catecholamine response associated with their pain.
Use caution with initial analgesia, recognizing the increase in mortality associated with hypotension in Traumatic Brain Injury (TBI).
The goal of BP management in the setting of head trauma is to manage as follows:
Age 13-49 SBP ≥ 110 mmHg.
Age 50-69 SBP ≥ 100 mmHg.
Age > 70 SBP ≥ 110 mmHg.
CPP 60-70 mmHg if ICP available.
Avoid aggressive attempts to maintain CPP > 70 with intravenous fluids. Vasoactive agents may be considered because of the risk of acute respiratory failure due to fluid overload. For concerns of hypovolemic shock, refer to CCTTP 6.10 Acute Resuscitation of the Unstable Trauma Patient.

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6.7.3 **Clinical Management:**

Conduct primary assessment, assure adequate ABC's. Any life-threatening injury should be treated immediately. If there is evidence of significant external blood loss, control bleeding. Refer to CCTTP 10.17 Hemostatic Gauze.
If the bleeding is confined to the scalp, consider CCTTP 10.6 Scalp Wound Stapling.
If patient has adequate spontaneous respirations, administer supplemental oxygen to maintain $SpO_2 \geq 92\%$.
Assess for intracranial injury including:
Evidence of altered mental status.
GCS of less than 9.
Evidence of Cushing's Triad.
Other evidence of rising intracranial pressure.
If these signs and symptoms are present, consider performing a neuroprotective intubation. Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.
Initiate and maintain full spinal immobilization as indicated. Refer to CCTTP 6.9 Spinal Emergencies.
Note and document if there is spontaneous movement of all extremities.
If mechanically ventilated:
Maintain $ETCO_2$ 35-40 mmHg until pCO_2 is measured and then trend pCO_2.

Place patient in reverse Trendelenburg, elevated head of bed 15-20 degrees. Maintain spinal precautions as indicated.
Establish IV and infuse 0.9% Normal Saline at maintenance rate unless hypoperfusion or other injuries dictate another rate.
If the patient remains hypotensive, refer to CCTTP 4.9 Refractory hypotension and shock.

6.7.4 **For Patients with Evidence of Herniation with the following physical signs:**
Unilateral pupillary dilation.
Rapidly decreasing level of consciousness.
Decorticate/decerebrate posturing.
Increase the ventilator rate sufficient to decrease $ETCO_2$ to at least 35 mmHg, correlating to a pCO_2 of 35 as soon as possible.
With GCS < 8, profound coma or deterioration of consciousness and/or signs of increasing ICP.
Hypertonic Saline 3%
5 ml/kg to a **MAXIMUM dose of 250 ml** through central or large peripheral line over 15 minutes.
ONLY for patients with signs of imminent herniation or progressive neurologic deterioration
OR
Infuse Mannitol
0.25 to 1 gm/kg of 20% solution IV over 15 minutes
Use ONLY for patients with signs of imminent herniation or progressive neurologic deterioration with a MAP of 70.
Note: Due to the logistic issues surrounding the use of Mannitol, it is the recommendation of the Medical Directors and the Clinical Practice Committee that the **first line osmotic agent** for the treatment of increased intracranial pressure **should be 3% hypertonic saline.**
Treat associated problems:
Cervical spine precautions. Refer to CCTTP 6.9 Spinal Emergencies.
Treat seizures per protocol. Refer to CCTTP 5.3 Seizure Management.
Dress open wounds as necessary per standard BLS management. If the wound requires stapling refer to CCTTP 10.6 Scalp Wound Stapling.
If bleeding continues, refer to CCTTP 10.17 Hemostatic Gauze for the use of hemostatic gauze.
Sedate as necessary. Aggressively treat pain. CCTTP 4.12 ANALGESIA for the patient without an advanced airway.
CCTTP 2.5 Post-Intubation sedation, pain control, and muscle relaxants.
Document neurological status.
Obtain ISTAT INR value and arterial blood gas (ABG) prior to transfer at sending hospital if possible. Record and report to receiving staff.
Consider Foley and orogastric tube in intubated patients.
Consider placement of arterial line. Treat with crystalloids or colloids in the presence of shock state.

Maintain systolic BP at the following measurements if possible:
Ages 15 to 49 AND greater than 70: 110mmHg.
Ages 50 to 69: 100mmHg.
The arterial line should NOT cause any delay in transport to a definitive tertiary center.
Cerebral perfusion pressure is the mean arterial blood pressure minus the intracranial pressure (CPP=MAP-ICP)
Continually reassess for changes in hemodynamics and neurologic status.
If patient has an indwelling ICP monitor, CPP 60-70 mmHg should be maintained.

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6.8 OCULAR EMERGENCIES

6.8.1 **Indications:**

Patient with injuries to the globe of the eye, including corneal damage, hemorrhage into the globe, penetrating injuries and rupture of the globe.

6.8.2 **Clinical Management:**

Exam will include:
Assess anatomy.
Pupil size, shape, equality, hyphema, or other traumatic injury.
Proptosis.
Bleeding or fluid emanating from the eye.
Extra-ocular movement.
Laceration of surrounding structures.
Checking visual acuity by finger counting.
Identify actual or potential injuries to eye and surrounding structures including:
Foreign body

- Embedded object
- Surrounding facial trauma

Reassure and calm patient.
Remove contact lenses as soon as possible
If hyphema (blood in the anterior chamber of the eye, in front of the iris) exists and there are no contraindications, transport with head of bed elevated to at least 45°.
Penetrating injuries:
DO NOT put any pressure on the eye.
Immobilize any penetrating object(s) and secure with a bulky dressing.
Non-pressure shield both eyes to prevent movement of injured eye.
Non-penetrating injuries:
Blunt trauma.
Apply rigid shield to affected eye (No patch).
Patch both eyes, if severe.
If there is significant proptosis with compromised visual acuity, **consult sending physician for emergent lateral canthotomy.**
Foreign substance:
Remove loose particulate matter with a cotton swab moistened with saline.
If chemical is involved, identify chemical for appropriate treatment.
Irrigate with 1000 ml NS per eye for at least 15-30 minutes.
If chemical is a base (caustic) and eye damage is evident, continue irrigation with NS until arrival at receiving facility.
If pain cannot be controlled adequately and there is NO evidence of global rupture:
Consider **Tetracaine** 0.5% solution 1-2 drops for pain or irrigation.
May repeat THREE times every 5 minutes for adequate pain control.

Treat pain per CCTTP 4.12 ANALGESIA for the patient without an advanced airway.

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6.9 SPINAL INJURIES

6.9.1 **Indications:**

Any patient with suspected or known spine injury.

6.9.2 **Pearls, Pitfalls and Considerations:**

Removal of spinal immobilization for patient with "negative" spine injury, per protocol, may require specific communication and interactive skills for non-English speaking or pediatric patients.

Cervical spinal cord injury patients have compromised respiratory function and may deteriorate enroute.

Consider pre-transport intubation. Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.

If a cervical collar has been applied, transport with collar in place.

If a cervical collar is not in place, then patient must have met the MEMS Spine Injury Protocol requirements (Maine EMS Spine Assessment & Management. Section 3, 4, and 5. Edition 2024).

Maine EMS protocols describe that the patient must be able to provide a reliable exam **and** had their "positive spine injury" ruled out with a full series of appropriate spine CT imaging.

If uncertainty exists regarding whether a cervical spine has been clinically or radiographically cleared, apply/reapply collar for transport.

6.9.3 **Clinical Management:**

Complete primary assessment to evaluate for critical injuries affecting airway, breathing, and circulation.

Simultaneously, protect spine (cervical, thoracic, and lumbar regions) with appropriate immobilization if required based upon clinical presentation and mechanism of injury.

Initiate oxygen therapy to maintain oxygen saturations greater than 92%.

Note and document any gross neurologic deficits prior to motion restriction / immobilization.

Document levels of sensory and motor function.

Assess for soft tissue injury, swelling, bony crepitus, pain, deformity, and muscle spasm.

Assess movement, sensation, and strength of extremities.

The use of a spinal backboard is limited to the use in extrication from positions where patients are not able to extract themselves. The use of a long backboard is not indicated in the routine transport of patients EVEN if there is an identified spinal cord and / or column injury.

In patients with diagnosed spinal injuries, patients should be transported in a flat and supine position unless mitigating circumstances exist (i.e. head injury or respiratory distress). Refer to Maine EMS Spine Assessment and Management #3.

Establish IV, 0.9% NS at maintenance rate or as dictated by perfusion or associated injuries.

Consider NG / OG tube as indicated.

Consider Foley catheter at referring institution if spinal cord injury is evident or there is known spinal column injury.

If patient develops neurogenic shock, follow CCTTP 4.9 Refractory hypotension and shock.

Be alert for occult trauma to head, chest, abdomen, and pelvis.
Refer to CCTTP 6.10 Acute resuscitation of the unstable trauma patient.

6.9.4 **Interfacility Transfers:**

Refer to Maine EMS Spine Assessment & Management. Section 3, 4, and 5. Edition 2024.
MEMS Interfacility transport recommendations:
Long backboards do not have a role in the transport of patients between hospitals EVEN IF SPINE INJURY IS DIAGNOSED.
Use of long boards during interfacility transport is associated with increased pain and potential for pressure sores and ulcers.
Patients should instead be managed with a cervical collar or equivalent cervical neck motion restriction device and firmly secured to the EMS stretcher.
If a sending facility has placed the patient on a longboard or request the use of a longboard, EMS providers should discuss the option of foregoing backboard use with the sending provider.
If a backboard is used, it must be padded adequately to maximize patient comfort.
The use of a spine backboard can still be used as a transportation device at the discretion of the flight team.
Treat pain and anxiety per CCTTP 4.12 Analgesia in a patient without an advanced airway and CCTTP 4.13 Anxiolysis and Sedation in a patient without an advanced airway.

6.9.5 **Positioning:**

The preferred position for all patients with spine management is flat and supine.
There are two circumstances under which raising the head of the bed to no more than 30° could be considered:
Patients in respiratory distress. Populations at risk for developing respiratory distress when lying flat include the elderly with underlying lung disease, patients with morbid obesity, and late term pregnancy patients.
Patients with suspected severe head trauma.

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6.10 ACUTE RESUSCITATION OF THE UNSTABLE ADULT TRAUMA PATIENT

6.10.1 **Indications:**

To identify and prioritize goals of resuscitation of the unstable/peri-arrest trauma patient.

6.10.2 **Pearls, Pitfalls and Considerations:**

In many of the individual protocols in the Trauma section, attention has focused on individual areas of injury.
It is important to note that there is a small population who present with significant hemodynamic instability and high potential for high morbidity and mortality from a variety of traumatic injuries.
As advanced providers, it is important to have a defined systematic approach to identify and prioritize areas of compromise to guide the resuscitation rather than specific diagnoses.
These patients who are physically unstable are rapidly progressing to an arrest state if not treated appropriately.
It is up to the providers to initiate rapid interventions to arrest this progression.
This protocol will attempt to outline key components of the resuscitation required to stop further decline.

6.10.3 **Clinical Management:**

Note: Like many resuscitation techniques, LifeFlight continues to emphasize resuscitation strategies based upon well-defined guidelines of traditional techniques with incorporation of newer evidence-based ideas and technology. This protocol will outline these below.
Initiate primary assessment and identify critical injuries to the respiratory system.
Maintain oxygenation with supplemental oxygen to maintain saturations greater than 92%
If airway compromise is identified, refer to CCTTP 2.4 Pharmacologically Assisted Airway Management.
Consideration of the co-morbidities and concurrent injuries of the patient must be maintained.
Patients with potential intracranial pathology, suspected concurrent spinal trauma, and those with relative contraindication to resuscitation medications, colloids and fluids must be identified and addressed.
Prior to placement of a definitive airway, staff must consider those patients who may have potentially distorted anatomy or will have a difficult airway when placement is attempted.
Back-up airway devices and needle/surgical cricothyrotomy techniques may be required.
Refer to the LifeFlight of Maine failed airway algorithm: CCTTP 2.7. Failed Airway Algorithm.
Confirmation of definitive airway placement can occur with physical exam, capnography, imaging (chest x-ray) and thoracic ultrasonography (i.e. E-FAST).
In the primary assessment, providers must observe for:
External injuries such as open wounds, leaking air, and chest wall deformity.
Additional physical signs must be identified including:
Crepitus, deformity, and asymmetric respiratory motion.

Breath sounds must be auscultated in both the apical and lateral chest areas.
Lastly, the sonographic E-FAST can be useful as an imaging tool in the out-of-hospital environment for identifying occult intrathoracic pathology including, but not limited to the following:
Tension pneumothoracies.
Massive hemothoracies.
Cardiac tamponade.
Flail chest.
Each of these diagnoses must be addressed immediately CCTTP 6.3 Chest Trauma.
If a patient presents in cardiac arrest after blunt or intrathoracic penetrating trauma, consideration to needle and/or finger thoracostomies should be considered if there is suspected evidence if injury. Refer to the following: CCTTP 10.12, 10.13, 10.14 Needle, Simple, and Tube thoracostomies.
In addition to the noted respiratory compromise, intrathoracic trauma can lead to a circulatory failure due to both hypovolemia and distributary shock due to impeded blood flow secondary to a tension pneumothorax.
When patients have circulatory compromise, treatment should be initiated even if a specific source is not readily identified. Basic physical exam in conjunction with basic diagnostics. If available, should be used including chest and pelvis radiographs and E-FAST ultrasound.
If a patient has presented with circulatory collapse with noted cardiac arrest after blunt or penetrating chest trauma, staff should consider the use of ultrasound for the identification of cardiac tamponade.
If identified on ultrasound, staff may consider recommending an ultrasound-guided pericardiocentesis to qualified individuals.
In those patients who have been identified to have failure of tissue and cell oxygenation, resuscitation strategies remain controversial, and no specific guideline exists.
Resuscitation efforts should focus on physiologic markers (urine output, mentation, etc.) rather than specific vital signs.
Standard resuscitation guidelines recommend that colloid infusion should be initiated ideally after one liter of crystalloid with patients presenting with signs and symptoms consistent with hemorrhagic shock. The goal of therapy is to improve oxygen delivery to the appropriate tissues. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
Initiate CCTTP 10.2 Tranexamic acid if massive resuscitation is initiated as indicated.
Large bore IV lines or central lines continue to be the mainstay for medication therapy or fluid infusion.
If central or peripheral access cannot be obtained, staff should consider the use of intraosseous access with the EZ I-O.
The humeral head is the preferred area of access.

Bleeding control, both internal and external, must be part of the treatment of the initial assessment with the use of alignment of long bone fractures, the use of hemostatic gauze (CCTTP 10.17 Hemostatic Gauze), stapler (CCTTP 10.6 Scalp Wound Stapling) for hemorrhage control), and pelvic binder (CCTTP 10.7 Pelvic Binder) in patients with open book pelvic trauma. The combination of these techniques with aggressive resuscitation measures may keep patients from progressing with further injury due to hypovolemia.
With those patients with concurrent multisystem trauma with concurrent head injury, special care must be instated to minimize episodes of hypotension to avoid secondary injury.
Those patients with severe brain injuries, a single episode of hypotension doubles overall mortality of these patients.
Continued resuscitation efforts are the mainstay of treatment and maintaining a systolic blood pressure greater than 100-110 will concurrently maintain a cerebral perfusion pressure of 60-70 or more.

6.10.4 Note: Medical versus trauma patients

It is essential to note that resuscitation techniques must focus on identifying, if possible, the injuries that are not only affecting the patient currently as well as additional potential injuries that may present in a delayed fashion.
Treatment must focus on arresting further bleeding and decompensation in patients with suspected traumatic injuries.
Out-of-Hospital Management of the Unstable Trauma Patient utilizes a variety of resuscitation techniques, but standard medical protocols (i.e. Advanced Cardiac Life Support) should only be utilized in identified patients that have medical etiologies of instability rather than the standard of care.
The use of vasopressor therapy in trauma resuscitation should be reserved only for selected patients who have medical etiologies of their hemodynamic instability. Typically, vasopressor therapy is reserved for patients suffering from a traumatic etiology only after all other therapies have been exhausted (i.e. there are no more crystalloids or colloids immediately available).
In patients suffering from hemodynamic instability secondary to a spinal cord injury (i.e. neurogenic shock), the use of alpha agonists may be indicated (typically after neuroimaging has been completed and reviewed.

6.10.5 Termination of resuscitation for traumatic cardiac arrest:

Exclusion criteria
Hypothermia patients (Refer to CCTTP 9.2 Hypothermia).
Near drowning and submersion patients (Refer to CCTTP 9.3 Near drowning and Submersion).
Patients whose presentation is consistent with a medical cause of cardiac arrest (CCTTP 3.5 Cardiac Arrest)
Inclusion criteria
Patients in cardiac arrest secondary to blunt and penetrating injuries.

6.10.6 As per Maine EMS protocols (01/01/2024):

Do not initiate cardiac arrest resuscitation if any of the following exist:

TRAUMA

Identifiable injuries incompatible with life.
Evidence of significant lapse of time since pulselessness:
Dependent lividity
Rigor mortis
Decomposition
Do not initiate resuscitation in blunt trauma patients who are apneic and pulseless.
Do not initiate resuscitation in penetrating trauma patients who are apneic and pulseless.

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7 TOXICOLOGY

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7.1 ALCOHOL EMERGENCIES

7.1.1 **Indications:**

Any patient experiencing some or all of the following symptoms resulting from cessation of habitual alcohol intake:
Malaise, tremulousness, sweating, agitation, elevated blood pressure, hallucinations, tachycardia, hypothermia, cardiovascular collapse, seizures.
Providers are reminded that both Delirium Tremens (DT's) which can cause altered mental status and withdrawal seizures can occur 6 to 24 hours after the last alcoholic drink.

7.1.2 **Pearls, Pitfalls and Considerations:**

Trauma, communicable disease and alcoholism are frequently companions. Other significant co-morbidities may exist.
If possible, determine when the patient last consumed alcohol and the quantity. Identify if the patient has had significant sequelae from alcohol use or withdrawal including seizures and delirium tremens in the past.
If the patient has a seizure, refer to CCTTP 5.3 Seizure Management, for detailed management.
Any significant simple or complex partial seizure is NOT alcohol related. The patient requires further investigation of the etiology of the seizure (i.e. head CT).
Determine if there are significant co-ingestants or other types of toxic alcohols consumed (i.e. ethyl alcohol, ethylene glycol, methanol and others).
If an alcohol level has been drawn, most patients will metabolize the alcohol based upon zero order kinetics at 25 mg/dl/hr.

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7.1.3 **Clinical Management:**

Establish and maintain an adequate airway and ventilation. Assess for trauma concurrently.
Monitor EKG, end-tidal CO_2 and O_2 saturations.
If the patient has altered mentation, complete fingerstick blood glucose.
For hypoglycemia, refer to appropriate CCTTP for Diabetic Emergencies
CCTTP 4.2 Adult Diabetic Emergencies.
CCTTP 11.14 Pediatric Diabetic Emergencies.
Initiate IV access and provide 0.9% NS to achieve adequate hydration, unless patient has a history of congestive heart failure, renal failure, or is in pulmonary edema,
Consider bolus with 500 ml NS and maintain 200 ml/hr.
If there is concern for fluid overload, contact OLMD for fluid administration guidelines.
Maintain NPO status during patient care.

Administration of **Lorazepam f**or tremulousness with or without behavioral agitation and seizures.
Use caution in patients who are heavily intoxicated or have current head injuries.
Lorazepam 0.15 mg/kg to MAX of 2 mg IV/IM as indicated.
In cases of status epilepticus, may repeat at 15 minutes if the patient has persistent seizure activity. Refer to CCTTP 5.3 Seizure Management.
Most patients who experience alcohol withdrawal seizures will not seize after the administration of appropriate doses of benzodiazepines.
If the patient becomes lethargic after benzodiazepine administration, consider airway protection. CCTTP 2.1 Airway Management.
Restrain if needed to provide a safe transport for the patient and team.
If the patient is considered unsafe, consider transport by ground, or, if appropriate, airway protection including rapid sequence intubation.
Refer to CCTTP 2.1 Airway Management.
Toxic alcohols
There are several types of toxic alcohols that require consideration in the intoxicated patient including:
Isopropyl Alcohol
Methanol
Ethylene Glycol
In the setting of ethylene glycol and methanol ingestions, rapid transport is required to a center that can provide emergent dialysis.
Consider **Fomepizole**. Consult the referring or receiving physician for dosing and initial administration.
During transport, contact the receiving physician or medical director for potential administration of **Sodium Bicarbonate** bolus or maintenance drip.

7.1.4 **Note: If there is a concern about a possible ingestion overdose, consider contacting the Poison Control Center at 1-800-222-1222.**

7.2 TOXIN EXPOSURES

7.2.1 **Indications:**

Any patient diagnosed or suspected of having an overdose of medications, drugs or products / or other toxin exposures, ensure patient is not contaminated.
If there is concern for contamination, contact local EMS/ Fire agency for decontamination.

7.2.2 **Pearls, Pitfalls, and Considerations:**

Management principles include reducing exposure and absorption, enhancing elimination and treatment of signs and symptoms.
Attempt to identify a syndrome for which a selected physiologic antagonist may be administered. It is beyond the capacity of these protocols to identify the treatment for each and every poisoning which may be encountered.
Please contact online medical control for specific treatment instructions.
Encourage sending or receiving institution to procure current treatment recommendations from **Northern New England Poison Control Center at 1-800-222-1222.**
LifeFlight staff can also call the poison center with any concerns as well at any point of patient care.

7.2.3 **Clinical Management:**

Ensure safety of providers prior to evaluation. All patients should be decontaminated prior to evaluation and treatment.
Assess and manage airway, breathing, and circulation.
In cases of respiratory distress, administer oxygen
In cases of respiratory failure, consider medication assisted airway management:
Refer to CCTTP 2.1 Airway Management.
If the patient experiences seizures, refer to CCTTP 5.3 Seizure Management.
Monitor hemodynamics including ECG, pulse, blood pressure, end-tidal capnography and oxygen saturations.
Obtain information on what was ingested and how long it has been since substance was initially ingested (if possible and safe, bring bottle or substance ingested).
Perform a bedside glucose check and if glucose is < 60 mg/dl, Refer to CCTTP 4.2 Diabetic Emergencies.
For all ingestions:
Note pupil size, reflexes, unusual breath odors or other specific signs and symptoms with which the patient is presenting.
Obtain 12-lead EKG.
Note QTc interval.
QRS interval.
Other cardiac electrical abnormalities.
With altered mentation, consider the following:
Consider sedation of agitated or anxious patient. CCTTP 4.13 Sedation and anxiolysis for the patient without an advanced airway.

If the patient exhibits evidence of respiratory failure or is unable to protect his or her airway, refer to CCTTP 2.1 Airway Management.

7.2.4 **Specific Identification and treatment of toxin exposures:**

Opiate Overdoses
If unknown or suspected narcotic overdose, consider **Naloxone** in 0.4 mg increments and titrate to effect in adult patients.
Pediatric patients: Naloxone 0.1mg/kg IV/IO/IN up to 20 kg.
Pediatric patients greater than 20kg: 0.1 to 0.2mg/kg to 2mg IV/IO/IM/IN
Titrate to respiratory effect.
Tricyclic antidepressant (TCA) is suspected with a widened QRS (< 100msec),
Sodium Bicarbonate: 1 mEq/kg up to 50 mEq IV.
May repeat x 1 to obtain a QRS interval < 100 msec.
If persistent widened QRS interval or significant ectopy, contact OLMD or New England Poison Center for option of:
Further boluses of Sodium Bicarbonate.
Sodium Bicarbonate infusion (Typically, 150 mEq Sodium Bicarbonate (3 amps) in one (1) liter of D_5W.
Obtain Intravenous access. Fluids can be kept at a KVO rate unless there is associated hypotension. If patient noted to have persistent MAP's less than 65, refer to CCTTP 4.9 Refractory hypotension and shock.
For all other known ingestions, contact OLMD or **Poison Control at 1-800-222-1222** for guidance.
Specific antidotes can be given under direct supervision or discussion with poison control and the sending/receiving providers.

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7.3 PATIENTS WITH SUSPECTED CYANIDE TOXICITY

7.3.1 **Indications:**

To be given in patients with suspected cyanide exposure who exhibit neurologic, respiratory, or cardiovascular compromise.
This includes cardiac arrest. Administration should be immediately upon recognizing the need and should not await a confirmatory test.
Only 40% of patients are able to detect the almond smell of cyanide. Cyanide is generated by the combustion of synthetic material in many structure fires.

7.3.2 **Clinical Management:**

Scene safety is a top priority for patients with toxin exposures in general. However, no patient decontamination is required for patients evacuated from cyanide gas exposure.
Assess and manage airway, breathing, and circulation.
If patient has adequate spontaneous respirations, administered supplemental oxygen to maintain $SpO_2 \geq 92\%$.
If necessary, secure an advanced airway via endotracheal intubation and ventilate with BVM or transport ventilator. Refer to CCTTP 2.2 Endotracheal Intubation.
Establish IV access of **NS/LR** @ a KVO rate. If patient displays signs of inadequate perfusion despite crystalloid resuscitation, refer to CCTTP 4.9 Refractory hypotension and shock.
Obtain **Lactate** and **Bicarbonate** level if possible.
With a noted HPI, VS, record of interventions, and lab values
CONTACT NEW ENGLAND POISON CENTER at 1-800-222-1222.

7.3.3 **If Unconscious and in Persistent Shock Despite Adequate Fluid Resuscitation:**

Simultaneously perform the following:
Obtain **Lactate** and **Bicarbonate** level if possible.
With a noted HPI, VS, record of interventions, and lab values, **CONTACT NEW ENGLAND POISON CENTER at 1-800-222-1222.**
Mix **Hydroxycobalamin** (Cyanokit) in preparation for administration.
Note: Even in emergent situations, discuss case with toxicologist on call prior to administration.
Hydroxocobalamin:
Adult: 5g mixed in total of 200ml Normal Saline infused over 15 minutes. If a favorable response is seen and a second dose becomes necessary, a second 5g dose may be considered.
Pediatric: 70mg/kg IV (max single dose 5g). May repeat once if needed.
Given the potential for coexisting carbon monoxide toxicity in the smoke inhalation patient, consideration should be made for this diagnosis as well (Refer to CCTTP 7.4 Carbon monoxide and other toxic gas exposures). Appropriate treatment and transport destination for possible need of hyperbaric oxygen can also be discussed with the Poison Center.
Treat seizures per CCTTP 5.3 Seizure Management.

7.4 CARBON MONOXIDE AND OTHER TOXIC GAS EXPOSURES

7.4.1 **Indications:**

For patients who are symptomatic after a toxic gas exposure to include:
Shortness of breath.
Cough.
Headache.
Altered mental status.

7.4.2 **Clinical management:**

Only providers with proper training and when appropriate PPE should enter environments that may have toxic gases.
Remove patient from environment.
Manage appropriate airway, breathing, and circulation.
Administer 100% oxygen.
If the patient exhibits evidence of respiratory failure, consider advanced airway management:
Refer CCTTP 2.1 Airway Management.
Obtain IV/I/O access and initiate NS at KVO rate. If the patient remains hypotensive consider appropriate fluid resuscitation and proceed to vasopressor therapy if the patient remains hypotensive.
Refer to CCTTP 4.9 Refractory hypotension and shock.
Complete 12-lead EKG.
If there is evidence of altered mentation, perform a bedside glucose check and if glucose is < 60 mg/dl, refer to CCTTP 4.2 Diabetic Emergencies for further details.

7.4.3 **Special circumstance. Carbon monoxide (CO) exposure.**

Clinical findings:
Patients with isolated CO poisoning rarely present with persistent respiratory failure.
Finger CO monitors may not accurately detect carbon monoxide level and should not be relied upon to guide treatment or alter transfer decision.
There is no correlation between CO level and End Tidal ($ETCO_2$) waveform capnography levels.
Patients with documented exposure with ANY signs or symptoms as noted above should have high flow (i.e. non-rebreather) oxygen initiation at the point of contact by LOM staff if not initiated previously.
Clinical management from section above should also be completed.
If there is concern for pregnancy, it is imperative that obstetrics be alerted because CO levels can be higher in the fetus when compared to the mother.
Consider transport to tertiary care facility capable of hyperbaric therapy. Contact OLMC for direct transport.
If unsure contact:
The Northern New England Poison Center 1-800-222-1222
Diver's Alert Network (DAN) 1-919-684-9111

DAN's emergency number will aid the provider in locating the most appropriate hyperbaric chamber for a patient with CO poisoning.

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8 BEHAVIORAL

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8.1 BEHAVIORAL EMERGENCIES

8.1.1 Indications:

Any patient who demonstrates restlessness, agitation, confusion, or potentially violent behavior regardless of underlying diagnosis.
The LOM CCT Provider will assess the patient and take appropriate measures to calm and reassure the agitated patient. Restraints the patient may be used if all other options have failed prior to transport to ensure a safe and secure environment.

8.1.2 Pearls, Pitfalls and Considerations:

Remember that agitation may signal a physiologic deterioration of the patient and accompany hypoxia, hypoglycemia, cerebral edema, etc.
If behavior compatible with safe flight cannot be achieved or predictably maintained, other transport modes MUST be considered. Ensure that patient is not carrying weapons or other items which may be used as such (e.g. ballpoint pens).

8.1.3 Clinical Management:

Assess mental, emotional, and physical status thoroughly prior to departure.
Anticipate changes in attitude and behavior of patient.
Maintain a calm demeanor and environment; give explanations to patient as appropriate.
Establish intravenous access. If there is a potential for agitation, make additional attempt to secure IV access (i.e. Cling, bandages, etc).
Attend to concurrent medical or trauma needs as per protocol.
Remember, changes in behavior may have a physiologic or pharmacologic explanation.
Medicate confused/combative patients as needed. Refer to CCTTP 4.13 Sedation and anxiolysis for the patient without an advanced airway.
If patient continues to demonstrate aggression or combativeness and is deemed a risk to flight safety and air transport is imperative, they should be sedated, paralyzed, and intubated. Discuss with OLMC or medical director prior to placing advanced airway for other reasonable options if they exist prior to transport if possible.
If unable to provide adequate anxiolysis and the patient remains unsafe for transport, or actively becomes unsafe during transport, refer to CCTTP 2.1 Airway Management.

8.2 DEPRESSION AND SUICIDAL IDEATION

8.2.1 **Indications:**

Evaluation, care, and treatment of the patient with anxiety and depression.
Ensure scene safety and involve law enforcement personnel if there is concern for safety of staff prior to initiating patient care.
Concurrent evaluation for patients with depression and suicidal ideation for medical concerns (i.e. ingestion) or traumatic injuries.

8.2.2 **Pearls, Pitfalls and Considerations:**

If there is a concern for traumatic injuries or medical syndromes, ensure appropriate primary and secondary assessments, vital sign and hemodynamic monitoring have been initiated.

8.2.3 **Clinical Management:**

Assess mental, emotional, and physical status thoroughly prior to departure.
Complete evaluation for other injuries or illness in the setting of critical care transport.
This protocol is not intended for patients with altered mentation.
Provide appropriate emotional support and maintain professional demeanor with this population of patients.
Provide appropriate anxiolysis for depressed or suicidal patients as needed. Refer to CCTTP 4.13 Sedation and anxiolysis for the patient without an advanced airway.
If patient continues to demonstrate aggression or combativeness and is deemed a risk to flight safety and air transport is imperative, they should be sedated, paralyzed, and intubated. Discuss with OLMC or medical director prior to placing advanced airway for other reasonable options if they exist.
If unable to provide adequate anxiolysis and the patient remains unsafe for transport, refer to CCTTP 2.2 Endotracheal Intubation

9 ENVIRONMENTAL

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9.1 FROSTBITE AND COLD INJURIES

9.1.1 **Indications:**

Any patient presenting with damage to the skin and underlying tissues as the result of exposure to low environmental temperatures.
Classification of Injury
See table below.
Assess Circulation
Capillary refill.
Doppler signals.

9.1.2 **Clinical Management:**

Remove the patient from further exposure to the cold. Remove cold and wet clothing if applicable.
Evaluate the patient's general condition for the signs and symptoms of hypothermia (CCTTP 9.2 Hypothermia).
Handle the frostbitten part gently.
Protect it from further injury.
Avoid pressure or friction.
Do not break blisters.
Do not allow the patient to stand or walk on a frostbitten lower extremity.
Avoid any unnecessary contact with other affected regions (i.e. upper extremity)
Do not attempt to thaw frostbitten parts enroute.
Cover the injured part loosely with a dry, sterile sheet or bulky dressing.
Vital sign monitoring should include rectal temperature with thermometer with suitable range or temperature sensing foley catheter if the patient requires constant temperature monitoring.
Keep the patient NPO and establish IV access.
Treat pain per CCTTP 4.12 ANALGESIA for the patient without an advanced airway
Assess for hydration:
Warmed NS bolus of 500ml to 1000ml followed by low dose infusion of 75ml to 150ml per hour.
Note: Patients with severe frostbite to the trunk or extremities should be transferred to a burn center for treatment.
Notify staff at receiving burn or tertiary center if there are signs and symptoms of inadequate circulation including:
Delayed or lack of capillary refill.
Diminished or absent doppler signals.
If inadequate circulation is identified, patient may be candidate for frostbite angiography or catheter directed thrombolytic administration by the receiving care team.
Interventional therapy for frostbite may be considered in patients with the following:

- Stable gas exchange and hemodynamics
- No flow after rewarming (No capillary refill or doppler signals).

- < 24-hour cold exposure time
- < 24-hour rewarmed ischemia time

Consult receiving trauma clinician for the option of the following:

- Heparin
- Prostaglandin

Note: Dosing of these two medications will be at the discretion of the receiving attending.

Classification of Injury:
Frostnip Skin becomes white and loses sensation. On rewarming, skin becomes hyperemic and paresthetic. Recovers completely. Paresthesias may persist for some weeks.
Superficial Frostbite *First Degree* Partial skin freezing Erythema, edema, and hyperemia No blisters or necrosis Occasional skin discrimination
Superficial Frostbite *Second degree* Full thickness skin freezing Erythema, substantial edema Vesicles with clear fluid May progressed to blisters, discrimination and black eschar
Deep Frostbite *Third degree* Full thickness skin and subcutaneous freezing Skin necrosis Blue – gray discoloration
Deep Frostbite *Fourth degree* Full thickness skin, subcutaneous tissue, muscle, tendon, and bone freezing Little edema Initially mottled, deep red, or cyanotic Eventually dry, black and mummified

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9.2 HYPOTHERMIA

9.2.1 **Indications:**

Any patient with low core body temperature (usually less than 35°C or 95°F) rectally, with or without accompanying signs and symptoms.

9.2.2 **Clinical Management:**

Prevent further heat loss:
Insulate from cold.
Protect from wind.
Remove wet clothing.
Cover with vapor barrier and blankets.
Move to warm environment.
Minimize extraneous stimuli and movement of patient. Do not rub or manipulate extremities.
Establish and maintain airway and ventilation.
Assess, breathing, and circulation.
Provide supplemental oxygen, preferably heated, and humidified.
Initiate airway protection as indicated. Refer to CCTTP 2.1 Airway Management.
Initiate hemodynamic monitoring (ECG, BP, end-tidal CO_2 and oxygen saturation).
Initiate and maintain two IV's with 0.9 % NS, warmed, if possible.
Consider temperature sensing foley catheter.

9.2.3 **Treatment:**

Mild to moderate hypothermia (32°F to 35°C or 89.6°F to 95°F):
Patient is cold but is not experiencing any severe adverse physiologic symptoms.
Monitor hemodynamics.
Apply warmed, humidified oxygen therapy.
Passive rewarming techniques.
Remove wet/ cold clothing.
Dry patient.
Cover patient with blankets (space blanket) and / or hypothermia wrap.
Encourage warm oral fluids if patient has clear level of consciousness.
Active rewarming techniques
Internal
IV Therapy NS 250 to 500ml bolus with warmed IVF (40°F to 42º C). Repeat as clinically indicated.
External
Transport to an appropriate center that is able to provide heating:
Forced air rewarmer (i.e. Bair Hugger).
Artic Sun rewarmer (can also be used for moderate or severe cases as well).
Be sure not to leave external heat sources unmonitored. Monitor for thermal burns aggressively.
Moderate hypothermia (28°F to 32°C or 82.4 to 89.6°F)
Monitor hemodynamics.

Apply warmed, humidified oxygen therapy.
Evaluation of labs (i.e. IStat for ABG and electrolytes).
EKG for evaluation of Osborne waves, bradycardia or other cardiac ectopy or dysrhythmias.
If patient is encephalopathic or has noted alteration in mental status, evaluate for other concurrent diagnoses (trauma, toxicology, sepsis, etc).
Complete standard fingerstick blood glucose. Refer to CCTTP 4.2 Diabetic Emergencies
Passive rewarming techniques as noted above.
Active internal rewarming techniques.
Consider IV Therapy. 0.9% NS 250 to 500ml bolus with warmed IVF (40°F to 42° Celsius). Repeat as clinically indicated.
Consider IV therapy Infusion 0.9 % NS or equivalent warmed maintenance fluid @ 100 to 150ml per hour.
Active external rewarming techniques as noted above
If the patient is unstable (i.e. Systolic BP less than 90 mmHg), initiate fluid resuscitation and refer to CCTTP 4.9 Refractory hypotension and shock.
Severe hypothermia (less than 28°C or less than 82.4°F) with life signs present:
Evaluation of labs (i.e. IStat for ABG and electrolytes) and EKG for evaluation of Osbourn waves, bradycardia or other cardiac ectopy or dysrhythmias
If patient is encephalopathic or has noted alteration in mental status, evaluate for other concurrent diagnoses (trauma, toxicology, sepsis, etc).
Complete standard fingerstick blood glucose. Refer to CCTTP 4.2 Diabetic Emergencies
Continue active and passive rewarming techniques as noted above.
If patient has moderate to severe hypothermia, consider transport to a tertiary center that is able to complete active internal rewarming including:
Peritoneal lavage.
Body cavity lavage.
Closed thoracic lavage.
Thoracotomy with mediastinal lavage.
AND / OR a tertiary center that is able to complete extracorporeal rewarming:
Cardiopulmonary Bypass.
Continuous Venovenous rewarming (CVVR).
Continuous Arteriovenous rewarming (CAVR).
Emergent hemodialysis.
Once patient's temperature is approximately 86° F (30°C), all ACLS procedures and drugs should be utilized in the usual manner.
Cardiac Arrest
Ascertain presence or absence of pulse or respirations for at least one minute.
Utilize ultrasound to evaluate for cardiac activity if available.
If absent, start CPR.
However, CPR should **NOT** be initiated with any of the following findings:
If core temperature is less than 60° F (15.5° C).

Obvious fatal injuries.
Frozen with ice in the airway.
Chest wall is too stiff for compressions.
Chest compressions should never be done if any clinical signs of life are present, even if a pulse is not palpable, and should be done only if functional cardiac activity is definitely absent (v-fib/asystole on monitor or patient loses pulse.)
Support ventilations with heated, humidified air or oxygen. Refer to CCTTP 2.1 Airway Management
Refer to cardiac section (CCTTP 3.4 Cardiac Dysrhythmias and CCTTP 3.5 Cardiac Arrest) for dysrhythmia or cardiac arrest for ongoing management.
Note: Defibrillation and anti-dysrhythmic medications have limited efficacy unless core temperature is greater than is 30° C (or 86° F) or greater.
If the core temperature is less than 30° C (or 86° F) and the patient remains in cardiac arrest, consider the following:
One round of ACLS interventions with medications and defibrillation.
Continue rewarming techniques (including those active and passive external and internal rewarming procedures).
Once the temperature is greater than 30° C (or 86° F),
Continue appropriate cardiac resuscitation.
Refer to CCTTP 3.7 Targeted temperature Management. for salient points in resuscitation.
Consult medical control for decision for transport if there is thought to continue to treat severe hypothermia at a tertiary center that is able to complete active internal rewarming including:
Peritoneal lavage
Body cavity lavage
Closed thoracic lavage
Thoracotomy with mediastinal lavage
AND / OR a tertiary center that is able to complete extracorporeal rewarming:
Cardiopulmonary Bypass
Continuous Venovenous rewarming (CVVR)
Continuous Arteriovenous rewarming (CAVR)
Emergent hemodialysis
Termination of resuscitation can be considered if there is no response to above therapies and core temperature is above 32° C (90° F).

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9.3 DROWNING OR NEAR DROWNING

9.3.1 **Indications:**

Any patient involved in a near-drowning incident.

9.3.2 **Clinical Management:**

Conduct primary assessment for compromised airway, breathing, and circulation.
Simultaneously, maintain spinal precautions if indicated.
Monitor hemodynamics.
If the patient has evidence of a compromised airway or is unable to protect the airway, refer to CCTTP 2.1 Airway Management.
Consider the use of PEEP in the setting of ventilation in the drowning patient. Refer to CCTTP 10.8 Mechanical Ventilation.
If the patient has spontaneous respirations, administer supplemental oxygen to maintain oxygen saturations of greater than 93%.
If there is evidence of significant bronchospasm, proceed to CCTTP 2.8 Acute Bronchospasm.
Begin or maintain cardiopulmonary resuscitation immediately as indicated.
Refer to CCTTP 3.5 Cardiac Arrest.
Establish two large bore IV's with 0.9% NS at TKO.
If there is concern for altered mentation, consider a fingerstick blood glucose check
Refer to CCTTP 4.2 Diabetic Emergencies.
Evaluate core temperature:
Complete rectal or esophageal temperature for accuracy.
Treat per CCTTP 9.2 Hypothermia if rectal body temperature is compromised.
Maintain warm environment and protect patient from further heat loss.
If the patient is hypotensive, consider specific etiologies and resuscitate appropriately.
CCTTP 4.9 Refractory hypotension and shock.
CCTTP 6.10 Acute resuscitation of the unstable trauma patient.
If pulmonary edema is present and it is felt to be secondary to near drowning:
Consider appropriate airway management. Refer to CCTTP 2.1 Airway Management.
In the setting of pulmonary edema and the patient is intubated, consider the use of higher levels of PEEP. Refer to CCTTP 10.8 Mechanical Ventilation.
If O2 saturation cannot be maintained or improved, consider oxygenation strategies similar to CCTTP 2.9 Cardiogenic Pulmonary Edema.
Consider Foley catheter at referring institution to monitor urine output.
If the patient remains hypoxic, despite interventions, consider initiating a discussion for transfer arrangements to a facility capable of ECMO.

9.4 HYPERTHERMIA/HEAT STROKE

9.4.1 **Indications:**

Any patient with exposure to environmental heat or drugs that increase body temperature above normal with the resulting loss of body fluids and electrolytes.
Heat illness should be thought of as a spectrum of disease from mild heat cramps to heatstroke.
Hyperthermia is defined as elevated core temperature of greater than 38.5° C (101.3°F).

9.4.2 **See below for Definitions of types of Hyperthermia:**

9.4.3 **Clinical Management:**

Conduct primary assessment for compromised airway, breathing, and circulation.
Initiate hemodynamic monitoring, including blood pressure, heart and respiratory rate, end-tidal CO_2 and O_2 saturations.
If there is alteration in mentation or concurrent hypoxia, refer to CCTTP 2.1 Airway Management.
Avoid succinylcholine in intubation as many of these patients may have concurrent hyperkalemia.
Protect the patient from heat challenge. If core temp is above 105° F, cool the patient by radical cooling.
Consider delay in transfer to initiate evaporative cooling techniques.
Remove clothing.
Place wet sheet on patient and direct a large fan on the patient concurrently.
Place ice packs in axilla and groin and moisten exposed skin to facilitate evaporative cooling.
If delays in transport are not feasible, consider maintaining wet sheet on patient during transport if appropriate.
Discontinue radical cooling if:

- Shivering begins.
- CNS function returns to normal.
- Temperature normalizes to 39 °C.

Assess for altered mentation.
Complete Fingerstick Blood Glucose. Refer to CCTTP 4.2 Diabetic Emergencies. for evidence of impaired glucose values.
Review history and physical to assess for other etiologies of hyperthermia (exposures, medications, etc.).
If there is concern for fluid depletion, dehydration or hypovolemic shock:
Consider IV crystalloids to MAX of 30 ml/kg unless contraindicated.
Consider Foley and NG tube if appropriate.
NG tubes may be used in conjunction with managing provider for cases of hyperthermia to instill warmed fluids. Consult receiving team for specific details if applicable.

Heat Exhaustion	Heat Stroke
Normal to slightly elevated core temperature	Elevated core temperature, usually greater than 40.5°C
Fatigue or malaise	Vague prodrome of weakness, nausea, vomiting, headache
Orthostatic hypotension, tachycardia	Altered mental status: CNS symptoms including confusion, ataxia, coma, seizures, delirium
Clinical signs of dehydration	Hot, dry skin (however, in some cases diaphoresis may still be present)
Nausea, vomiting, diarrhea (due to splanchnic and renal vasoconstriction)	Hyperdynamic cardiovascular response [8] (high central venous pressure [CVP], low systemic vascular resistance [SVR], tachycardia)
Intact mental status	Elevation of hepatic transaminases, usually in the tens of thousands range
Responsive to cool environment, fluid and electrolyte replacement	Coagulopathy
	Rhabdomyolysis and renal failure

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9.5 ELECTRICAL AND LIGHTNING INJURIES

9.5.1 Indications

There are four common types of electrical injuries that may be encountered.
True electrical injuries - The person becomes part of the electrical circuit and has an entrance and exit site.
Flash injuries - Superficial burns caused by arcs that burn the skin, no electrical energy travels through the skin.
Flame injuries - Caused by ignition of the persons clothing by arc; electricity may or may not travel through the person's body.
Lightning injuries - A unique type of injury that occurs at extremely high voltages for the shortest duration; the majority of electrical flow occurs over the body.

9.5.2 Clinical management

Patients with an electrical injury must be treated as a trauma patient until proven otherwise with appropriate spine immobilization precautions in place.
Those patients in respiratory or cardiac arrest (typically in a lightning strike scenario), should be aggressively resuscitated with aggressive ACLS and /or trauma resuscitation techniques if indicated.
In lightning strikes, the most common reason for cardiac arrest is airway obstruction due to tongue relaxation.
Without evidence of traumatic injuries, refer to CCTTP 3.5 Cardiac Arrest.
With evidence of trauma, refer to CCTTP 6.10 Acute resuscitation of the unstable trauma patient.
In patients who are not in extremis, intravenous access, hemodynamic monitoring, and measurement of oxygen saturation should be started during the primary survey.
If there is alteration in mentation, the provider must assess for respiratory impairment:
Refer to CCTTP 2.1 Airway Management.
Once the patient is moderately stabilized, complete a 12-lead EKG for evaluation. Note:
ST segment elevation.
T-wave inversion.
QTc interval.
Cardiac ectopy and dysrhythmias.
Complete Istat evaluation of basic electrolytes and ABG as indicated.
Medical Therapy
Fluid replacement is the most important aspect of the initial resuscitation.
As with conventional thermal injury, electrical injuries cause massive fluid shifts with extensive tissue damage and acidosis
Refer to CCTTP 6.2 Burns for recommendations of fluid resuscitation according to American Burn Association Fluid Resuscitation guidelines.
If indicated, place foley catheter for monitoring urine output.
Discuss with providers (sending and receiving) for the option of:

Sodium Bicarbonate 1-2meq/kg bolus or infusion.
In severe cases, mannitol can be considered to promote osmotic diuresis per receiving trauma/ burn physician.
Surgical Therapy
Functional outcomes of electrical burn wounds are inversely proportional to the time lapsed before the start of the evaluation, resuscitation, and surgery.
As part of the nature of the electrical trauma, tissue damage leads to vascular thrombosis and skin and muscle necrosis.
During the acute evaluation, assess for wound severity, swelling, or evidence of impaired circulation (i.e. numbness, paresthesias, or loss of pulses / delayed capillary refill).
Many patients with significant electrical injuries may require fasciotomies in the acute phase for treatment of compartment syndrome.
Treat pain as per CCTTP 4.12 ANALGESIA for the patient without an advanced airway.
There is no indication for antibiotic therapy for a patient with an acute injury.

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10 PROCEDURES

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10.1 PACKED RED BLOOD CELLS (PRBC) AND NEVER FROZEN PLASMA (NFP) ADMINISTRATION

10.1.1 Indications for PRBC's:

- Adult and pediatric patients eligible for pack red blood cell administration.
- Adult patients with signs and symptoms for hemorrhagicum shock with concurrent history of acute blood loss (secondary to surgical or medical ideologies) despite appropriate resuscitation with crystalloids and adequate hemorrhage control.
- Clinical indication for hemorrhagicum shock requiring Patrick blood cell transfusion include the following:

Adults:

- Heart rate greater than 100 bpm.
- Systolic blood pressure less than 100 mmHg.
- Altered mental status with signs and symptoms consistent with hemorrhagic shock.
- Pallor.
- Delayed capillary refill.
- Common ideologies of hemorrhagic shock to include (but not limited to):
    - Trauma.
    - Blunt or penetrating trauma to the chest, admin, and pelvis.
    - Pelvic fractures or suspected pelvic instability.
    - Amputations proximal to the knee or multiple amputations (regardless of vital signs).
    - Continued bleeding without the ability to control exsanguination.

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Medical:

- Acute (non-traumatic) medical hemorrhage.
- Massive gastrointestinal hemorrhage.
- Great vessel disruption.
- Postpartum hemorrhage.

Pediatrics:

- Tachycardia.
- Signs and symptoms of impaired organ perfusion.
- Temperature instability.
- Relative hypotension (based upon age and weight of the child).

10.1.2 Indications for Never Frozen Plasma

Adults:

- Evidence of hemorrhagic shock with clinical signs and symptoms as noted above with the following laboratory findings:
- Base access < -6.0.
- Hemoglobin < 11 g/dL.
- Platelets < 200,000.
- Life-threatening bleeding from any source with an elevated INR of > 1.7.
- Anticipated emergent or urgent invasive/surgical procedures with concurrent life-threatening hemorrhage.
- Acute disseminated intravascular coagulation with concurrent life-threatening hemorrhage.
- Intracerebral hemorrhage with INR > 1.7 (traumatic and/or non-traumatic).
- To include patients with intracranial bleeding (epidural and subdural hematomas, some raccoon or intraparenchymal hemorrhages)
    - Note: Elevations in the INR can result from multiple clauses including Coumadin therapy, congenital factor deficiency, liver disease, and acute coagulation of trauma.

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Pediatrics:

- Currently, the administration of never frozen plasma is currently being withheld in patients less than 16 years of age and < 50 kg.

Contraindications:

Documented intolerance to plasma or its components.

Congenital deficiency of IGA in the presence of anti—IGA antibodies (this information is rarely identified prior to patient contact and thus it is imperative that providers monitor for signs and symptoms of anaphylaxis with plasma transfusions).

Note: If a LifeFlight team is caring for a patient who has continued to demonstrate hemodynamic instability from a traumatic injury or medical condition with significant hemorrhagic shock, infusion of liquid plasma and packed red blood cells should be in a 1:1 ratio. Additionally, if resuscitation is occurring, the use of Tranexamic acid (TXA) should be considered. Lastly, in the setting of trauma, PRBCs should be administered first

for oxygen carrying capacity. If the patient has already saved PRBCs and the ratio is not 1:1, then the first product should be Never Frozen Plasma.

10.1.1 **Clinical Management:**

If available, one unit of Group A Liquid Plasma (LP), one unit of O-negative blood, and one unit of O-positive blood will be properly packed in a travel pack with ice for all LOM flights. A temperature indicator attached to the blood should be visible inside the cooler. Blood products must stay in travel pack with ice. If removed and not transfused, blood products will have to be discarded.

Remove the blood products from the cooler and check the temperature indicator. Use only if proper temperature of 4 to 6 º Celsius is maintained. Record temperature status, blood and LP unit #, and the time the transfusion was initiated in the patient care record.
O Positive PRBC's- Female patients KNOWN to be 50 years of age and older and all male patients.

O Negative PRBC's- If age is uncertain or female patient less than 50.

Consider placing blood products in a pressure bag for rapid administration.
Initiate transfusion as per NLEMMC PCD 11.008 and CMMC "Administration of Blood Components."

Return the completed transfusion documentation to the blood bank. Unused blood must be returned to LOM blood bank refrigerator upon return to the base hospital.

Note on Transfusion Reactions:

If a transfusion reaction is suspected, stop transfusion immediately and present suspect blood unit and tubing to receiving facility for testing. Refer to other appropriate protocols such as 2.7 Pulmonary Edema, 4.1 Anaphylaxis or 4.9 Refractory Shock and Hypotension

If a suspected transfusion reaction has occurred, notify base hospital blood bank as soon as possible upon completion of transport, and complete transfusion reaction (blue) form for NLEMMC and Transfusion Reaction Protocol form for CMMC.

10.2 TRANEXAMIC ACID (TXA)

10.2.1 Indications:

Involved in trauma (blunt or penetrating). History of present illness is documented in chart.
Eligibility:

- Age ≥ 16 years and the following:
- Signs and symptoms consistent with severe hemorrhage (internal or external bleeding) .with unstable hemodynamics as evidenced by tachycardia, hypotension or other evidence of shock.
- Tachypnea greater than 24 breaths per minute or bradypnea less than 10 breaths per minute.
- Evidence of peripheral vasoconstriction including cool, pale skin, and delayed capillary refill of greater than two seconds.
- Duration since the time of initial injury is less than 180 minutes (3 hours). Preferably less than 60 minutes since initial traumatic insult.
- LifeFlight staff can consult with medical control for those patients who may benefit from this medication, including impending hemodynamic instability that staff feels will require additional colloid transfusion.

10.2.2 Contraindications

- Time elapsed from initial insult greater than 180 minutes or time elapsed since injury is unknown.
- Patients younger than 16 years old.
- Patients greater than 24 weeks pregnant (or pregnant with fundus above the umbilicus suffering hemorrhagic shock secondary to trauma.
- Those patients who have clear contraindication for antibrinolytic therapy agents (i.e. thrombotic disease and disseminated intravascular coagulation, etc.)
- Concurrent use of TXA and rFVIIa or PCC's is CONTRAindicated.
- Patients with hemorrhage due to G.I. bleeding.
- Medical Control discretion as to the appropriateness of antifibrinolytic agents in this patient.

10.2.3 Clinical Management:

Assess and manage airway, breathing, and circulation (ABC's) with simultaneous C-spine immobilization/stabilization. Treat life-threatening injuries as they are discovered as outlined in CCTTP 6.10 Acute resuscitation of the unstable trauma patient

If the patient remains hemodynamically unstable and staff suspect that the patient will continue to require aggressive colloid administration in the next 24 hours, administer tranexamic acid as described.

Tranexamic Acid: 1g IV mixed in a 250ml of 0.9% NS over 10 minutes in a dedicated IV line, if possible).

Note: During initial report to the hospital and at the time of transition of care to hospital staff, please record time of injury and time of TXA initiation.

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10.3 MANAGEMENT OF COAGULOPATHY

10.3.1 Indications:

Patients on anticoagulant therapy with prolonged coagulation times with traumatic injuries or surgical emergencies anticipated to require immediate operative intervention.

10.3.2 Clinical Management:

Administer Vitamin K (phytonadione), Liquid Plasma (LP), Never Frozen Plasma (NFP), Prothrombin Complex Concentrate (PCC) and Cryoprecipitate according to the guidelines.

10.3.3 Pearls, Pitfalls and Considerations:

The use of intravenous Vitamin K has become more mainstream.
The possibility of anaphylaxis has lessened in recent years but can still can occur.
Oral and intravenous Vitamin K are the preferred routes of administration over subcutaneous Vitamin K because of the erratic absorption rate of subcutaneous Vitamin K.
Subcutaneous administration is no longer indicated.
OLMD should be consulted before administering Prothrombin Complex Concentrate (K-Centra) platelets or cryoprecipitate.
Communication between sending facility and receiving facility is valuable due to the delay in obtaining some blood products and their availability as some facilities.
There has been some data in the use of PCC in the setting of reversing direct 10a inhibitors (including Apixaban, Edoxaban, fondaparinux, and rivaroxaban.)
Be aware that some providers will request that 4 factor PCC can be used as an adjunctive reversal agent.
Additionally, some data also supports the use of cryoprecipitate for the reversal of patients who have received fibrinolytic therapy with hemorrhagic conversion.

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Indications	Recommended Action
Serious or life threatening internal or extracorporeal hemorrhage and/or high probability of emergent surgical intervention with INR greater than 1.7 or PTT greater than 45 seconds.	If the patient has serious bleeding or rapid reversal is indicated for immediate surgical intervention: Discontinue use of anticoagulants, monitor the INR until it falls within the therapeutic range, administer **Liquid Plasma** and/or consult with OLMD for the use of **Fresh Frozen Plasma** and **PCC.**
Serious or life threatening internal or extracorporeal hemorrhage and/or high probability of emergent surgical intervention with INR greater than 1.7 or PTT greater than 45 seconds in patient population undergoing Coumadin therapy.	If the patient has serious bleeding or rapid reversal is indicated for immediate surgical intervention: Discontinue use of anticoagulants and monitor the INR until it falls within the therapeutic range. Administer **Never Frozen Plasma** and **Vitamin K** 10mg in 50 mL 0.9% NS IV administered over a period of 20 minutes, and/or consult with OLMD for the use of **Never Frozen Plasma**

Serious or life threatening internal or extracorporeal hemorrhage and/or high probability of emergent surgical intervention with Fibrinogen less than 150mg/dl.	If the patient has serious bleeding or rapid reversal is indicated for immediate surgical intervention: Consider **Cryoprecipitate** (Consult with OLMD)
Serious or life threatening internal or extracorporeal hemorrhage and/or high probability of emergent surgical intervention with Platelet count less than 75,000/mm3	If the patient has serious bleeding or rapid reversal is indicated for immediate surgical intervention: Consider **Platelet** transfusion (Consult with OLMD)
Patient who has received a large amount of blood products and have an Ionized Calcium level below 1.0	Administer **Calcium Gluconate** 1 gram IV over 10 minutes.

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10.4 RAPID REVERSAL OF COAGULOPATHY IN NON-TRAUMATIC INTRACRANIAL HEMORRHAGE

10.4.1 Indications:

Patients with identified active intracerebral bleeding.
Patients who are on Vitamin K antagonist therapy (warfarin, Coumadin, Jantoven).
International Normalized Ratio (INR) greater than 1.7
There is some data now that supports the use of PCC in the setting of reversing the effects of direct 10a inhibitors (Apixaban, edoxaban, fondaparinux, and rivaroxaban)

10.4.2 Contraindications:

Patients with a history of thromboembolic event (deep vein thrombosis, pulmonary embolism or ischemic stroke) within the last three months.
Urgent reversal for surgery in the absence of active major bleeding (i.e. this therapy is not indicated for the sub-acute or chronic bleed).
Patients with hypersensitivity to K-Centra or any of its components (factors, heparin, and albumin).
Patients with disseminated intravascular coagulation (DIC).
Patients with suspected or confirmed heparin-induced thrombocytopenia.
Patients whose care is deemed futile.

10.4.3 Clinical Management:

Establish patent intravenous intravascular access with large bore IV.
Confirm via CT scan, the intracerebral hemorrhage.
Consider INR by laboratory staff at sending facility.
Identify both inclusion and exclusion criteria.
Initiate Vitamin K (Phytonadione) IV 5-10 mg.
Identify receiving physician and provide extensive history and physical findings.
Obtain order from physician for administration of K-Centra.
Document date, time, and name of the ordering physician.
Clarify with provider that his or her name will be the name on the medical record for the administration of therapy.
Document time of administration, route, dose, and any complications.
In hand-off report to receiving staff, relay information in detail to accepting provider in person.
IT IS NOT SUFFICIENT TO GIVE REPORT TO ACCEPTING ANCILLARY PERSONNEL.

10.4.4 Dosing Guidelines

Dosing per sending clinician.

10.5 EZ-IO INTRAOSSEOUS VASCULAR ACCESS

10.5.1 Purpose:

To establish criteria for the initiation of intraosseous infusion on critically ill or injured adult and pediatric patients.

10.5.2 Policy:

This procedure us to be performed using the EZ-IO AD for patients weighing 40 kg and over, and the EZ-IO PD for patients weighing 3-39 kg.

10.5.3 Indications:

Patients who meet any of the following criteria:
In need of vascular access for volume replacement, blood or medication administration, and who have either poor vein selection or failed access attempts (> 2 attempts or > 90 sec.).
Decreased level of consciousness (GCS < 6 with no purposeful movement) due to medical or traumatic insult or injury.
May be used on conscious patients; consider Lidocaine anesthetic.

10.5.4 Contraindications:

Fracture of the bone selected for IO infusion. (Consider alternate site).
Excessive tissue at insertion site with absence of anatomical landmarks. (Consider alternate site).
Previous significant orthopedic procedures (IO within 24 hours; if prosthesis consider alternate tibia).
Infection at the site selected for insertion. (Consider alternate site).
Not intended for prophylactic use.

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10.5.5 Special Notes:

All medications and blood or blood products that are administered via the IV route may be administered IO.
Device may be left in place for up to 24 hours.

10.5.6 Equipment:

EZ-IO® Driver.
EZ-IO AD® or EZ-IO PD® Needle Set.
Alcohol or Betadine Swab.
EZ-Connect® or Standard Extension Set.
10 ml Syringe.
Normal Saline (or suitable sterile fluid).
Pressure Bag or Infusion Pump.
Lidocaine (preservative free).
EZ-IO® Yellow wristband.

10.5.7 Clinical Management:

Assemble and prepare all equipment, including bag of normal saline with tubing purged.
Maintain standard precautions.

PROCEDURES

Determine EZ-IO AD or EZ-IO PD indications.
Evaluate for contraindications.
LifeFlight of Maine approved insertion sites are
- Proximal humerus (adult only)
- Proximal tibia (adult and pediatric)
- Distal femur (pediatric)

Prepare the insertion site using aseptic technique
Prepare the EZ-IO driver and appropriate needle set
Stabilize the site and insert appropriate needle set
Remove EZ-IO driver from the needle set while stabilizing the catheter hub
Remove the stylet from the catheter, place stylet in shuttle or approved Sharps container
Confirm placement, connect primed EZ connect.
Syringe flush the EZ-IO catheter with the appropriate amount of Normal Saline.
Check for infiltration.
Adult:
If time allows and not contraindicated, infuse 40 mg **2% Lidocaine (without Epinephrine**) over 120 seconds to minimize pain during infusions.
Allow medication to dwell in IO space for 60 seconds, if possible.
Flush with 5-10 ml Normal Saline.
Slowly administer **2% Lidocaine (without Epinephrine**) over 60 seconds.

Infant/Child:
If time allows and not contraindicated, infuse 2% **Lidocaine (without Epinephrine)** 0.25 mg/kg, MAX 20 mg over 60 seconds

Allow medication to dwell in IO space for 60 seconds, if possible.
Flush with 2-5 ml Normal Saline.
Begin infusion utilizing pressure i.e. syringe bolus, pressure bag, or pump for continuous infusion where applicable.
Dress site, secure tubing, and apply wristband as directed.
Monitor EZ-IO site and patient condition.
Document procedure attempt, needle size, location and assessments, including patency and how procedure/intervention were tolerated.

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10.6 SCALP WOUND STAPLING FOR HEMORRHAGE CONTROL

10.6.1 Indications:

To assist in the control of bleeding from scalp wounds.

10.6.2 Contraindications:

Staples can be applied over bones and viscera; however, during application there must be a distance of not less than 6.5 mm from the surface of the skin to the underlying bone, vessel or viscera.

The skin stapler is provided sterile and is intended for one-time use only. Discard after use.

The use of the skin stapler should not delay transport.

10.6.3 Clinical Management:

Remove any dressings and inspect the wound.

With gloved hand, hold edges of laceration together.

Place tip of stapler onto skin and squeeze lever. One staple at a time will penetrate the skin and hold the skin closed.

If skull or brain tissue is visible, a saline soaked dressing may be applied over the wound first, prior to stapling.

During closure of the wound, a largely protruding piece of gauze should remain visible to alert the receiving facility as to the contaminated nature of the closure.

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10.7 PELVIC BINDER

10.7.1 Indications:

The pelvic binder will be used to provide stabilization, aid in pain management, and attempt to lower the mortality rate when caring for patients that have possible pelvic fractures.

10.7.2 Clinical Management:

Assess for abrasions or contusions around the pelvic area.
Assess for superficial hematoma above the inguinal ligament, scrotum, and thigh.
Assess limb length discrepancy and deformity.
Assess pelvic stability by bimanual compression of the iliac wings.
Examine the external rectal, penile, and vaginal areas for bleeding.
Slide the binder under the supine patient. If a sheet has been placed as a binder, gently remove.
Center binder over greater trochanters.
Cut the free end of the binder to leave 6-8" gap.
Attach Velcro straps and plate to free end of binder.

10.7.3 Considerations:

Binder should be snug. The provider should not be able to get more than 2 fingers between binder and patient.
The binder can be left in place for 24-48 hours.
The application of the binder should not delay transport.

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10.8 MECHANICAL VENTILATION

10.8.1 **Indications:**

Ventilation of patient with an indwelling tracheal or supraglottic airway.
Special Considerations:
All patients with an artificial airway in place must be accompanied with an appropriate sized Bag Valve and mask, a 10 cc syringe during transport, and viral (HEPA filter).
Lung protective ventilator strategies should be used on all patients.
Obstructive ventilator strategies (permissive hypercapnea and prolonged expiratory time) should be used on all patients with concern for, or presence of, autoPEEP. These patient may also have a substantially elevated serum bicarbonate level.
Continuous monitoring of waveform capnography is required.
Notification of a LOM Medical Director is necessary if this cannot be achieved.
The morphology of the waveform should be documented in the PCR.
SIMV in the transport of acutely ill patients is rarely indicated.
If used, assure adequate pressure support to reduce increased work of breathing for patient triggered breaths.

10.8.2 **Contraindications:**

None.

10.8.3 **Procedure:**

Trigger
Volume Control Ventilation is generally the standard breath type unless:
Ventilation is suboptimal due to high PIP alarms.
Poor oxygenation exists, despite appropriate alveolar recruitment with PEEP to 20.
Flow requirements cannot be met with current compliance and inspiratory times.
The patient is found ventilating well in PRVC or PCV, and this modality can be safely continued during transport.
Pressure Regulated Volume Control
Breaths are delivered in a decelerating inspiratory flow pattern to a target pressure, calculated from the previous breath, maximizing mean airway pressures when used in concert with PEEP.
The target pressure is adjusted as patient's pulmonary compliance changes, based on the desired volume.
The maximum allowed target pressure will be at least 5 cmH_20 less than the set High Airway Pressure Alarm setting.
Caution should be used in spontaneously breathing patients as variability in tidal volumes can be extreme.
Caution should be used in obstructive lung disease patients as rapidly changing compliance can preclude adequate ventilation.
If in CPAP mode (rarely used), it is imperative to have pressure support dialed in as well to maintain an adequate spontaneous Vt and monitor signs of elevated PCO_2 with change in mental status.

Lung protection
Vt (Tidal Volume) should be 8 ml/kg IBW (Ideal Body Weight)
Ideal Body Weight (calculated based on height measured in inches)
MALE: 50 + 2.3 (Height-60)
FEMALE: 45.5 + 2.3 (Height-60)
Reduce Vt until pPLAT (plateau pressure) < 30
Tidal volumes as low as 4 ml/kg can be used if necessary
CAUTION
Consider increasing rate to maintain Ve (minute ventilation)
Closely monitor I:E (Inspiratory Expiratory Ratio) and avoid inverse ratio ventilation
Oxygenation
100% FiO_2 should be utilized until PO_2 is identified or obtained and is > 90mmHg
PEEP should be initially 5 cmH2O on all patients
While strategies exist that address hypoxia with sequential increases in PEEP and FiO2, hyperoxia and free oxygen radicals have not been shown to be of concern in the acute resuscitative phase of an injury or illness.
PEEP should be increased to 20 cmH2O to promote alveolar recruitment, prior to reflexively moving to pressure control ventilation.
PEEP may also be increased to reduce FiO2 requirements in the long-term setting.
Ventilation
Ventilatory RATE
Used to control minute ventilation to accommodate patient needs as they relate to pCO2 and respiratory acidosis.

$$\frac{Current\ Respiratory\ rate\ x\ pCO2}{Desired\ pCO2} = New\ Respiratory\ Rate$$

Note: When making adjustments, it is imperative to recall that for every change of 10 in PCO_2, pH will change by .08 in the opposite direction. Sometimes the desired PCO_2 may not be the normal (40) but higher if they retain CO_2, examine the HCO_3 and to make this determination.
Flow and I:E ratio
Inspiratory time (i-Time)
Reducing the i-Time increases flow (VCALC)
Reducing the i-Time will increase the Peak Inspiratory Pressure
Be cognizant of I:E ratio and inadvertent inverse ratio ventilation.
If the patient has high flow demands that cannot be achieved in Volume with changes to the I time or Vt, consider changing to PCV as the patient has 180 lpm available and may become more comfortable with this type of ventilation.

10.9 NON-INVASIVE MECHANICAL VENTILATION (NPPV)

10.9.1 **Special Considerations:**

NPPV with a transport ventilation is NOT identical to Bi-Level positive airway pressure ventilation.
Alterations in the ventilator settings in an attempt to mimic BiPAP are necessary.
Care should be taken to develop a rapport between the Revel ventilator and the patient when using NPPV

10.9.2 **Indications:**

Adult patients with respiratory compromise of sufficient severity to warrant ventilatory support where intubation is not desired or immediately necessary.
Respiratory distress with moderate to severe dyspnea, use of accessory muscles, and abdominal paradox.

10.9.3 **Contraindications:**

Apnea
Recent surgery to face, upper airway or upper GI tract
Altered level of consciousness
Emesis
Absent or insufficient ability to protect the airway

10.9.4 **Procedure:**

Mask Seal
Minimal air leaks will cause a “blower demand” alarm, significantly altering respiratory assistance from the ventilator.
Reduce IPAP by 2-4 from sending BiPAP
Consider changing Rise Time and Flow Termination
Rise Time set to Profile 2
Flow Termination set to 40%
Manage anxiety and alarms
Connect to patient

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10.10 BRONCHODILATOR ADMINISTRATION FOR VENTILATED ADULT PATIENTS

10.10.1 Objective:

To enable the Critical Care Transport Team to administer bronchodilator therapy to intubated adult patients who are actively wheezing or exhibiting other signs of airflow restriction on exam.

10.10.2 Pearls, Pitfalls and Considerations:

Combivent is Albuterol and Atrovent (ipratropium bromide) mixed together as one medication.
Atrovent is contraindicated for patients with allergies to soy lecithin or related food products such as soybeans or peanuts.
High dose bronchodilator therapy may be necessary to reverse the bronchospasm associated with acute asthma.
Consider appropriate steroid therapy to accompany the inhaled bronchodilators. See CCTTP 2.8 Acute Bronchospasm

10.10.3 Clinical Management:

Any multi-dose inhaler (MDI) must be "activated" prior to use.
Shake well and do three priming sprays before administering the medication to the patient.
The MDI adaptor should be placed on the inspiratory limb of the circuit (not the limb with the PEEP valve) between the corrugated tubing and the wye. The blue arrow on the MDI adaptor should be pointing to the patient.
Albuterol MDI should be administered as close as possible to the beginning of the inspiratory cycle.
There should be a delay of approximately 30 seconds between puffs.
The MDI canister should be removed from the ventilator tubing and shaken between puffs.
Be sure the MDI adaptor cap is closed whenever the MDI is not in place to prevent leaks from the ventilator circuit.
Consult OLMD prior to administration of either medication if patient's heart rate is greater than 150.
Subsequent bronchodilator therapy should consist of **Albuterol** MDI, up to 8 puffs, repeated as necessary at 20-minute intervals.

10.11 TRANSVENOUS/EPICARDIAL (TEMPORARY) PACEMAKER

10.11.1 Indications:

A temporary pacing electrode is utilized to increase the heart rate in the bradyarrhythmias and asystole or to overdrive pace tachyarrhythmias.
It may also be used prophylactically following a myocardial infarction and for diagnostic testing (pacing induced ischemia).

10.11.2 Preparation:

Explain the procedure to the patient.
Assemble the necessary equipment/supplies.

10.11.3 Insertion and Care:

The pacing electrode insertion is done by a physician qualified in the procedure.
The LOM provider may assist insertion as follows:
Monitor the patient's heart rhythm.
Prepare the external pacing generator:
Set the mA at 6 or as suggested by the sending physician
Set the rate at 10 bpm below the patient's intrinsic rate or that of the TCP
Set the sensitivity fully clockwise (most sensitive)
Connect the proximal (+) and the distal (-) leads to the extension cable.
Tighten the connectors securely, but do not tape the connections.
Note the depth of the pacer wires as per any venous cannulated device
Turn on the external generator and observe the EKG monitor for evidence of pacing and capture.
Turn the sensitivity control counterclockwise slowly until the pacemaker begins to fire; This is the threshold
Set sensitivity at one-half the threshold value
Cover the insertion site with a sterile dressing.
Be sure the pacing electrode position is anchored securely with tape.
Secure the pacing generator and place the plastic cover over the pacemaker controls.
Obtain portable CXR for electrode placement after insertion.
Note: This is a different indication than obtaining an x-ray after an airway is completed. Please evaluate for PTX or pneumopericardium.

10.11.4 Considerations:

Monitor the patient's heart rhythm closely during insertion.
Ventricular irritability is common as the electrode is positioned in the right ventricle.
When the "paceport" PA catheter is inserted, a continuous infusion regulated by an infusion pump must be connected to the orange port.
This will maintain patency of the port in the event the Chandler probe needs to be repositioned.
The pacing lumen will accommodate infusions up to 30 ml/hr.
Document depth of insertion of pacing catheter.
The electrical safety precautions include the following:

All line-powered equipment must be grounded (i.e., pronged plugs).
Non-sterile gloves are worn when handling the exposed electrode tips.
The pacing electrode tips should be individually insulated when not connected to the pacing generator.
Failure to capture is usually due to electrode displacement or a high stimulation threshold in the electrode area. The LOM provider should:
Check and tighten all connections.
Increase the pacemaker output/mA.
Turn the patient to a left lateral recumbent position.
Consider contacting receiving cardiologist if effective capture is not regained after the above interventions.
Monitor the patient closely, manage accordingly to ACLS guidelines as needed.
Prepare to reposition the transvenous pacing electrode if needed.
Place the external pacer on the patient and pace if needed for symptomatic bradycardic arrhythmia.
Failure to pace without a spike present is usually caused by a broken or loose connection, electrode fracture, inhibition of pacemaker output, battery or circuit failure. The LOM provider should:
Check and tighten all connections.
Check for any equipment that might cause electrical interference and remove if possible.
Replace the batter and/or pacing generator.
Place the external pacer on the patient and pace if needed for symptomatic bradycardic arrhythmia.
Monitor the patient closely, manage according to ACLS guidelines as needed.
Failure to “sense” occurs when the pacemaker does not sense an intrinsic beat. Competitive pacing spikes or complexes are seen on the EKG. With failure to sense, the under-sensing leads to over-pacing. The LOM provider should:
Check and tighten all connections.
Check the sensitivity setting; make it as sensitive as possible. (Dial set fully clockwise at 5 o’clock).
Place the patient in a position where adequate sensing was last observed. A left lateral recumbent position may help.
Increase the pacing rate to override the intrinsic rhythm, if possible.
Turn the pacemaker off if it is not needed, but do not disconnect from the electrode wires.
Notify the physician of this immediately.
Monitor the patient closely if effective sensing is not regained after the above interventions.
Over-sensing usually occurs because the pacemaker sensitivity is set too high.
It should be suspected when pauses are seen intermittently on the EKG or when the paced rate falls below that set on the pacemaker generator.
This pacemaker induced problem may be mistaken for electrode fracture or impending generator failure.

Over-sensing leads to under-pacing.
The LOM provider should:
Decrease the sensitivity on the pacemaker (turn the dial counter clockwise).
Replace the pacemaker generator if the problem continues.
Consider transcutaneous pacing.

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10.12 NEEDLE THORACOSTOMY

10.12.1 **Indications:**

Tension pneumothorax

10.12.2 **Equipment:**

Turkel needle
10 ml syringe
Scalpel
Lidocaine and 5 ml syringe with needle

10.12.3 **Clinical Management:**

TURKEL:
Identify landmarks and cleanse site with Chlorhexadine or other suitable antimicrobial.
Make a small stabbing puncture over the 2nd rib with scalpel. Consider Lidocaine local anesthetic if available.
Introduce the Turkel device through the 2nd intercostal space using sufficient pressure to detect movement of the color indicator within the handle.
The indicator will change color to pink when the blunt cannula is in the retracted position within the needle shaft and the sharp bevel of the needle is exposed.
Advance the device to the desired depth at 90° to the skin (perpendicular)
The indicator will change to green, signaling the device has entered a "free cavity" or failure of the safety mechanism resulting in an exposed sharp needle bevel and the needle should be removed.
The fenestrated catheter may be left in place once the needle has removed, if it is determined that the catheter is indeed in the pleural space.
Attach a syringe to the back of the needle and aspirate air and/or fluid to confirm placement.
The needle can be removed and the fenestrated catheter left in place and/or used for drainage, or to periodically aspirate air.
Once the needle is removed from the fenestrated catheter, a ball lock device will engage, prohibiting reinsertion of the needle. Do not attempt to reinsert the needle into the catheter.
Secure the fenestrated catheter to the skin with tape and periodically open the distal valve to allow air to escape.
If a previously functioning catheter stops functioning, attempt to push sterile saline through the catheter to dislodge any clot that may have occluded the fenestrations or proximal openings.
If patient is burned or excessively dirty about the insertion site
Administer **Ceftriaxone** 75 mg/kg to MAX 2 grams
If above not available, **Cefazolin**
< 40 kg; contact receiving clinician
40-80 kg; 1 gram
> 80 kg; 2 grams

10.12.4 **Note: If there is no relief, proceed to Simple Thoracostomy (CCTTP .13 Simple Thoracostomy) if indicated.**

10.13 SIMPLE THORACOSTOMY

10.13.1 **Indications:**

This procedure should only be done in patients in extremis, when there remains clinical signs of a tension pneumothorax despite at least 2 needle/Turkel thoracostomies.
In obese patients, the 5th intercostal space anterior axillary line should also be used.
The patient must be intubated and on supportive ventilation. Consider local anesthesia with lidocaine.

10.13.2 **Clinical Management:**

Prepare the axillary area on the symptomatic side with betadine and drape in the usual sterile fashion.
The point of insertion occurs at a line drawn from the armpit (anterior axillary line) to the side (lateral) of the nipple in males, or to the side (about 2 inches) above the sternoxiphoid junction in females.
Make a 3-4 cm incision through the skin and subcutaneous tissues between the 4th and 5th ribs.
Continue the incision through the intercostal muscles, right down to the pleura.
Using a Kelly clamp, **go over the top of the chosen rib** (see below) and enter the pleura.
Enter the pleural space and spread the forceps widely.
Insert gloved finger through your incision and into the thoracic cavity.
Make sure you are feeling lung (or empty space) and not liver or spleen.
Cover the incision with a bulky, but loose dressing.
Reinforce or change, if necessary, but do not allow dressing to become occlusive.
Repeat steps above, if indicated.
All patients receiving any thoracostomy procedure should have ample pain control and sedation as per protocol.

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10.14 TUBE THORACOSTOMY

10.14.1 Indications:

This procedure should only be done with an attending physician. LFOM staff are credentialed to assist the placement of a chest tube, but currently are not validated for independent placement.

The patient must be intubated and on supportive ventilation.

10.14.2 Clinical Management:

Prepare the axillary area on the symptomatic side with betadine and drape in the usual sterile fashion.

The point of insertion occurs at a line drawn from the armpit (anterior axillary line) to the side (lateral) of the nipple in males, or to the side (about 2 inches) above the sternoxiphoid junction in females.

Make a 3-4 cm incision through skin and subcutaneous tissues between the 4th and 5th ribs.

Continue the incision through the intercostal muscles, right down to the pleura.

Using a Kelly clamp, go over the top of the chosen rib (see below) and enter the pleura.

Enter the pleural space and spread the forceps widely.

Insert gloved finger through your incision and into the thoracic cavity.

Make sure you are feeling lung (or empty space) and not liver or spleen.

Grasp end of the chest tube (32-36 Fr in adults; 18-24 in children) with the Kelly forceps and insert through the hole in the pleura into the thoracic cavity.

Remove Kelly and manually advance tube superiorly and posteriorly.

Make sure that all fenestrations are within the chest.

Clamp outer tube end with Kelly. Suture and tape tube in place.

Attach end of tube to a Heimlich valve or a drainage system and connected suction.

Obtain post procedure CXR if time permits and services are available.

10.15 RADIAL ARTERY CANNULATION

10.15.1 **Indications:**

Consider arterial cannulation when two or more of the following indications exist:
Continuous monitoring of blood pressure in patients with recent history of hypotension and/or patients for whom you are suspicious of continued hypotension during transport.
Patients receiving one or more vasoactive medications, particularly when they must be precisely maintained within a narrow range of blood pressure.
Continuous monitoring of blood pressure in patients for whom hypertensive episodes are of particular concern for contributing to morbidity or mortality.
Determination of blood pressure in high acuity patients when other conventional means are not available or assessment of perfusion is compromised.
Access site for continuous ABG and electrolyte analysis in high acuity patients over a protracted transport time.

10.15.2 **Contraindications:**

Compromised circulation in the limb selected for cannulation.
Evidence of infection in limb selected for cannulation.
Time needed to perform procedure would unnecessarily delay patient transport in presence time sensitive injury or illness.
Cannulation in limb with dialysis shunt.
Patients under 40 kg.
Brachial, pedal and ulnar cannulation.

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10.15.3 **Cautions:**

INR over 1.8 and/or PT over 37 seconds.
Platelet count under 20,000.
Failed Allen's test (radial).
More than 2 attempts at cannulation.

10.15.4 **Equipment:**

250 or large bag of NS
Transducer set
Pressure bag
IV start pack
Gloves and eye protection
20 gauge Arrow cath set with integrated wire
Wrist immobilization
Lidocaine
Stat-Lock device

10.15.5 **Clinical Management:**

Select site to be cannulated with deference given to distal cannulation.
Consider utilizing ultrasound to identify site and guide during insertion.

PROCEDURES

Choose a site with the strongest palpable pulse with preference to the left side of the patient.
Radial:
Perform Allen's test in selected limb to determine collateral flow.
Consider utilizing ultrasound to verify ulnar artery blood flow via pulse-wave or color Doppler
Prepare equipment including setup and zeroing of pressure transducer line.
If radial site is selected, consider immobilization wrist in slight extension with towel roll or commercial immobilization device.
Consider local anesthetic injection of lidocaine.
Prep cannulation site with Chlorhexadine or other suitable antimicrobial agent.
Using aseptic technique, insert the catheter at a 45-degree angle.
Upon receiving blood return into the catheter, lower the angle of the catheter and slide the guide wire into the artery.
Stop if resistance is felt.
Reposition catheter and begin again if indicated.
If artery is punctured but not cannulated, direct pressure must be held on site for 120 seconds.
No more than two attempts at cannulation should be made at the sending facility.
Once wire is inserted into vessel, carefully slide catheter over the wire into the vessel.
Hold firm pressure over distal end of catheter in order to occlude blood flow out of catheter and remove/dispose of guide-wire assembly.
Attach pressure transducer line to hub of catheter and watch for favorable waveform.
Accidental undetected disconnection of pressure line from hub of catheter is a potentially fatal complication.
If waveform is not visualized, check connections, stop cocks, attempt to flush transducer pressure line and reposition catheter and/or limb.
Secure catheter with Stat-Lock device in addition to tape.
Apply tincture of benzoin around insertion site and tape pressure transducer line into place.
Monitor waveform and correlate NIPB with arterial pressure values.
Check for signs of bleeding and catheter dislodgement.
Cannulation site will be positioned so it is visible during transport.

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10.16 ESCHAROTOMY

10.16.1 **Objective:**

To establish a guideline for field escharotomy.

10.16.2 **Indications:**

The presence of burn trauma with one of the following:
Impending of established vascular compromise of the extremities or digits
Impending or established respiratory compromise due to torso burns (Burns do not need to be circumferential).

10.16.3 **Special Considerations:**

Escharotomy does not take precedence over primary airway, breathing and circulation interventions.
Avoid the ulnar nerve at the elbow and common perineal nerve at the knee. (See diagram for those and other areas to avoid).
Avoid incision on neck due to possibility of damaging great vessels.

10.16.4 **Clinical Management:**

Obtain baseline circulatory/respiratory status.
Provide pain control if indicated.
Clean site.
Using a sterile scalpel, perform incision through eschar sufficiently to see obvious separation of wound edges.
Control bleeding and cover with sterile dressings.
Reassess circulatory/respiratory status.
Elevate affected limb (s), if possible.
Chest:
Incise along the mid-axillary lines.
A transverse incision across the abdomen below the costal margin and/or the top of the chest can be made joining the vertical incisions.
Abdominal transverse incision may be especially important with pediatric patients.
Limbs:
Incisions should be performed on the mid-axial lines between flexor and extensor surfaces, bilaterally if indicated.
Use caution with incisions across the flexural creases of joints.

10.16.5 **See Diagram Below:**

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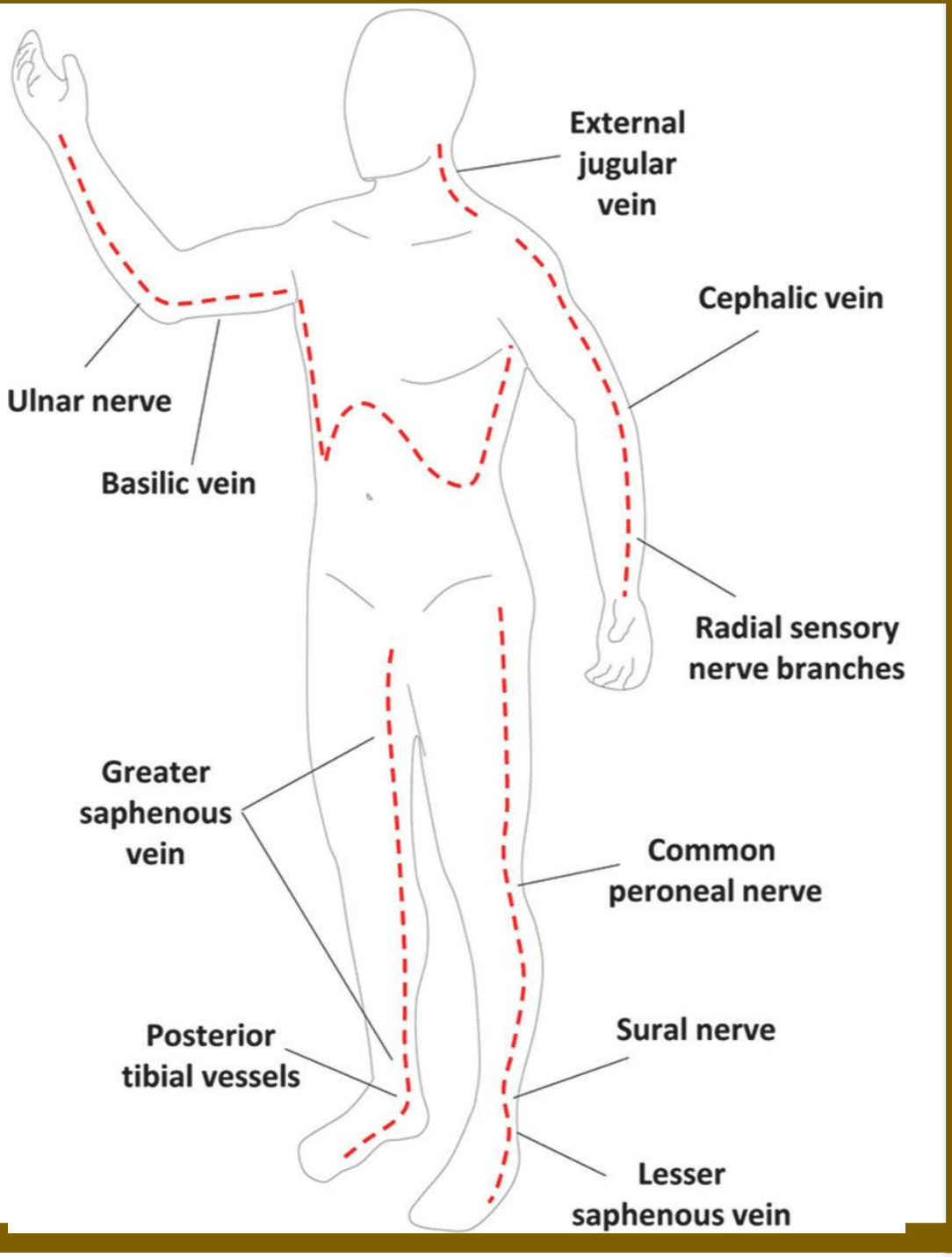
PROCEDURES


External jugular vein
Cephalic vein
Ulnar nerve
Basilic vein
Radial sensory nerve branches
Greater saphenous vein
Common peroneal nerve
Posterior tibial vessels
Sural nerve
Lesser saphenous vein

10.17 HEMOSTATIC GAUZE

10.17.1 **Objectives:**

To use impregnated hemostatic gauze to arrest acute exsanguination in the unstable patient.

10.17.2 **Indications:**

Severe bleeding

10.17.3 **Cautions:**

Known hypersensitivity to hemostatic dressing

10.17.4 **Clinical Management:**

Assure that the patient's airway is open and that breathing and circulation are adequate.
Apply oxygen if needed.
Immediately apply pressure directly on the wound with a sterile dressing. (Note: If available and bleeding is severe, a hemostatic dressing should be applied directly to the bleeding site simultaneously with direct pressure.
If bleeding soaks through the dressing, apply additional dressings while continuing well-aimed direct pressure.
If severe bleeding persists from the trunk, neck, head or other location where a tourniquet cannot be used, hemostatic gauze dressings should be used.

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10.18 SURGICAL CRICOTHYROTOMY

10.18.1 **Indications:**

To allow rapid entrance into the airway for ventilation and oxygenation when other means of airway control (BVM, intubation, etc.) have proven unsuccessful.

10.18.2 **Contraindications:**

The ability to obtain airway control and effective ventilation by less invasive means.
Pediatric patients (less than 8 years old).
Inability to identify proper landmarks.

10.18.3 **Equipment:**

Oxygen
Suction
Bag Valve mask
Using the Emergency Cricothyrotomy Cuffed set:
Betadine
#15 scalpel
10 ml syringe
Introducer needle
TFE introducer catheter
Wire guide
Curved dilator
Airway catheter (trach)
4 x 4's
Tracheal ties
For standard surgical technique:
Scalpel
6-7 ETT
Betadine
Gauze
Kelly clamp

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10.18.4 **Clinical Managements:**

Using the Emergency Cricothyroid Cuffed set:
Open the airway and position the head so the neck is clearly visible.
If the patient has sustained any type of spinal trauma, maintain cervical spine precautions at all times.
After locating and palpating the Cricothyroid membrane, clean the area thoroughly with Betadine or Chlorhexadine.
Stabilize the Cricothyroid membrane and make a vertical incision in the midline using the #15 scalpel blade.
The incision should be long enough to accommodate the dilator and trach.

Attach the 10 ml syringe to the 18-gauge TFE catheter and advance it through the incision into the airway at a 45° angle to the frontal place on the midline in a caudad direction.
While advancing the needle forward, verify correct placement in the trachea by aspirating for free air return.
Remove the syringe and needle, leaving the TFE catheter in place.
Advance the soft, flexible end of the wire guide through the TFE catheter into the airway several centimeters.
Remove the TFE catheter, leaving the wire guide in place.
Advance the handled dilator, tapered end first, into the connector end of the airway catheter until the handle stops against the connector.
Advance the dilator over the wire guide until the proximal stiff end of the wire guide is completely through and visible at the handle of the dilator.
It is important to always visualize and hold the proximal end of the wire guide during the airway insertion procedure to prevent its inadvertent loss into the trachea.
Maintain the wire guide position; advance the emergency airway access assembly over the wire guide with a rotating motion into the trachea.
Care should be taken not to advance the tip of the wire guide within the trachea.
Remove the wire guide and the dilator simultaneously.
Inflate the cuff.
Manually secure the tracheostomy tube while beginning to ventilate the patient using a Bag Valve mask.
Confirm placement by auscultating for equal, bilateral breath sounds and observing for equal, bilateral chest expansion.
Continuous waveform capnography should be used to confirm initial and ongoing patency of the advanced airway
Secure the tracheostomy tube in place with tracheostomy tape or ties/
Using standard surgical technique:
Open the airway and position the head so the neck is clearly visible.
If the patient has sustained any type of spinal trauma, maintain cervical spine precautions at all times.
After locating and palpating the cricothyroid membrane, clean the area thoroughly with betadine or Chlorhexadine.
Stabilize the cricothyroid membrane and make a 2cm vertical incision in the midline using the #15 scalpel blade.
Dissect bluntly through the subcutaneous tissues until the membrane is visible.
Carefully make a 2-3 cm horizontal incision through the membrane.
Use a curved hemostat to apply traction to the cricothyroid membrane allowing for tube insertion.
Insert and appropriately sized, cuffed endotracheal tube into the cricothyroid membrane incision, directing the tube distally into the trachea until the cuff is securely in the trachea.
Inflate the cuff.

Manually secure the tube while beginning to ventilate the patient using a bag valve mask.
Confirm placement by auscultating for equal, bilateral breath sounds and observing for equal, bilateral chest expansion
Continuous waveform capnography should be used to confirm initial and ongoing patency of the advanced airway
Secure tube.
Continue to assist ventilation via BVM with continual assessment of adequacy of ventilation.

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10.19 NEEDLE CRICOTHYROTOMY

10.19.1 Indications:

Inability to effectively ventilate the patient by any other means.
Pediatric patient (less than 8 years old) with inability to ventilate by any other means (surgical cricothyrotomy is contraindicated for this age group).
This procedure is only used for short term (<45 minutes) of ventilation and oxygenation.

10.19.2 Contraindications:

The ability to effectively ventilate the patient by any other means.
This procedure is not a substitute for airway control with a cuffed tube.

10.19.3 Equipment:

Bag Valve mask
Oxygen
Suction
Betadine
Jet ventilator

10.19.4 Clinical Management:

Open the airway and position the head so the neck is clearly visible.
If the patient has sustained any type of spinal trauma, maintain cervical spine precautions at all times.
After locating and palpating the cricothyroid membrane, clean the area thoroughly with Betadine or Chlorhexadine.
Attach the syringe to a 14-gauge angiocath.
Stabilize the cricothyroid membrane between the thumb and index finger.
Insert the catheter into the cricothyroid membrane at a 45° angle in a caudad direction.
While advancing the catheter, gently aspirate with the syringe.
When air is easily aspirated, the catheter lumen is in place in the trachea.
When the tracheal lumen is entered, withdraw the needle and advance the catheter.
The connector on a size 3 ETT will fit into the IV hub. Additionally, a 3 ml syringe with the plunger removed can be attached to the IV hub and the connector from a size 7 ETT should fit right into the barrel.
Attach either the BVM or jet ventilator to the catheter and ventilate the patient.
Confirm placement by auscultating the equal breath sounds and observing for equal, bilateral chest expansion.
Secure the catheter to the neck.
To ventilate using the thumb control on the valve
Deliver 100% oxygen in intermittent bursts; < 50 psi at a rate of 20 bursts/minute.

10.20 ENDOTRACHEAL TUBE CUFF PRESSURE

10.20.1 **Indications:**

Every cuffed endotracheal tube for both pediatric and adults must be monitored during transport.

10.20.2 **Contraindications:**

None.

10.20.3 **Equipment:**

Approved manometer for measurement of endotracheal tube cuff pressures

10.20.4 **Clinical Management:**

Using the approved manometer, attach the device to the endotracheal cuff pilot balloon.
Identify measurement.
Adjust the amount of air in the pilot balloon to achieve a pressure between 20–30 cm H_2O.

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10.21 FEVER

This protocol applies to patients with measured temperature is greater than or equal to 100.4º F or 38 º C who have not received any acetaminophen – containing medications in the past six hours, do NOT have underlying liver disease and are not allergic to acetaminophen.

1. If an infection is suspected, refer to CCTTP Sepsis.

2. begin passive cooling by turning on fan/air-conditioning in patient compartment and uncover patient.

3. If no contraindications to the use of acetaminophen exist, for patients five years and older and 20 pounds/9.4 kg or greater unless directed by either sending or receiving clinicians, consider the following options:

   a. Oral Acetaminophen chewable tab: 10–15 mg per kilogram routed to the nearest half tab (may be chewed or swallowed whole)

   b. IV Acetaminophen

   ≥50 kg: 650 mg every 4 hours or 1 g every 6 hours; maximum single dose: 1 g/dose; maximum daily dose: 4 g/day.

   <50 kg: 12.5 mg/kg every 4 hours or 15 mg/kg every 6 hours; maximum single dose: 15 mg/kg/dose (≤750 mg/dose); maximum daily dose: 75 mg/kg/day (≤3.75 g/day).

   c. Rectal Acetaminophen: 15mg/kg PR every four to six hours for a maximum of 650 mg suppository.

Pearl: rectal temperature is the most reliable temperature measurement, follow closely by oral and axillary routes. Temporal measurement of temperature has low reliability.

This protocol was adopted and updated from Maine EMS Gold 20. 2024

Dosing schedule for oral acetaminophen tablets:

Weight (lbs. /kg)	Dose	Number of 160mg chew tabs (double number for 80 mg tabs)
20 – 26 lbs. / 9.4 – 12.0 kg	160 mg	1 tab
27 – 32 lbs. / 12.1 – 14.7 kg	200 mg	1 tab
32 – 38 lbs. / 14.8 – 17.3 kg	240 mg	1.5 tabs
38 – 44 lbs. / 17.4 – 20.0 kg	280 mg	1.5 tabs
44 – 50 lbs. / 20.1 – 22.7 kg	320 mg	2 tabs
50 – 56 lbs. / 22.8 – 25.3 kg	360 mg	2 tabs
56 – 65 lbs. / 25.4 – 29.3 kg	400 mg	2.5 tabs
65 – 76 lbs. / 29.4 – 34.7 kg	480 mg	3 tabs
76 – 89 lbs. / 34.8 – 40.3 kg	560 mg	3.5 tabs
89 – 120 lbs. / 40.4 – 55.0 kg	640 mg	4 tabs
121 lbs. and up / 55.1 kg and up	960-1000mg	6 tabs

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11 PEDIATRICS

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11.1 PEDIATRICS

11.1.1 Notes from the State of Maine Pediatric Intensivist Staff:

Goals:

These guidelines are designed for children ages 29 days to 12 years, **or** less than or equal to 40 kg.

Please refer to the LifeFlight of Maine protocols for neonate patients less than 28 days of extrauterine life.

Patients who are older or who have greater weight can be addressed as adult patients and/or discussed with pediatric intensive care unit (PICU) staff, medical directors, or on-line medical control.

Contact receiving Pediatric Intensive Care Unit (PICU) staff:

For patients to be admitted to the PICU from another facility and prior to departure with patient, air medical crew are required to have a conversation with the receiving Pediatric Intensivist to ensure alignment of management plans between the sending and receiving clinicians.

In some cases, when calling the receiving hospital, calls may be directed to a resident physician. LifeFlight staff are encouraged to specifically ask to confer with the attending in these arenas.

Pediatric Intensivists at Maine Medical Center and Northern Light Eastern Maine Medical Center are available to LOM crew for consultation and medical control for any patient under the age of 18 regardless of patient destination.

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11.2 PEDIATRIC MONITORING AND GENERAL CONSIDERATIONS

11.2.1 Indications:

All pediatric patients will be monitored during transport.

11.2.2 Operations:

Pediatric patients between 4.5 kg and 18.1 kg should be secured in the Pedi-Mate, appropriately sized car seat secured the flight stretcher, or immobilized as indicated in the setting of trauma.
Neonatal patients under 4.5 kg should be secured in a LifeFlight of Maine approved isolette.
Infants are never co-bedded in the isolette.

Family Presence
Within safe operation limits, transport of an interested parent or other family member with a pediatric patient should occur.
It is imperative to document the exception of a family member if he or she does not accompany a pediatric patient or is separated by operational circumstances (i.e. motor vehicle accident with multiple patients and subsequent destinations).
Neonatal Protocols are provided as a reference and should only be implemented up to and including your individual scope of practice.
Neonates are defined as those patients who are less than 28 days of extrauterine days of life.

11.2.3 General guidelines.

All patients will be continuously monitored with EKG, pulse oximetry, non-invasive BP, and $ETCO_2$ if intubated.
Medical stabilization should reflect the level of care as outlined in ATLS, PALS, NRP, and LifeFlight of Maine guidelines.

Refer to appendices for reference for the following:

a. Normal Vital Signs
b. Electrical Defibrillation/ Cardioversion
c. Pediatric Equipment Guide
d. Pediatric Glasgow Coma Scale

An accurate weight in KILOGRAMS or GRAMS is essential for pediatric patients.
If a specific weight is not available, the use of a length-based resuscitation guide may be used to estimate weight.
The use of a reference for normal vital signs and lab values is necessary for pediatric patients of different sizes and ages and can be found in Appendix C?
BP's (via NIBP or transducer) will be checked as specific diagnoses warrant including sepsis, trauma, or other critical diagnoses).
Alarms should be set appropriate for age.

Temperature will be continuously monitored during transport using appropriate techniques as dictated by the condition. (If initial temperature ≤ 36ºC or ≥ 38ºC).

11.2.4 **Note: In the setting of sudden cardiac arrest, the use of C-A-B (circulation / chest compressions – airway- breathing, of which chest compressions is the first step in management. The A-B-C pathway remains the accepted method for rapid assessment and management of any critically ill patient.**

Johns Hopkins Hospital

Harriet Lane Handbook 2018

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11.3 PEDIATRIC ASSESSMENT AND STABILIZATION

11.3.1 Part 1. Assessment of Perfusion:

Assess Pulse (may take up to 10 seconds) in appropriate location depending on child's age and anatomy.

- If pulseless, begin chest compressions. Refer to CCTTP 11.7 Pediatric cardiac arrest. If pulse, begin A-B-C pathway of evaluation.

Assess other indicators of perfusion:

- Capillary refill.
- Mentation.
- Urine output (Diaper assessment or Foley Catheter).

Assess accurate vital signs (Appendix xxx: Pediatric vital signs)

- Tachycardia.
- Bradycardia.
- Blood pressure.
  - Systolic BP = [70 + (2x age in years)]

11.3.2 Part 1. Management of Perfusion:

- Chest compressions. Refer to CCTTP 11.7 Pediatric cardiac arrest.
- Use of cardiac monitor or defibrillator. Refer to CCTTP 11.2 Pediatric monitoring and general considerations.
- Resuscitation with poor perfusion and shock. Refer to:
  - CCTTP 11.4 Pediatric fluid administration
  - CCTTP 11.16 Pediatric refractory hypotension and shock

11.3.3 Part 2. Assessment of Airway:

- Assess airway patency and evaluate for possible obstruction.

Assess for spontaneous respirations:

  - If no respirations, refer to CCTTP 11.5 Airway Management
- If spontaneous respirations are present, assess for adequacy of respirations
- Examine for signs of respiratory distress and failure:
  - Grunting
  - Stridor
  - Tachypnea
  - Flaring
  - Retractions
  - Accessory muscle use
- If there is concern for an airway or respiratory emergency, refer to CCTTP 11.6 Pediatric respiratory emergencies.

11.3.4**Part 2. Management of Airway:**

Refer to CCTTP 11.5 Airway Management

11.3.5**Part 3. Assessment of the Respiratory System:**

Assess for respiratory distress or compromise
Assess for respiratory failure
Refer to CCTTP 11.6 Pediatric respiratory emergencies

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11.4 PEDIATRIC FLUID ADMINISTRATION

11.4.1 Indications:

Calculation of initial maintenance fluid requirements in the infant and child who has received adequate fluid resuscitation and presents with effective systemic vascular perfusion.

11.4.2 Clinical Management:

- Bolus
  - Normal Saline at 20 ml/kg

or

  - Lactated Ringers at 20 ml/kg

- Maintenance
  - For infants less than 28 days
    - Please refer to the NICU section of LifeFlight guidelines.
  - For children aged 28 days or greater to the age of 18 years:
    - **D_5 LR or D_5 0.9%NS** with or without supplemental potassium. The use of 20 meq's of potassium should be also administered in the fluids unless contraindicated.
    - Maintenance fluid should be administered using the 4-2-1 rule (an hourly rate of 4 mL/kg for the first 10 kg, 2 mL/kg for each kg between 10 and 20 kg, then 1 mL/kg for every kg over 20 kg.)

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Example: The maintenance rate for a 15 kg child is 40 ml/hour + 2 ml/kg per hour (2 ml x 5 kg)=50 ml/hour

Children larger than 20 kilograms:

11.4.3 Pediatric Maintenance Fluid Requirement

Approximate Weight	ML/HR
5 kg	20 ml/hr
10 kg	40 ml/hr
15 kg	50 ml/hr
20 kg	60 ml/hr
25 kg	65 ml/hr
30 kg	70 ml/hr
35 kg	75 ml/hr
40 kg	80 ml/hr

11.5 PEDIATRIC AIRWAY MANAGEMENT

11.5.1 Indications:

- Pediatric patients who present with an obstructed airway, compromised spontaneous breathing (hypoventilation), unremitting hypoxemia and apnea.

11.5.2 Clinical Management:

- If a patient exhibits effective spontaneous ventilation, administer supplemental oxygen appropriate for patient's condition and attach to monitoring devices.
  - Nasal cannula
  - Simple facemask
  - Non-rebreather
- If a patient exhibits ineffective ventilation, attempt to open the airway.
  - In the trauma patient, utilize a jaw-thrust maneuver in combination with cervical spine immobilization.
  - In the non-trauma patient, utilize the head-tilt, chin-lift maneuver.
- If apnea is present, or if ventilation if ineffective, attempt to ventilate using the bag-valve-mask with 100% oxygen. Use airway adjuncts as indicated.
  - An oropharyngeal airway is indicated for the unconscious patient without a gag reflex.
  - A nasopharyngeal airway may be better tolerated in the patient with a gag reflex.
- If unable to ventilate, reposition the head and/or neck and reattempt to ventilate. If still unable to ventilate, assess for upper airway obstruction.
  - Clear airway (suction, Magill forceps if object is visualized).
  - Back blows, chest thrusts ≤ 1 year; Heimlich maneuver ≥ 1 year.
  - If obstruction is noted and irresolvable, surgical airway is needed.
  - Refer to needle and surgical cricothyroidotomy (CCTTP 10.18 Surgical Cricothyrotomy and 10.19 Needle Cricothyrotomy)
- Indications for endotracheal intubation include:
  - Inadequate central nervous system control of ventilation.
  - Functional or anatomic airway obstruction.
  - The need for high peak inspiratory pressure to maintain effective alveolar gas exchange.
  - Probable loss of airway control during transport due to the nature of the illness or injury.
  - Severe systemic illness (sepsis) or injury with shock.
  - Suspected intracranial lesion (e.g. head injury with GCS < 8).
  - Evidence of airway burns and/or smoke inhalation.
  - Severe cardiogenic shock.

11.5.3 **CAUTION: Unless an asthmatic child is in extremis (compromised mental status), do not intubate prior to achieving communication with the receiving Pediatric Intensivist due to the high risk of cardiovascular collapse or arrest in this procedure.**

- Pediatric Intubation Specific guidelines. Refer to CCTTP 11.5 Pediatric airway management.
  - Tube Size and depth:
    - Pediatrics: Cuffed ETT in the pediatric population is the standard. However, this should not be cause for changing an otherwise functioning uncuffed ETT tube, which has been previously placed.
    - Endotracheal tube sizes:
      - Cuffed ETT (mm) = (age/4) + 3.5
      - Uncuffed ETT (mm) = (age/4) + 4
    - Approximate Tube Depth (cm) = ETT size (mm) x 3

11.5.4 **Medications specific for pharmacological Assisted Intubation in the pediatric population**

Premedication:
Atropine 0.02 mg/kg IV (Note: MIN is 0.1mg to MAX of 0.5 mg).
Indicated for patient < 1 year of age.
Considered for patients < 5 years of age.
For prevention of laryngeal stimulation induced bradycardia and excess salivation.

Induction agent:
Ketamine 2 mg/kg IV or I/O

- Ketamine is contraindicated in patients < 3 months of age.
- In instances where intracranial pressure may be elevated due to a mechanical obstruction, **Etomidate** remains the induction agent of choice.

Age	Birth	6 mos.	1 year	2 year	3 year	4 year	5 year	6 year	8 year	10 year	12 year	14 year	Adult
Average Weight (kg)	3.5	7	10	12	14	16	18	20	25	30	40	50	70
Endotracheal Tube Size (mm)	3-3.5	3.5-4	4	4.5	4.5	5	5	5.5	6	6.5	7	7.5	8
Insertion Depth (cm)	9	11	12	13	14	14	15	15	16	17	18	20	22

11.5.5**Pediatric Pharmacologically Assisted Airway Management**

11.5.6**Indications:**

- It may be necessary on occasion to sedate and utilize neuromuscular blockade before or during transport to facilitate intubation of the pediatric patient with a compromised airway when standard methods have failed and would delay care.
- Indications for pharmacologically assisted intubation include:
  - Failure to protect or maintain the airway (i.e. GCS< 9, partial/ full airway obstruction)
  - Can the patient phonate with a clear and unobstructed voice?
  - Can the patient swallow spontaneously and handle normal oropharyngeal secretions?
  - Failure to oxygenate or ventilate (i.e. laryngospasms, ARDS, status asthmaticus).
  - Anticipated clinical course.
  - Deterioration-suspected or anticipated clinical deterioration.
  - Transport-protection of patient and/or flight crew during transport due to combativeness, agitation, or altered mentation.
  - In certain cases, patients in policy custody may require airway stabilization for safety.
  - Impending airway compromise-i.e. inhalation injuries, angioedema.

11.5.7**Equipment as outlined in CCTTP 2.2 Endotracheal intubation**

11.5.8**Pharmacologically Assisted Intubation (RSI) Summary:**

1. PREPARATION

- Denitrogenation:
  - Monitor oxygen saturations and provide 100% oxygen by non-rebreather mask for 3 minutes at a minimum.
  - Coach patient to take eight vital capacity breaths, if possible.
  - If patient is obtunded or if the respiratory effort is inadequate and the patient is hypoxic with oxygen saturations of less than 92% consider BVM with PEEP valve at Fi02 of 100%,
- Apneic Oxygenation:
  - Place nasal cannula on patient in preparation for passive apneic oxygenation. Once the patient has been sedated adequately, the nasal cannula liter flow should be turned up to 15 liters per minute (apneic oxygenation).
- Monitor vital signs (ECG, heart rate, blood pressure, pulse oximetry, and end tidal wave form capnography).
- Position spine/stabilization/airway anatomy.
- HELP Position in morbidly obese patients. Refer to CCTTP 2.2. Endotracheal intubation.
- IV Access/Meds:
  - Ensure appropriate IV access. Preferably two sites.
- Bougie on every attempt as this is the preferred device with which to achieve intubation.

- Equipment/backup options.
  - Have backup devices (King Airway and other airway devices) at the bedside.

2. PREMEDICATION

- **Atropine** can be used as a drying agent and to block bradycardia caused by laryngeal stimulation in pediatric patients. It is also used in setting of a second dose of succinylcholine.
- For all patients < 1 year of age and to be considered for patients < 5 years of age:
  - **Atropine** 0.02 mg/kg IV
    - Minimum dose: 0.1 mg IV
    - Maximum dose 0.5 mg IV
    - Onset: Immediate Peak at 2-4 minutes
    - Duration variable
  - NOTE: There is little evidence demonstrating that Fentanyl is clinically beneficial and should **NOT** be administered as a neuro protective pre-medication in RSI, empirically.

3. INDUCTION

- If time allows for correction of hypotension (SBP < 100 mmHg) and/or predicted to be < 100 mmHg, initiate plan to address peri-RSI hypotension.
- Insure adequate fluid resuscitation.
- REDUCE the dose of the induction agent.
- Consider initiation of bolus or infusion vasoactive medications as per discussion with receiving PICU attending

- **Etomidate** 0.3 mg/kg IV push
  - Most commonly used sedative/induction agent in RSI with widest range of applications
  - Maximum dose: 40 mg single dose
  - Onset: 15 to 45 seconds
  - Duration: 3-12 minutes

- **Ketamine** 2 mg/kg IV or 4 mg/kg IM (MAX 250mg IV and 500mg IM)
  - RSI induction agent of choice in the instances of pediatric bronchospasm or hypotension.
  - Ketamine is CONTRAindicated in patients < 3 months of age.
  - Can be considered for hypotensive, bronchospastic patients as well as those patients with severe sepsis. It can also be used for patient in imminent arrest due to its beta-adrenergic effects.
  - Maximum dose: 250 mg IV or 500 mg IM single dose.
  - Onset: Less than 30 seconds.
  - Duration: 5-15 minutes.

4. PARALYSIS

- **Rocuronium** (First Line agent): 1.2 mg/kg IV.
  - Maximum dose: 150 mg IV.
  - Onset: 60 to 120 seconds (maximum peak).
  - Duration: Dose dependent, but typically 30-60 minutes.

- **Vecuronium** (Second Line Agent): 0.1 mg/kg IV
  - Maximum dose: 10 mg IV
  - Onset: 75 to 90 seconds (maximum peak)
  - Duration: 60-75 minutes

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5. INTUBATION

- Please refer to CCTTP 2.2 Endotracheal Intubation for actual procedure.

6. POST-INTUBATION

- Add Agents that are needed for ongoing management. If sedation and analgesia are not adequate, patients can awake, but still be paralyzed.
- For SBP < 100, Refer to CCTTP 11.16
- For ongoing sedation and analgesia, Refer to CCTTP 11.12 and 11.13

11.6 PEDIATRIC RESPIRATORY EMERGENCIES

11.6.1 Clinical Management:

- Once at the bedside, the clinician must complete an appropriate assessment of the child with respiratory distress to include:
  - Vital signs (HR, RR, temperature, oxygen saturation)
  - Work of breathing:
  - Respiratory Rate
  - Retractions:
    - Suprasternal
    - Scalene muscle contractions
    - Use of abdominal accessory muscles
  - Air Entry (asymmetric, evidence of inadequacy)
  - Adventitious lung sounds (bronchospasm, stridor, etc.)
  - Positioning (tripod)
  - Mentation (Lethargy, altered level of consciousness
- Maintain airway and oxygenation. Refer to CCTTP 11.5 Pediatric Airway management.
- Bradycardia in the pediatric patient may be a sign of respiratory failure. It should be initially treated with oxygen and increased ventilation.
- Early conversation and the use of telemedicine with the Pediatric Intensivist is crucial in this patient population.
- Common causes of respiratory emergencies can be grouped based upon location in respiratory anatomy:
  - Upper airway emergencies (See CCTTP 11.5.2)
    - Foreign Body aspiration
    - Croup
    - Epiglottitis
    - Retropharyngeal abscess
    - Peritonsillar abscess
    - Bacterial tracheitis
  - Lower airway emergencies
    - Asthma
    - Bronchiolitis
    - Pneumonia

11.6.2 Upper Airway Causes of Respiratory Failure Include:

- Foreign body/mechanical obstruction
  - 80% of cases in the 1-3 year-old age group
  - Abrupt onset of respiratory signs and symptoms
  - Possible diminished breath sounds on affected side
  - Stridor
- For airway management, refer to CCTTP 11.5 Pediatric Airway management

Note: BLS maneuvers including back blows and chest thrusts can be reviewed in AHA CPR guidelines.

- For surgical or needle cricothyrotomy, refer to CCTTP 10.18 Surgical Cricothyrotomy and 10.19 Needle Cricothyrotomy

- Epiglottitis:
  - Signs and symptoms may include:
    - An ill, anxious, and toxic appearing child seated in tripod position
    - Most common in ages 2-7
    - Drooling
    - Respiratory distress and stridor
    - High fever (> 102° F)
    - Sore throat
  - Airway management of epiglottis is difficult due to severe epiglottic swelling.

Refer to CCTTP 2.4 Pharmacologically Assisted Airway Management

If airway management is necessary, clinicians with specific training in pediatric airway management should be consulted prior to departure from sending facility.

Initial efforts should be directed toward oxygenating the patient and positioning to facilitate ventilation with minimal manipulation.

If the patient has assumed a tripod position, continue to allow this posture during transport.

Consult pediatric intensivist for any patient with suspected epiglottis pre-departure.

Additionally, follow steps in management for pediatric sepsis prior to departure including:

Obtaining appropriate laboratory studies.

Fluid resuscitation.

Broad spectrum antibiotic therapy.

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Severe croup (Laryngotracheobronchitis):
Common signs and symptoms:
Fever.
Barking cough.
Stridor.
Patients rarely appear toxic as in epiglottitis.
Dexamethasone (Decadron) 0.6mg/kg IV, IM or PO (give IV formulation orally)
Provide cool air mist with stable environment
If stridor at rest is present, prepare the nebulizer with **racemic epinephrine** (0.05 ml/kg of a 2.25% solution to a max single dose of 0.5 ml.)
May repeat every 1 to 2 hours as needed for severe stridor
This should be administered with 3 ml NS
If there is evidence of ongoing respiratory distress or failure, consult PICU staff for option of airway management. Refer to CCTTP 11.5 Pediatric Airway management.
If child fails to respond as expected to therapy, consider other etiologies:
Retropharyngeal abscess.
Bacterial tracheitis.
Subglottic stenosis.
Epiglottitis.
Foreign body.
In consultation with PICU staff, consider emergent radiography prior to departure.

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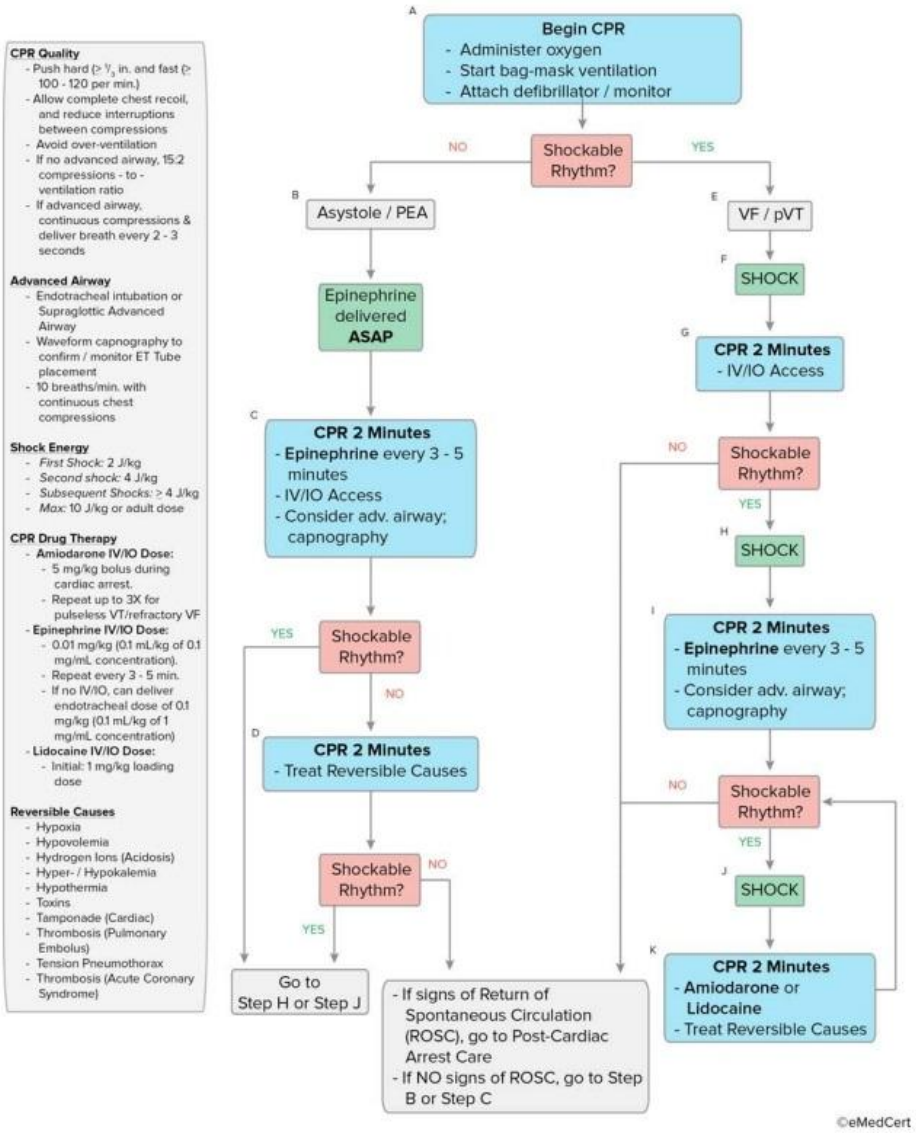
11.6.3**Lower Airway Causes of Respiratory Failure:**

Common causes include:
Asthma and bronchospasm.
Viral infections including RSV, coronaviruses.
Bacterial pneumonia.
Interstitial or alveolar disease.
Anaphylaxis.
Congenital heart disease.
Trauma.
Ensure appropriate treatment for the underlying etiology has been addressed prior to departure.
Refer to CCTTP 11.5 Pediatric Airway management
Passive oxygenation with FIO_2 titrated to SPO_2>92%.
For specific diagnoses:
Asthma:
Refer to CCTTP 2.8 Acute Bronchospasm
Additional pediatric specific concerns:
Dexamethasone 0.6mg/kg with a maximum of 10mg IV, PO or IM.
Contact **Pediatric intensivist** for option of magnesium sulfate
50mg/kg IV over 20 minutes to a maximum of 2g IV.
Be aware that hypotension may occur with Magnesium administration.
Pneumonia
Refer to CCTTP 11.5 Pediatric Airway management.
Refer to CCTTP 11.8 for management of pediatric sepsis.
Anaphylaxis
Refer to CCTTP 11.5 Pediatric Airway management
Refer to CCTTP 4.1 management of anaphylaxis and allergic reactions.
Pediatric Congenital heart disease
Refer to CCTTP 11.5 Pediatric Airway management
Refer to CCTTP 11.15 Pediatric cyanotic heart disease
Trauma
Refer to CCTTP 11.5 Pediatric Airway management
Refer to CCTTP 6.3 Chest trauma
Refer to the following CCTTP's for further guidance in pediatric trauma management as it pertains to effects on the respiratory system..
CCTTP 11.5 Pediatric Airway management
CCTTP 10. 12 Needle thoracostomy.
CCTTP 10. 14 Tube thoracostomy

11.7 PEDIATRIC CARDIAC ARREST

11.7.1 Protocol: CARDIAC ARREST per PALS Algorithms



11.8 PEDIATRIC SEPSIS

11.8.1 **Indications:**

To identify those pediatric patients with septic shock.

Septic shock is defined as a clinical diagnosis of sepsis with profound compromise in the cellular and circulatory system level leading to a higher risk of morbidity and mortality:

Pediatric patients with septic shock are defined by having:

- A vasopressor requirement to maintain a mean arterial pressure (MAP) that is appropriate for age and weight.
- MAP = $(1/3)P_{sys} + (2/3)P_{dia}$

AND

- A serum lactate of greater than 2mmol/L.

Pediatric patients with sepsis will have compromised tissue perfusion which can be identified by concurrent signs and symptoms

- Altered mental status.
- Compromised hemodynamics.
- Inadequate tissue perfusion.

Additionally, the Society of Critical Care Medicine defines pediatric hypotension as:

In children less than 12 months of age:

Systolic Blood ≤ 50mmHg.

In children aged 1 to 5 years:

Systolic blood pressure ≤ 60mmhg.

In children greater than 5 years:

Systolic blood pressure < 70mmHg.

OR

Presence of the following physical findings

Cold extremities.

Prolonged capillary refill > 3 seconds.

Fast / weak pulse.

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The Surviving Sepsis campaign of 2020 has focused on early aggressive therapy to combat the sequelae associated to severe septic shock in a rapid manner. This campaign has evolved and updated as literature and research results have improved. This applies to both pediatric and adult patient populations.
Once identified, blood cultures (**at least one set**) and appropriate antibiotic therapy and resuscitation MUST occur within 60 minutes of presentation AND prior to transport unless otherwise directed by the receiving provider.
Refer to Reference Guide for antibiotic therapy choice guidelines.

11.8.2 Pearls, Pitfalls, and Considerations:

Once identified, septic shock must be treated with appropriate crystalloid infusion to maintain the following:
Urine output of greater than 0.5 ml/kg/hr.
A lactate less than 2.0mmol/L.

11.8.3 Clinical Management:

Assess airway, breathing, and circulation. Maintain adequate airway and ventilation. If the patient has any alteration in mental status, consider advanced airway placement per CCTTP 11.5 Pediatric Airway management
Obtain at least one peripheral IV (preferably two). If IV access is not possible, proceed to an I/O or request sending providers to place central line catheter.
Place patient on cardiac monitor and reassess patient's hemodynamic status frequently during patient transport including continuous pulse oximetry, heart rate, and respiratory status.
Obtain core temperature. (Rectally, if possible)
If the patient has any alteration in mental status, check fingerstick blood glucose
If measured glucose level is low (FSBG < 60 mg/dl):
Refer to CCTTP 11.14 Pediatric Diabetic Emergencies
Antipyretics. If the child has a measured temperature (preferably rectal), consider acetaminophen:
15mg/kg PO, PR every 4-6 hours PRN for fever. Refer to CCTTP 10.21 Fever.
Given the debate of the use of **Etomidate** in the setting of sepsis due to adrenal suppression, **Ketamine** should be considered as an **equivalent** induction agent in the setting of rapid sequence intubation.
If the patient has spontaneous respirations, provide supplemental oxygen to maintain oxygen saturations greater than 92%.
Administer 40 to 60 ml/kg (based on IBW) in bolus fluid (10-20ml/kg per bolus) over the first hour, titrated to clinical markers of cardiac output and discontinued if signs of fluid overload develop, for the initial resuscitation children with septic shock or other sepsis-associated organ dysfunction.
Balanced/ buffered solutions should be used for fluid resuscitation (i.e. lactated ringers)
If the patient's hemodynamic status does not improve with crystalloid infusion, or the patient's lactate remains greater than 2mmol/L, refer to CCTTP 11.16 Pediatric refractory shock.

Vasopressor therapy initially to target a mean arterial pressure (MAP) for the age and calculated or measured weight:
Norepinephrine and **epinephrine** infusions can be use interchangeably. There is no specific recommendation for these two vasopressors.
Vasopressin 0.03 units/minute (1.8 units/hr) can be added as a third line agent with intent of either raising MAP in children require high dose catecholamines for treatment of septic shock with MANDATORY consultation of PICU staff.
(**Vasopressin** is a fixed medication and is typically not titrated).
It should not be used as a single agent.
Dopamine
Used only in conjunction with the receiving PICU attending
Dosing: 5 – 20 mcg/kg/min IV
Phenylephrine is not indicated for use in patients with pediatric sepsis.
If using vasopressor therapy, peripheral infusions can be initiated if no central access is available.

11.8.4 **Consultation with receiving pediatric intensivist for additional management strategies:**

Corticosteroids
If the patient remains hypotensive despite aggressive fluid resuscitation and vasopressor use, *contact* the receiving Pediatric Intensivist for the option of administration of **hydrocortisone (solu-cortef)** (from sending hospital).
Anemia.
If the patient is noted to have a hemoglobin of less than or equal to 7.0 with associated hemodynamic instability, contact receiving pediatric intensivist for recommendations for packed red blood cell transfusion
Refer to CCTTP 10.1 Packed red blood cells and liquid plasma
Hypocalcemia.
Contact receiving pediatric intensivist for option of calcium gluconate in setting of septic shock.
Pediatric Hyperglycemia in the setting of sepsis:
Monitor blood glucose as indicated
If glucose is greater than 180 mg/dl:
Contact receiving PICU attending and

Refer to CCTTP 11.14 Pediatric diabetic emergencies for appropriate control of hyperglycemia

Persistent lactic acidosis

Contact receiving physician for option of **Sodium Bicarbonate 8.4%** over 3-5 minutes if pH is less than 7.1
There is very limited indication for its use
Dosing per receiving pediatric intensivist ONLY

In the setting of refractory shock or oxygenation/ventilation failure (after addressing other causes of shock and respiratory failure, transport to a center capable for pediatric VA or VV ECLS

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11.9 PEDIATRIC POISONING

11.9.1 **Indications:**

Any pediatric patient who has been acutely poisoned by virtue of exposure (via any route) to a substance which exerts deleterious effects upon the body.

11.9.2 **Clinical Management:**

Obtain a history of the poisoning
Determine substance, route (ingestion, inhalation or topical), chronology, and medical intervention attempts.
Contact the Poison Control Center before leaving the scene/outside hospital, if this has not been done. (1-800-222-1222)
If the patient has any alteration in mental status, check fingerstick blood If measured glucose level is low (FSBG < 60 mg/dl):
For patients greater than 40kg
Dextrose 50% - Infuse 1 ml / kg IV to a maximum of 50 ml IV
Children between 10kg and 40kg
Dextrose 10% - Infuse 5 ml / kg IV to a maximum of 100ml IV
If the child requires more than 100ml of dextrose 10%, contact receiving clinician or OLMD for further gudiance.
For children < 10kg, refer to neonatal protocols for reference and utilization up to your scope of practice

11.9.3 **Note: In poisonings causing hypoglycemia, it is appropriate to use dextrose to treat patients in extremis (i.e. obtundation), but many of the drugs for Type 2 Diabetes which may cause hypoglycemia will get worse with dextrose administration. Staff will be required to discuss care with PICU attending and potentially staff at Northern New England Poison Center after first dose.**

Review laboratory values and EKG that have been completed:
CBC
CMP
Mg
Phos
ABG / VBG as applicable
Serum drug screen (ETOH, Salicylates, acetaminophen)
Urinalysis
Urine Drug screen
Complete electrocardiogram for evaluation of QTc
Maintain a low threshold for contact of medical control, pre-departure.
Secure airway per Pediatric Airway Management protocol and ventilate and oxygenate per Pediatric Respiratory Failure protocol as needed (Refer to CCTTP 11.5 Pediatric airway management).
Obtain vascular access per protocol.

Monitor vital signs and assess the patient, including neurological evaluation.
Gastric lavage only if recommended by staff at New England Poison Center and airway can be maintained
Specific antidotes to be administered in conjunction with staff at Northern New England Poison Center and the pediatric intensivist.

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11.10 PEDIATRIC SEIZURES

11.10.1 Indications:

For the patient experiencing seizures, the Critical Care Transport Team will attempt to identify the cause and treat accordingly.
Common, treatable causes of acute pediatric seizures include hyperthermia, hypoglycemia, hypoxemia, trauma, metabolic and toxic disturbances, electrolyte alterations and infections. Transport may also be indicated for exacerbation of chronic seizures for which causes may include previous head injury, familial or congenital origin and idiopathic etiologies.

11.10.2 Clinical Management:

Assess airway, ventilate as needed, and administer high-flow oxygen if there is evidence of hypoxemia.
Monitor vital signs in appropriate intervals as noted in CCTTP 11.2 Pediatric monitoring and general considerations.
If there is evidence of fever, consider etiology and monitor for possible sepsis (CCTTP 11.8 Pediatric Sepsis)
Administer Acetaminophen 15 mg/kg/PO/PR/PNGT if appropriate.
If the patient has any alteration in mental status, check fingerstick blood If measured glucose level is low (FSBG < 60 mg/dl):
For patients greater than 40kg
Dextrose 50% - Infuse 1 ml / kg IV to a maximum of 50 ml IV
Children between 10kg and 40kg
Dextrose 10% - Infuse 5 ml / kg IV to a maximum of 100ml IV
If the child requires more than 100ml of dextrose 10%, contact receiving clinician or OLMD for further guidance.
For children < 10kg, refer to neonatal protocols for reference and utilization up to your scope of practice
High flow oxygen is most appropriate during an active grand mal seizure. Insertion of an oropharyngeal or nasopharyngeal airway is appropriate if it can be done prior to trismus.
Refer to CCTTP 11.5 Pediatric airway management
Be alert for signs of emesis. Suction and turn head to side to avoid aspiration. Log roll if patient has potential for spinal injury.
Refer to CCTTP 11.11 Spinal injury if there is concern for spinal trauma

11.10.3 Medicate the Seizing Patient as Indicated Below:

Choose one benzodiazepine
Midazolam 0.05mg/kg to 0.1 mg/kg to MAX 5 mg IV Repeat x 2
Lorazepam 0.05mg/kg to 0.1 mg/kg to MAX 2 mg IV Repeat x 1
Watch for respiratory depression and hypotension. Be prepared to secure the airway. Refer to CCTTP 11.5 Pediatric airway management if necessary.

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If seizures persist and cannot be controlled:
Age > 1
Levetiracetam (Keppra) 50mg / kg IV (Maximum 3000mg)

Fosphenytoin 20 pe/kg in 100 ml over 10-20 minutes
MAX dose 1500 mg PE
Watch for cardiac dysrhythmias
Infuse at rate < 150 pe/min
Phenobarbital. Consult with PICU Intensivist.

If Age < 1, patient has allergy to Fosphenytoin or continues to have seizures:
Levetiracetam (Keppra). Consult with PICU Intensivist.
Phenobarbital. Consult with PICU Intensivist.

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11.11 PEDIATRIC SPINAL INJURY

11.11.1 Indications:

Any patient with a known spinal column injury, a (spinal) neurological deficit, or a mechanism of injury consistent with possible spinal injury will be properly immobilized for transport.

11.11.2 Pearls, Pitfalls and Considerations:

Follow Maine EMS protocol for spinal immobilization and refer to CCTTP 6.9 Spinal Emergencies for clearance and IFT transport.
Backboards should be utilized to extricate patients from vehicles and other situations when they are unable to extricate themselves (critical patients, patients with lower extremity injuries, severe head injuries, etc.)
In some limited scenarios it may be useful to use a backboard or similar device in the setting of pediatric emergencies. These can include:
Cases in which the back part is being utilized as an element of the splinting strategy.
Cases in which the patient is at risk for vomiting but unable to protect her own airway and may be required to turn to the side for airway protection during transport.
Cases in which the child is unresponsive or agitated (i.e. traumatic brain injury).
Cases in which removal of the backboard would otherwise delay transport to definitive care in a critical patient.

11.11.3 Clinical Management:

Immobilize patient with device that functions best for patient's size, at discretion of LOM crew. As noted previously, the role of the backboard is limited. Other devices including KED's or pediatric backboard's (Pedi-Pac's) may be used at the discretion of the transport team.
Protect the patient's airway as needed before and after immobilization. Refer to CCTTP 11.5 Airway management.
Administer oxygen as appropriate.
Initiate intravenous access and treat neurogenic shock. If there is concern for traumatic injury, refer to CCTTP 6.10 Acute resuscitation of the unstable trauma patient
Consider appropriate anxiolytic if vital signs are adequate and if needed to prevent/decrease excessive movement within immobilization devices. Refer to CCTTP 11.12 Pediatric Sedation and anxiolysis.
If the patient requires intubation and airway management, refer to CCTTP 11.5 Pediatric airway management

11.11.4 Notes from Maine EMS

- In children using a booster seat or lap shoulder belt during a motor vehicle collision, consider having the patient self-extricate after applying a cervical collar if needed.
- Caution should be an exercised in young patients less than three years of age, a spinal assessment maybe less sensitive in discerning spinal factors in these populations. However, age alone should not be a factor in decision making for prehospital spinal care, rather the patient's ability to reliably provide a history should be considered.
- For the infant or toddler who is already strapped in a car seat with a built-in harness, extricate the child while strapped in the car seat.

- Children who do not require a spinal immobilization or lying flat may be safely transported in an age appropriate car seat secured to the stretcher.
- Children who do require a spinal immobilization or lying flat should be directly secured to the stretcher.

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11.12PEDIATRIC SEDATION AND ANXIOLYSIS

11.12.1 Indications:

Treatment for severe pain, anxiety, and agitation.
Intubation with mechanical ventilation.

11.12.2 Cautions:

Consult attending physician for these circumstances:
Impending respiratory failure (non-intubated)
Shock
Drug overdose
Altered mental status

11.12.3 Clinical Management:

For sedation and anxiolysis in the NON-intubated patient:
Midazolam:0.02-0.05 mg/kg to MAX 2 mg IM/IV every 5 minutes
Lorazepam: 0.02-0.05 mg/kg IV/IM/ to a MAX 2mg every 15 minutes
Contact receiving Pediatric Intensivist for option of **Ketamine**
If hypersalivation is present, consider **Atropine** 0.01 mg/kg with minimum dose of 0.1 mg
For mechanical ventilation:
Midazolam:0.05 to 0.1 mg/kg to MAX 4 mg IV/IM every 5 minutes
Lorazepam: 0.05 to 0.1 mg/kg to MAX 4 mg IV/IM/PR every 15 minutes
Propofol: 0.1-1 mg/kg bolus, then 5 to 200 mcg/kg/min infusion
Ketamine: 1 mg/kg IV for hypotensive and/or bronchospastic patients
Contraindicated in patients < 3 months of age
May follow initial dose with 0.25-0.5 mg/kg IV
May initiate an INFUSION 0.5-2 mg/kg/hr
Ketamine also possesses potent analgesic properties

11.13 PEDIATRIC ANALGESIA

11.13.1 **Indications:**

Any pediatric patient with pain due to injury or disease.

11.13.2 **Clinical Management:**

Maintain adequate airway and ventilation
Administer O_2 as indicated
Monitor EKG and O_2 saturation
Attempt to treat cause of pain (e.g. reposition, etc.) and concurrently utilize techniques including non-pharmacological treatment of pain (i.e. ice, elevation, etc.)

11.13.3 **For Pain Unrelieved by Other Interventions, Medicate With:**

Acetaminophen: 15 mg/kg PO or PR
Fentanyl: 0.5-1 mcg/kg IV/IM q 5-10 minutes with titration to pain control, wakefulness and airway protection.
Consider 0.5 to 2 mcg/kg intranasal route as well if there is an available atomizer.
OR
Morphine Sulfate: 0.1 mg/kg IV/IM every 10 minutes PRN pain
For infants < 2-3 mos., use 0.03-0.05 mg/kg q. 10 minutes
Concurrent therapies:
For nausea and vomiting
Ondansetron (Zofran): 0.1 mg/kg IV over 2-5 minutes to MAX of 4 mg
Use caution in patients less than 12 months of age or < 10 kg
Dosages may be repeated every 20-30 minutes for a total of two doses
For narcotic overdose:
Administer **Naloxone (Narcan**) 0.1 mg/kg IV/IM (MAX dose = 2mg) for respiratory depression or signs of a narcotic overdose and manage airway as needed.
Dissociative medication:
Contact receiving Pediatric Intensivist if above therapies are unsuccessful for options
Ketamine: 0.2 mg/kg to MAX 25 mg and consider infusion
Ketamine Infusion: 0.05-0.2 mg/kg/hr to MAX dose of 20 mg/hr

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11.14 PEDIATRIC DIABETIC EMERGENCIES

11.14.1 Indications of HYPOglycemia

Glucose assessment should be performed as a matter of routine with any critically ill child, or in whom the diagnosis is uncertain.
Children of one year of age or less are particularly at risk for hypoglycemia.
If the patient has any alteration in mental status, check fingerstick blood If measured glucose level is low (FSBG < 60 mg/dl):
For patients greater than 40kg
Dextrose 50% - Infuse 1 ml / kg IV to a maximum of 50 ml IV
Children between 10kg and 40kg
Dextrose 10% - Infuse 5 ml / kg IV to a maximum of 100ml IV
If the child requires more than 100ml of dextrose 10%, contact receiving clinician or OLMD for further guidance.
For children < 10kg, refer to neonatal protocols for reference and utilization up to your scope of practice
Glucagon

<20 kg	0.5 mg IM
>20 kg	1 mg IM

11.14.2 Indications of HYPERglycemia and Diabetic Ketoacidosis:

Pediatric patients presenting with elevated blood glucose levels in the setting of possible known or newly diagnosed Diabetes Mellitus (DM).
Pediatric patients presenting with related signs and symptoms for possible DKA, such as Kussmaul breathing, poor peripheral perfusion, altered mental status, vomiting, a history of weight loss, polyuria, polydipsia, or polyphagia.

11.14.3 Considerations:

Consider sepsis work-up as clinically indicated for patients presenting with DKA. (If CBC obtained, initial WBC will likely be elevated and may not be indicative of underlying infection).
High risk patients for cerebral edema include:

- Patients < 5 years of age.
- Those with an initial pH < 7.0.
- Newly diagnosed DM patients
- Significantly dehydrated patients with marked elevations in BUN.
- Sodium NOT correcting
- Bicarbonate administration
- Severe Hypokalemia (Less than potassium of 3.3mEq/L)

IV bolus of insulin is not indicated.
Initiation of insulin infusion is not mandatory but should be considered for worsening acidosis or a long transport.
Call Pediatric Intensivist prior to initiation of insulin therapy.

11.14.4**Diagnostic Criteria for DKA:**

To meet criteria for entering DKA protocol, patients should meet one of the clinical indications listed above, and the following biochemical parameters:
Glucose value greater than 200 mg/dl (may be < 200 mg/dl in rare situations, especially in infants).
Serum bicarbonate less than 15 mEq/L.
Venous blood pH less than 7.25 or arterial pH less than 7.3.
Presence of elevated serum ketones (> 1.5 mmol/L) or positive urine ketones (large).
Known or high index of suspicion of diabetes mellitus.

11.14.5**Evaluation:**

Monitor vital signs, weight (in kg), oximetry, neurologic status and cardiac rhythm.
Obtain venous I-STAT. Repeat Glucose every 30 minutes or as directed by PICU staff.
Although rapid corrections of glucose are of less concern than previously hypothesized, continue to monitor change in FSBG over treatment period.
Check neurologic status (mental status and pupil response) every hour.
Watch for signs of cerebral edema (altered mental status, severe headache, hypertension, and bradycardia).
In consultation **only** with PICU staff: With order from receiving attending, consider Mannitol 0.25 to 1 gm/kg IV bolus or 3 % Hypertonic saline.

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11.14.6**Intervention:**

Fluid management:
IV bolus: Start IV/IO and draw blood for labs.
Only give an IV bolus of 20 mL/kg 0.9% NS or LR (maximum 1L) over 1 hour directed by PICU attending for hypotension or hypoperfusion
Consult Pediatric Intensivist if further fluid needed.
After completion of bolus, start maintenance IV fluids of 0.9% NS with 20 mEq of KCL added at the rate described below in table.
Glucose Management (When insulin infusion has already been initiated).
Monitor patient for falling glucose levels as described below.
If Glucose is below 250 mg/dl, change IV fluid to **1 L D_5W NS** with **20 mEq KCL** added at the rate described below in table.
If Glucose continues to fall despite D_5 0.9%NS with 20 mEq KCL added at a rate described below in table, continue fluid and decrease Insulin by 0.25 u/kg/hr.
Review and monitor potassium levels prior to initiation of insulin. Potassium levels must be greater than 3.3 mEq/L before initiating insulin. If the patient has been started on an insulin

infusion with potassium levels less than 3.3 mEq/L, pause infusion until discussed with receiving pediatric intensivist.

If Insulin infusion has been initiated by sending facility, monitor for falling glucose levels as described below and contact Pediatric Intensivist.
Insulin infusion:

- Start immediately after completion of initial fluid bolus.
- Mix 50 units human regular Insulin in 500 ml 0.9 % NS (0.1 u/ml final concentration).
- Run 50 ml of solution through IV tubing to saturate binding sites on the tubing.
- Infuse IV piggyback at a rate of 0.1 units/kg/hr (1 ml/kg/hr) on IV pump for children > 3 years of age.
- Infuse IV insulin drip rate of 0.05 units/kg/hr (0.5 ml/kg/hr) for children < 3 years of age.
- Continue IV insulin infusion with IV maintenance fluid infusion until serum HCO_3 is > 18 mEq/L.

11.14.7 Pediatric Maintenance Fluid Requirement in DKA

Approximate Weight	ML/HR of either 0.9% NS or D5 0.9% NS if FSBG less than 250mg/dl
5 kg	30 ml/hr
10 kg	60 ml/hr
15 kg	75 ml/hr
20 kg	90 ml/hr
25 kg	98 ml/hr
30 kg	105 ml/hr
35 kg	113 ml/hr
40 kg	120 ml/hr

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Note: above are 1½ time normal maintenance infusion
ANY IV use of **Sodium Bicarbonate** is at the discretion of the receiving Pediatric Intensivist
ONLY IN CARDIAC ARREST

11.15 PEDIATRIC CYANOTIC HEART DISEASE

11.15.1 Objectives:

Restoration of cardiac output to improve tissue oxygenation and inadequate perfusion by maintaining an open ductus arteriosus and expanding intravascular volume as appropriate.

11.15.2 Clinical Management:

Assess and manage airway, breathing, and circulation.
Monitor $ETCO_2$ if intubated.
Apply oxygen and determine response. Refer to CCTTP 2.1 Airway Management
Obtain the largest IV access for the patient's size, two if possible.
If unable to obtain IV access, IO access should be obtained without further delay, refer to CCTTP 10.5. EZ-IO intraosseous vascular access.
If no improvement in hypoxia with oxygen **or** if there is evidence of hypoperfusion, contact Pediatric Intensivist for the following options for management of ductal dependent lesions:
Prostaglandin E1 (Alprostadil) infusion.
Carefully monitor patient for hypotension due to vasodilatory effects with Prostaglandin.
Start 0.1 mcg/kg/min infusion and titrate to improved oxygenation and systemic perfusion, usual 0.02-0.5 mcg/kg/min.
Ensure that an inline filter is in place.
Monitor for signs of respiratory failure and apnea with administration of Prostaglandins. Refer to CCTTP 2.1 Airway Management
If signs of pulmonary vascular congestion and/or fluid overload are present, withhold fluid bolus and administer Furosemide (Lasix) 1 mg/kg IV.
If no evidence of fluid overload:
Resuscitate with 10 ml/kg crystalloid bolus over 5-10 minutes. May repeat after each assessment for fluid overload
Repeat up to for a total of 60 ml/kg if patient remains in shock, unless signs of fluid overload are present.
For patients failing initial fluid bolus, initiate inotropic support
Epinephrine 0.05 mcg/kg/min titrated for effect to MAX dose of 0.5 mcg/kg/min (1 mcg/min titrated for effect to MAX dose of 10 mcg/min for a 20kg patient)
Norepinephrine Start at 0.05 mcg/kg/min IV (1 mcg/min for a 20kg patient) Titrate by 0.02 mcg/kg/min as indicated
Dose range: 0.05-0.6 mcg/kg/min IV (1-12 mcg/min for a 20kg patient)
Dobutamine in the setting of Cardiac decompensation with (ONLY INDICATED with direct order from receiving PICU attending):
0.5-1 mcg/kg/min IV continuous infusion initially, then 2-20 mcg/kg/min; not to exceed 40 mcg/kg/min IV
If blood glucose < 60 mg/dL, refer to CCTTP 11.14 Pediatric diabetic emergencies
Monitor urine output by indwelling urinary catheter if available. Titrate resuscitations to 1 ml/kg/hr.

11.16 PEDIATRIC REFRACTORY HYPOTENSION AND SHOCK

11.16.1 Objectives:

To optimize the management of pediatric patients demonstrating the clinical signs of shock, secondary to non-traumatic origins (i.e. no evidence of hemorrhage or anemia)

11.16.2 Special Considerations:

All vasoactive medications administered to pediatric patients should be given via the appropriate pump for age and size of the patient.
Consider all causes of shock, including,

- Obstructive
- Hypovolemic (excluding hemorrhagic)
- Cardiogenic
- Distributive

Therapeutic endpoints:

- Normalization of heart rate
- Capillary refill less than 2 seconds
- Normal pulse strength with minimal difference between central and peripheral pulses
- Urine output greater than 1 ml/kg/hr
- Normal mental status

11.16.3 Clinical Management:

Identify symptoms indicative of evolving or ongoing shock.
Manage patient aggressively; fluid replacement and airway management.
Refer to CCTTP 11.5 Pediatric airway management
Refer to CCTTP 11.4 Pediatric fluid resuscitation and ongoing maintenance fluid administration
Refer to CCTTP 11.8 Pediatric Sepsis
Establish effective IV access.
Obtain FSBG and/or capillary, venous, or arterial blood gas with glucose.
Frequently monitor blood glucose level and correct for hypoglycemia. Refer to CCTTP 11.14 Pediatric diabetic emergencies

11.16.4 Treatment:

Initiate Isotonic Saline or balanced fluid bolus (i.e. Lactated Ringers) of 20 ml/kg over 10 minutes. Repeat boluses as needed. (Total required is often up to 40 to 60ml/kg).
Refer to CCTTP 11.4 Pediatric Fluid Resuscitation.
Shock refractory to fluid therapy.
Vasopressor choice should be discussed with PICU providers at sending and receiving institutions:
Norepinephrine infusion:

- Start at 0.05 mcg/kg/min IV (1 mcg/min for a 20kg patient).
- Titrate by 0.02 mcg/min as indicated.
- Dose range: 0.05-0.6 mcg/kg/min IV (1-12 mcg/min for a 20kg patient).

There is no true maximum dose, but consider additional agent once the titration has reached 0.3 mcg/kg/min IV (6 mcg/min for a 20kg patient)

Epinephrine infusion

- 0.05 mcg/kg/min titrated for effect to MAX dose of 0.5 mcg/kg/min (1 mcg/min titrated for effect to MAX dose of 10 mcg/min for a 20kg patient).

Dopamine infusion

- 5 mcg/kg/min titrated for effect to MAX dose of 20 mcg/kg/min.

Dobutamine in the setting of Cardiac decompensation (ONLY INDICATED with direct order from receiving PICU attending):

- 0.5-1 mcg/kg/min IV continuous infusion initially, then 2-20 mcg/kg/min; not to exceed 40 mcg/kg/min IV.

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12 OBSTETRICS

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12.1 PERINATAL AND OBSTETRICS

12.1.1 General Considerations in Pregnancy:

In the current northern New England healthcare landscape, LifeFlight is being requested to move more critically ill pregnant mothers in the peri- and ante-natal period rather than having precipitous delivery in a facility that is marginally equipped to deal with critically ill neonates. Pre-departure assessment and stabilization is as critically important for the pregnant patient as for the neonate. Once enroute by either ground or air assets, few options are available, either diagnostically or therapeutically.

If fetal distress develops, it is difficult to intervene during patient transport.

Monitor status of child pre-departure.

If the LifeFlight team has concerns around the appropriateness or feasibility of the transfer, it is imperative that the team discuss options of care prior to initiating a transfer for which the team is ill equipped.

Physician dialogue is imperative.

Similar to other types of specialty transfers, it is appropriate to contact the receiving clinician if any of the following signs or symptoms are present prior to transport:

- Coagulopathy (Disseminated Intravascular Coagulation)
- Fetal distress
- Excessive maternal hemorrhage
- Regular contractions (active labor)
- Hemodynamic instability
- Severe abdominal pain
- Seizures / neurological instability
- Pulmonary edema
- Severe hypertension
- Advanced cervical dilation (> 4 cm) relative to gestational age
- Controlled labor, on MgS04 or other tocolytics; patient transfer is acceptable.
- Uncontrolled labor necessitates dialogue between referring clinician and peri-natologist/ OB medical control.
- Indications for F. H. T. monitoring include the following:
  - Increased contractions
  - Bleeding
  - D.I.C.

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12.2 VAGINAL BLEEDING ASSOCIATED WITH PREGNANCY

12.2.1 Indications:

Vaginal bleeding, abruptio placenta, and placenta previa.
Awareness of pathophysiology is important to distinguish and properly treat placental problems.
Abruptio placenta is premature separation, partial or complete, of placenta from the uterine decidual lining.
Abruption generally occurs after the 20th week of gestation.
Because hemorrhage may occur into the abdominal / pelvic cavity, shock can develop despite relatively little visible (vaginal) bleeding; under resuscitation is the most common management error.
Abdominal pain and or uterine cramping are usually present.

- Abruption may be spontaneous or associated with trauma. Other precipitating factors include: Hypertension, Pre-eclampsia, Vigorous labor, or Premature rupture of membranes

Disruption of the ureteroplacental unit resulting from abruption leads to fetal distress as well as maternal hemodynamic compromise due to hemorrhage.
Delivery is treatment of choice.
Placenta previa occurs when the placenta attaches to the lower uterine segment in such a fashion as to partially or completely occlude the internal us.
Normal placental migration occurs early in pregnancy, thus placenta previa is not diagnosed in early pregnancy.
Patients with placenta previa are predisposed to disruption of the ureteral placental unit which may lead to feel demise and or maternal hemodynamic compromise from hemorrhage
Unlike the case with abruption, placenta previa related hemorrhage passes through the vaginal outlet and is not occult.
Unlike the case with abruption, patients with placenta previa do not always require emergency delivery.

12.2.2 Clinical Management:

Consider delayed transfer if maternal or fetal distress is already noted.
Assess and manage airway, breathing, and circulation control as indicated.
Refer to CCTTP 2.1 Airway Management
With either placental abruption or previa, vaginal speculum examination is very risky and it may precipitate uncontrollable hemorrhage and or labor.
Strict bed rest in the left lateral recumbent position.
If bleeding copiously, elevate legs or if possible consider the Trendelenburg position to increase blood supply to vital organs.
Determine if the patient has increased uterine tone or specific areas of tenderness (i.e. increased uterine irritability or cramping). Determine the amount of bleeding.
Estimate volume of bleeding and determine if it is arterial or venous in origin.
Monitor cardiac rhythm, pulse oximetry, and maternal vital signs.

OBSTETRICS

Obtain large bore IV access (at least two) and fluid resuscitate as indicated.
Establish fetal heart monitoring and determine gestational age of the fetus.
Never perform vaginal exam with placenta previa
Frequently assess fetal heart rate and report persistent late decelerations, tachycardia and loss in variability to receiving facility prior to arrival.
If hypotension is present, consider judicious crystalloid resuscitation.
If hypotension persists consider, colloid administration for further resuscitation.
Refer to CCTTP 10.1 Packed red blood cell and liquid plasma.
Discuss with physician about the use of RhoGAM when there is a risk of iso immunization (fetal – maternal hemorrhage when maternal blood is RH negative).
Assess for signs of labor.
Consider insertion of an indwelling urinary catheter, especially if contractions are present.
Emotional support to the mother and family.
Observe for signs of DIC, including evidence of petechiae, coagulopathy by hematuria, ecchymosis, bleeding from IV sites, and document the PT/PTT as well as the CBC.
Consider administration of tocolytics in the presence of premature labor, for the purpose of completing the transport only, if ordered by receiving physician.
IV **Terbutaline** is contraindicated in the presence of hemorrhage.
For patient who exhibits a coagulopathy, obtain appropriate blood component products for administration enroute, as per referring institution.
It is important to notify the accepting institution for any significant changes to have appropriate personnel waiting for the transporting team's arrival.

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12.3 PAIN AND/OR NAUSEA IN PREGNANCY

12.3.1 Indications:

Pregnant patients who have pain from labor or from an illness or injury who are hemodynamically stable should be medicated to help reduce or alleviate pain.
Pregnant patients who have nausea and/or vomiting may be treated with a medication to relieve the symptoms and increase comfort.

12.3.2 Clinical Management:

Assess patient's hemodynamic status and level of pain and/or nausea.
For pain, administer:
Fentanyl (Class C) 0.5-2 mcg/kg to MAX 150 mcg IV PRN.
For nausea and/or vomiting, administer:
In the first trimester of pregnancy, Ondansetron (Zofran) is now generally avoided.
Metoclopramide (Reglan) (Class B) is recommended.
5-10mg IV every four hours as needed for nausea and vomiting.
In the second or third trimesters of pregnancy
Ondansetron (Zofran) (Class B) 4 mg IV push. For persistent nausea/vomiting, may need repeat every 20-30 minutes PRN up to two doses (8 mg total).
Zofran is contraindicated in the first trimester of pregnancy.

Reassess patient hemodynamically, and document level of relief of pain and/or nausea.
Naloxone may be used to reverse respiratory depression induced by narcotics (Class B).

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12.4 PREGNANCY INDUCED HYPERTENSION

12.4.1 Indications:

BP greater than 140/90 after the 20th week of pregnancy.
This may be accompanied by proteinuria and edema.
Treatment is more urgent if any of the following have occurred:

- Pre-term labor.
- Intracerebral bleeding.
- Seizures.
- Severe, continuous headache, often frontal or occipital.
- Dimness or blurring of vision.
- Persistent vomiting.
- Decreased urine excretion (< 400 ml/24 hours); increased proteinuria (3+4+).
- Fetal growth retardation.
- Cardiac decompensation including:
  - Pulmonary edema
  - Cyanosis.

Eclampsia is defined as being present when seizures complicate pre-eclampsia. The latter is potentially lethal for the mother and / or fetus.
In addition, staff must be cognizant of the potential HELLP syndrome if the patient complains of RUQ abdominal pain.
Clinical information that should be obtained at a time of transfer include:

- Blood pressure history and therapeutic response during the current presentation.
- Seizure activity: time of onset, duration, and nature
- Termination of seizure: pharmacologic versus spontaneous.
- Medications administered and route (Note: patients with epidural catheters are particularly likely to become hypotensive).
- Pertinent lab values
- Magnesium level for patients receiving magnesium sulfate.
- Urine protein and total urine output
- Platelet count, PT/PTT, and disseminated intravascular coagulopathy profile
- Liver enzymes (AST and ALT)
- Renal function (BUN /Cr, electrolytes)
- Hematocrit (may be elevated)

12.4.2 **Clinical Management:**

Definitive treatment can only be accomplished through delivery of the fetus (s).
This should be considered prior to transfer if the hospital has the capability to perform the delivery.
Assess and manage airway, breathing, and circulation.
Provide supplemental oxygen to maintain $SPO_2 > 95\%$.
Refer to CCTTP 2.1 Airway Management
Place patient in the left lateral recumbent position and decrease sensory stimulation as much as possible in transport.
Large bore IV access.
Foley catheterization is required in virtually all cases to enable monitoring of your output.
Magnesium sulfate should be instituted only after you're an output is at least 10 mL/hour is confirmed.
Monitor cardiac rhythm, maternal vital signs, deep tendon reflexes, and fetal heart rate by Doppler every 15 minutes.
For patients in whom seizure control has been difficult, LifeFlight staff should have a low threshold for pre-transport intubation given the risk of aspiration and other complications of intra-transport seizure activity.
The use of long-acting neuromuscular blockade is the eschewed as this masks on going or recurrent seizure activity.

12.4.3**Seizure Prophylaxis:**

Magnesium Sulfate is used for prevention of seizures.
Dosage:
Mix 4 grams **Magnesium** Sulfate in 50 ml of 0.9 % NS and administer over 10 minutes.
If the BMI is greater than 35, give 6 grams of Magnesium sulfate.

Follow this with an infusion (concentration of 1g/25mL. Mix 4 grams in 100ml) and begin infusion at 2 g/hr
This may need to be increased if seizure occurs or in the presence of hyperreflexia.
Magnesium Toxicity:
Absent reflexes
Respiratory or cardiac depression
Treatment:

- Stop Magnesium infusion
- **Calcium Gluconate** 1 gram IV over 10 minutes.

12.4.4**Seizures:**

Seizure activity should be treated with supportive care first:
Treatment of choice is to load on **Magnesium** Sulfate 4-6 g bolus and then a continuous infusion of 1-2 grams per hour, unless receiving physician prefers **Phenytoin**.
Phenytoin 18-20 mg/kg IV @ 12.5-25 mg/min (slower than usual dose due to altered protein binding).
Lorazepam 0.15 mg/kg to MAX dose of 2 mg and may repeat twice.
Contact OLMD if considering an antihypertensive agent.
CCTTP 4.10 Hypertensive emergencies
The goal is to keep the diastolic pressure at approximately 90 to 105 mmHg and the systolic around 160mmHg.
Labetalol may be considered to control blood pressure.
Avoid diastolic pressure of less than 90.
If acute pulmonary edema is present with respiratory distress, consider:
Elevation of the head
Airway Management. Refer to CCTTP 2.1 Airway Management.
Consider **Furosemide** but use only with receiving **OB OLMD** consult (20-40 mg IV over 2-4 minutes).

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12.5 PRETERM LABOR

12.5.1 **Indications:**

Preterm labor is defined as regular or rhythmic contractions that produce cervical changes after the 20th week of gestation and prior to the 37th week of gestation.
Contractions noted to be occurring every ten minutes or less and are associated with effacement and dilation.
The cause cannot always be identified.
Clinical information should be obtained to include the following:

- Specifics of uterine contraction frequency and character
- Medications used for tocolysis and/or fetal maturation
- Past medical history components relevant to the use of medications in premature labor to include:
  - Renal failure (Magnesium renally excreted and thus magnesium sulfate is relatively contraindicated in the patients with ARF).

Maternal disease states associated with potential increase of adverse effects from terbutaline. These include:

- Coronary artery disease
- Migraines
- Diabetes mellitus
- Hypertension
- Myasthenia gravis

Relative contraindications to steroid administration:

- History of hyperglycemia
- Altered mental status
- Systemic fungal infection
- Lack of updated vaccinations
- Tuberculosis

General contraindications to tocolytic therapy:

- Chorioamnionitis
- Eclampsia
- Ongoing hemorrhage

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12.5.2 **Clinical Management:**

Prepare for imminent delivery.
Confirm presenting part.
Assess and manage airway, breathing, and circulation.
Initiate cardiac monitoring, pulse oximetry, and serial vital signs.
Administer oxygen 2 to 4 liters nasal cannula or 6-10 liters. Mask as indicated to maintain SPO_2 > 95%.
Maintain left lateral recumbent position, not only to improve uterine perfusion and decrease uterine irritability, but to decrease pressure on the cervix from the presenting part.
Avoid letting the patient sit or bend to avoid pressure on the cervix during transport.
Initiate or maintain IV access and volume resuscitate as appropriate.
Infuse 125ml per hour of 0.9 %NS.
Contractions can be caused by dehydration in the mother so a 250ml or 500ml bolus of 0.9% NS may be considered prior to tocolytics therapy when there is a history of fluid depletion.
Monitor contraction frequency and duration.
Fetal monitoring should occur routinely (i.e. every five minutes) and note changes associated with maternal contractions should be identified.
Avoid vaginal exams if the membranes are ruptured unless delivery is imminent or fetal bradycardia develops.
Emotional support to the mother and family.
This may include coaching the mother with breathing during contractions.
Be prepared for delivery.
You may be asked to continue antibiotics as initiated at the referring institution.
Antepartum steroids may have been administered to the patient prior to your arrival to accelerate fetal lung maturity.
The decision to administer tocolytics agents should follow upon a dialogue between the referring clinician and accepting perinatologist.
The air medical crew must achieve clarity as to the management plan, to include contingencies, prior to departure with the patient.

12.5.3 **Tocolysis Options:**

1. Indomethacin is the first line agent and can be used from 20.0 weeks gestation to 31.6 weeks gestation.
    a. Dosing: 25-50mg PO q6 hours for up to 48 hours.
    b. Contraindications: Oligohydramnios, Maternal ulcer/GI bleeding, Severe pre-eclampsia or Eclampsia, Rupture of membranes, hypersensitivity to indomethacin
2. Nifedipine-First line agent >32.0 weeks gestation.
    a. Dosing:
        i. Loading Dose: 20mg PO (If after 90 minutes the patient is still having greater than four contractions per hour, give another 10mg

ii. Maintenance Dose: 20mg PO q 6-8 hrs.

3. **Terbutaline** 0.25 mg Subcutaneously every 20 minutes x 3 doses or total of 0.75 mg
   a. Hold if maternal pulse > 120 beats per minute.

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12.6 PREMATURE RUPTURE OF MEMBRANES

12.6.1 Indications:

Rupture of the amniotic membranes in a pregnancy of preterm gestation (prior to 37 weeks gestational age).

12.6.2 Clinical Management:

Assess and manage airway, breathing and circulation.
Administer oxygen 2 to 4 liters cannula or 6-10 liters/mask as indicated to maintain SPO_2 > 95%. Refer to CCTTP 2.1 Airway Management
Initiate hemodynamic monitoring including cardiac monitoring pulse oximetry and serial vital signs.
Maintain left lateral recumbent position, not only to improve uterine perfusion and decrease uterine irritability, but to decrease pressure on the cervix during transport.
Initiate or maintain IV access and maintain Normal Saline at a maintenance rate.
Monitor contraction frequency and duration.
Avoid vaginal exams if the membranes are ruptured unless delivery is imminent or fetal bradycardia develops.
The use of tocolytics is controversial.
Generally, they may be administered to facilitate transport to an appropriate care facility or until a course of steroids is complete.
See previous discussion regarding use of tocolytics. Refer to CCTTP 12.5 Preterm Labor.
You may be asked to continue antibiotics as initiated at the referring institution.
Antepartum steroids may have been administered to the patient prior to your arrival to accelerate fetal lung maturity.
Remember the major complication associated with pre-term labor is delivery of an immature fetus. Be prepared for delivery and resuscitation should it occur.
Emotionally support to the mother and family.

12.7 TRAUMA IN PREGNANCY

12.7.1 **Indications:**

Any trauma, no matter how minor, blunt or penetrating, during pregnancy.

12.7.2 **Clinical Management:**

Initiate trauma care as outlined in the LifeFlight of Maine Trauma Protocol Section. Refer to section CCTTP Section 6 Trauma.
Assess and manage airway, breathing and circulation.
Airway management as indicated. Refer to CCTTP 2.1 Airway Management
Administer supplemental O_2 to maintain $SaO_2 > 95\%$.
The pregnant trauma patient should have spinal immobilization as indicated for any trauma patient.
The board should be tilted to the left with blankets to avoid compression of the great vessels.
If there is no use of a back board, consider placing the patient in an appropriate position (including the side) that allows for appropriate motion restriction simultaneously.
Initiate or maintain at least 2 large bore IV's with NS fusing.
Initiate trauma resuscitation in standard fashion and refer to
CCTTP 6.1 Abdominal and pelvic trauma
CCTTP 6.10 Acute resuscitation of the unstable trauma patient
Avoid hypovolemia as fetus will be compromised early due to uterine vasoconstriction to shunt blood to vital maternal organs.
Request packed red blood cells from transferring hospitals if indicated. Refer to CCTTP 10.1 Packed red blood cells and liquid plasma
Note: These patients should only receive O negative blood products
Assure monitoring of cardiac rhythm, maternal vital signs, fetal movement (if mother can speak), fetal heart rate, oxygen saturation and $ETCO_2$.
If uncontrollable vaginal bleeding and shock are present or if there are signs of a non-reassuring fetal heart rate, emergent Caesarean section may be indicated immediately on arrival at the receiving facility.
Contact the receiving facility as soon as possible.
Do not consider any type of Peri-mortem caesarian section in the field UNLESS there is a board-certified OB/ GYN present who is willing to accept all responsibility of management.
A modification of CPR in pregnancy is the left lateral position.
In the setting of a resuscitation of an unstable pregnant trauma patient, the standard use of resuscitation medications is indicated.
Refer to CCTTP 6.10 Acute resuscitation of the unstable trauma patient
If facts and circumstances of the patient's demise are such that peri-mortem Caesarean section is a consideration, consultation with Online Medical Control must be accessed before cessation of resuscitative efforts. Possible indications include:

- Witnessed arrest.
- Effective CPR.

- Unsuccessful ROSC.
- Gestational age greater than 30 weeks.

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12.8 UNPLANNED DELIVERIES

12.8.1 Indications:

In general, transport should NOT be considered if delivery is imminent or likely to occur during transport.
Contact receiving clinician to discuss appropriate plan of care.
Caution in patients who are actively laboring and have the following risk factors for precipitous delivery:

- Multiparous patients
- Cervix dilated 3-4 cm or more with active labor and a substantially effaced cervix
- Contractions less than 5 minutes apart
- History of rapidly progressing labor
- Primparous patients

12.8.2 Guidelines for Unplanned Delivery:

Vertex delivery (head presentation)
Position the mother appropriately
Put a towel underneath her buttocks so that you can pull down to deliver the shoulders of the baby.
Put sterile gloves on and drape the delivery area with a sterile towel.
Have bulb suction, clamps, and sterile scissors within reach.
Give reassurance to the mother and encourage her to take slow, deep breaths between contractions and to pant with contractions.
When there is pressure of the perineum, gently support it with one hand.
If delivery is imminent and the amniotic sac is still intact, rupture the membrane.
Support the infant's head as it emerges and rotates externally.
Check the infant's neck for coils of umbilical cord.
If it is coiled around the neck tightly and cannot be slipped over the head, it must be clamped doubly and cut between the clamps and then unwound.
During a uterine contraction, gently grasp the baby's head and depress it towards the rectum.
This enables the anterior shoulder to emerge under the symphysis pubis.
Next, raise the head and the posterior shoulder can be born over the perineum.
If infant and mother stable, delay clamping the cord for 1-2 minutes, dry and place infant on mother for skin-to-skin contact.
When clamping the umbilical cord, use two clamps or ties placed two inches apart and at least 8 inches from the infant's navel.
Cut the cord between the clamps or ties and examine the ends to be sure there is no bleeding.
Dry the infant. If the infant and mother's conditions are stable, place infant skin to skin with the mother to promote thermal regulation.
Delivery of the placenta should occur within 30 minutes after the delivery of the infant.
Apply gentle traction on the umbilical cord to deliver the placenta.
Do not pull.

Signs of placental separation include:
Lengthening of the cord
Gush of bright red blood
Fundus rises up in the abdomen.
Once the placenta is delivered, **Oxytocin** 30U/500 ml NS IV infusion should be started and administered at 500 ml/hr
Apply direct pressure to any tears of the perineum that may be bleeding.
If bleeding is suspected other than a perineal tear, massage the fundus of the uterus. If bleeding is not excessive then massage the fundus every 15 minutes.
Typically, fundus is at the level of the umbilicus after delivery of placenta.
Evaluation/Management of the infant:
Suction the oropharynx first, then both nares with the bulb syringe when the head is delivered.
If meconium is present, after the delivery the laryngoscope is employed to see whether there is meconium at or below the level of the vocal cords.
If there is any meconium, AND patient is NOT vigorous (floppy or listless) it should be suctioned out before any resuscitative measures are done, especially positive pressure ventilations.
Suction multiple times until the tube is clear of meconium.
Administer blow by 100% O_2 until the baby is pink centrally. Support ventilations if the apical rate is less than 100 and/or respirations are absent or depressed.
Maintain body temperature.
Initiate cardiac compressions of > 100/minute if the apical rate is less than 80 per minute.
If drug therapy or volume resuscitation is indicated, consider cannulating the umbilical vein for vascular access.
Refer to neonatal section for reference and utilization up to your scope of practice

12.8.3 **APGAR Scores Should be noted at One and Five Minutes After Birth:**

	0	1	2
Appearance, Color	Blue, Pale	Centrally Pink	Completely Pink
Pulse, HR	None	Less than 100	Greater than 100
Grimace, Reflex	None	Grimace	Cough, Gag, Cry
Activity	Flaccid	Some Flexion	Well-flexed, Active
Respiratory effort	None	Weak, Irregular	Good, Crying

12.9 COMPLICATIONS OF DELIVERY

12.9.1 Indications:

For use in management of patients experiencing a complicated delivery.

12.9.2 Breech Presentation (buttocks or feet presentation):

If delivery is in progress, allow the buttocks and trunk of the baby to deliver spontaneously.
Direct the mother to push with contractions.
Once the legs and arms are delivered, support the body on the palm of your hand and insert your finger into the baby's mouth and bring the chin down to allow the head to deliver.
Have an assistant provide supra-pubic pressure to facilitate delivery of the head.

12.9.3 Shoulder Dystocia (the situation in which the head has been born but the shoulders cannot be delivered by the usual methods):

Place the patient in supine position with head of bed flat.
The patient's legs are flexed, with the knees pulled back up onto the thighs.
Hips are abducted out as much as possible increasing the AP diameter of the pelvis.
Suprapubic pressure can be used to attempt and push the anterior shoulder under the symphysis bone. **Do not use fundal pressure**.
Consider reaching into the vagina to deliver the anterior shoulder by trying to rotate it into the pelvis, extraction of the posterior arm or using a corkscrew maneuver to rotate the shoulders out of the pelvis.
Delivery of anterior shoulder must occur within several minutes.
Record delivery of the head and delivery of the body

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12.9.4 Prolapsed Cord:

The umbilical cord lies beside or below the presenting part.
Compression of the umbilical cord between the presenting part and the maternal pelvis reduces or cuts off the blood supply of the fetus and if uncorrected leads to fetal death.
If fetal bradycardia occurs after rupture of the membranes, prolapsed cord should be considered.
A diagnosis is made by seeing the cord either outside of, or in the vagina or feeling the cord on exam. Place a hand in the vagina and push and hold the presenting part up and away from the cord. Maintain until patient is in the operating room.
Alternatively, the bladder may be filled via Foley catheter to maintain the head in a favorable position.
Minimize manipulation of the cord.
At the same time preparations are made for delivery.
The woman is placed in the knee-chest or Trendelenburg position, with the hips elevated and the head low.
Initiate high flow oxygen via non-rebreather.
Fetal heart rate is checked by Doppler, if available, and may possibly be palpated in the cord.
Terbutaline 0.25 mg SC as a tocolytic agent, to decrease frequency of contractions.
If the baby is okay and the cord is protruding out of the vagina, a gauze with sterile saline may be placed on it.

12.9.5**Amniotic Fluid Embolus:**

Amniotic fluid embolus occurs when amniotic fluid gains access to the maternal circulation during labor or delivery resulting in obstruction of the pulmonary vasculature.
In addition to the actual amniotic fluid causing emboli, particulate matter such as meconium, lanugo hairs, fetal squamous cells, bile, fat and mucin may also cause pulmonary emboli.
Maintain airway and supplemental ventilation and oxygen as indicated.
Refer to CCTTP 2.1 Airway Management.
Two large bore IV's and fluid resuscitate as needed.
Monitor mother and fetus frequently and treat mother's symptoms as indicated.
Watch for evidence of D.I.C.

12.9.6**Post-Partum Hemorrhage: (PPH) Continuous Bleeding After Delivery**

Fundal massage
Bimanual uterine massage
Observe and treat for hemorrhagic shock
Consider:

Methergine 0.2mg IM/PO No more than 5 doses and Do not administer if hypertension exists
TXA 10-15mg/kg IV, max 1Gm if PPH is not resolving.
Misoprostol 1000mcg PR
Prostaglandin (15 methyl prostaglandin F2 alpha) 250ug IM from sending facility (Contraindicated in asthma).
Oxytocin 30 units added to 500 ml of 0.9 % NS and delivered at 500 ml/hr. This should not be started until AFTER the placenta is delivered

If bleeding continues, discuss with receiving clinician:
Identify lacerations (cervical or perineal) and manage with appropriate BLS wound care.
Direct pressure until it can be repaired
Fluid resuscitation as indicated. Manage hypovolemic shock as noted.
Refer to CCTTP 4.9 Refractory hypotension and shock.

12.9.1**Uterine Rupture:**

Monitor and treat for hemorrhagic shock.
Refer to CCTTP 4.9 Refractory hypotension and shock.
In consultation with receiving clinician:
Administer **Oxytocin** 20 units IM
If bleeding continues, administer Oxytocin 30 units in 500 ml of NS at 500 ml per hour
May consider TXA 10-15 mg/kg up to 1 GM IV

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12.10 RUPTURED ECTOPIC PREGNANCY

12.10.1 Goal:

Once identified, the ruptured ectopic pregnancy is a true obstetrical emergency.
Patients must be transported to a center where an emergent exploratory laparotomy can be completed to correct this potential source of bleeding in an emergent fashion.

12.10.2 Clinical Management:

Assess and manage airway, breathing, and circulation.
Airway management as indicated. Refer to CCTTP 2.1 Airway Management.
Administer supplemental O_2 to maintain $SaO_2 > 95\%$.
Establish two large bore intravenous lines, with NS infusing as needed for hypovolemia.
If the patient is hypotensive, initiate IV fluid resuscitation with one liter of 0.9 % Normal Saline and then transition to colloid resuscitation.
Refer to CCTTP 10.1 Packed red blood cells and liquid plasma.
If the patient remains hypotensive, refer to CCTTP 4.9 Refractory shock and hypotension.
Place position of comfort or flat for treatment of hypotension.
Notify receiving facility of patient condition, and need for emergent operative intervention.
Keep patient NPO. Decompress stomach with NGT as needed.

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13 EPILOGUE - MIGRATING FROM PROTOCOLS TO PRACTICE - WAYPOINTS ALONG THE JOURNEY

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Epilogue

13.1 BACKGROUND

Since its inception in 1998, LifeFlight of Maine (LFOM) has worked to define care in the out-of-hospital transport environment that meets the needs of critically ill patients in Maine and Northern New England. The medical staff at LFOM have identified that in order to successfully provide an advanced level of care, they need to address a variety of clinical arenas that pertain to the scope of practice of the LifeFlight team. As noted by the Association of Critical Care Transport (ACCT), providing appropriate therapeutic care to ill patients in an out-of-hospital environment requires not only a contemporary set of standards or protocols from which teams can work, but also, commitments from the organization of to provide other key components to ensure the high quality of care provided in this environment. These other areas include selecting high functioning staff that have the knowledge and ability to perform critical care, developing an education model for initial and ongoing medical education, and a high-quality improvement plan to ensure that appropriate care is being delivered.

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13.2 EDUCATION

The critical care transport team at LFOM is made up of the nurse and paramedic combination. The reasoning for this type of team is that each provider is able to provide expertise in the environments in which LFOM encounters patients. In the last several years, many of the team providers have been able to be cross trained for both positions which allows for additional education in a variety of clinical arenas. Paramedics offer skills related to out of hospital management, acute resuscitation, and the ability to provide skills and knowledge around placing advanced airway adjuncts while acute care nursing staff have expertise in the management of patients in the Emergency or Intensive Care Unit setting. Many of these providers at the time of hire have greater than 3700 hours of clinical expertise or at least five years of experience caring for the acutely ill or injured patient population. In addition, at the time of hire, clinicians must have appropriate certifications and licenses (i.e. paramedic and nursing) along with basic stand-alone courses including BLS, ACLS, ATLS, and TNATC.

Once the provider is hired into the LifeFlight system as paramedic, nurse or a cross-trained provider, a multi-phased comprehensive orientation is undertaken. This instructional period has been broken down in a series of blocks and has been executed in a variety of fashions based upon whether the orientee is being brought in as an individual or as a member of a group. In the last several years, as new hires have been oriented in the system, LifeFlight has worked to develop a phased academy in an effort to streamline training while maintaining a rigid review of required topics. In the end, the critical care transport specialist, either a paramedic or nurse will have the knowledge and skills to transport neonate, pediatric, and adult patients with a variety of diagnoses in a safe manner. The initial training for oncoming LifeFlight providers includes topics and skills that are not addressed in a typical advanced level support curriculum. These topics are outlined in Table 1. Topics and skills addressed during orientation for a new Critical Care Transport (CCT) provider. Additionally, the use of simulation and direct patient care are also utilized during the phased training as well.

13.3 TOPICS AND SKILLS ADDRESSED DURING ORIENTATION

Table 1. Topics and skills addressed during orientation for a new Critical Care Transport (CCT) provider (as outlined in ACCT standards).

Airway / Respiratory	Cardiovascular	Gastro/ Urinary	Pharmacology	Other	Specialty
Advanced airway management	Management of ventricular assist device (VAD's)	Gastric tube placement and management	Vasoactive agents	Radiographic image interpretation	Temperature stabilization
Supraglottic airway device insertion	Management of extracorporeal membrane oxygenation (ECMO)	Urinary catheter initiation and management	Paralytics / muscle relaxants	Ultrasound imaging	Beetle and uterine monitoring
Chest / Lung Injuries	Intra-aortic balloon pump (IABP)		Anti-inflammatory medications	Management of indwelling medical devices	Esophageal compression tubes
Ventilation	12 lead interpretation		Anticonvulsants	Invasive and noninvasive temperature monitoring	
Mechanical ventilation management	In dwelling port access		Anesthetics	Thoracic and extremity escharotomy and fasciotomy	
Non-invasive mechanical ventilation management	Intraosseous access		Narcotics		
	Pacemaker monitoring and management		Thrombolytics		
	Invasive hemodynamic monitoring		Anti-emetics		
	Blood/fluid woman devices		Antibiotics		
	Blood product administration		Resuscitation medications		
	Operation of infusion pumps		Electrolyte replacement		
	Arterial cannulation		Prostaglandin, surfactant		
	Wound closure		Blood and blood products		
	Point of care testing		Tranexamic acid (TXA)		

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As a new hire progresses during the initial phases of orientation, the preceptor identifies based on acquisition of skills and knowledge when the provider can progress to the next step. At the completion of each block, the orientee will undergo a testing manikin simulation to allow movement towards independent practice. After orientation is completed, the provider will have a supervisory period of approximately 150 transports and two years of close supervision to allow initial growth as a critical care clinician. Additionally, during this period, the provider will be requested to obtain and advanced Transport Certification (CFRN, CTRN, CNPT, FP-C or CCP-C). It is only after all of these components are completed, that a provider works independently with typical annual reviews.

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13.4 ONGOING EDUCATION AND SKILL MAINTENANCE:

As a provider works in the clinical arena, the base fund of knowledge must be maintained and, in many cases, grow to meet the ever-changing landscape of critical care medicine. At LifeFlight, the approach to ongoing education is multifaceted. Ongoing education is imperative to the success of our crews. Staff participate in standard didactic sessions as well as participate in skill sessions to insure competence with clinical scenarios and specialized equipment. Additionally, staff also have opportunities to work with key providers with knowledge of key populations to ensure clinical competency (i.e. pediatric critical care simulations with pediatric intensive care staff). Lastly, the ongoing education is tailored to staff needs based upon trends seen during case review brought forward by staff involved in quality assurance and process improvement (QAPI).

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13.5 QUALITY ASSURANCE AND PERFORMANCE IMPROVEMENT:

In any high functioning organization quality assurance and performance improvement (QAPI) must be the cornerstone. LifeFlight is no exception. Review of quality and safety metrics is another key component of the QAPI process. The QAPI team works with physician providers who perform medical oversight. In combination with specific case review and the ability to evaluate longer term outcomes in the operational and clinical arenas, the QAPI committee is committed to improving the systems of care in the transport environment.

In recent years, LifeFlight has been an active participant in the Ground and Air Medical Quality (GAMUT) database which allows critical care transport programs to share data and begin system-wide benchmarking across the country. LifeFlight has worked to develop software and systems designed to not only look at key aspects of clinical care, but just as importantly examine operational decisions around transport as well. Since the inception of the GAMUT database, our QAPI staff have been able to take our data and then compare to other programs to determine if the systems in Maine meet to rigors of other programs around the country.

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13.6 MEDICAL OVERSIGHT:

LifeFlight has invested heavily in physician and provider involvement since its inception. Critical care transport staff work directly with providers in either establishing a resuscitation or continuing a previously initiated level of critical care treatment. In these patient populations, applying the strategies of care, completing the appropriate pharmacological or procedural interventions must be completed with those trained and can direct the care delivered at the bedside. Given the fact that each transfer is a "physician prescriptive event," LifeFlight has engaged with medical staff to ensure that the care at the bedside is the most advanced available and meets the standards of clinical care in all facets.

Two levels of medical oversight exist at LifeFlight of Maine currently. We have several medical directors that are involved in day-to-day aspects of the care provided within the system. These providers are well versed in the aspects of out of hospital medicine including its limitations and nuances around the ability of staff to complete care within the system. Additionally, these providers review in real time care provided by LifeFlight staff and address clinical concerns of crews, sending and receiving clinicians, and address operational issues at the time of transport. The medical directors work directly to provide immediate feedback or timely oversight to crews or in the case of specialty care transports (i.e. neonates, the use of mechanical cardiac assist devices) can reach out to these specialists to obtain immediate answers to questions that arise during transport.

Lastly, the medical directors are also responsible for the review of most calls for which LifeFlight is requested. Case reviews occur to assure that care provided by the team matches contemporary medical care as well as adherence to the clinical standards set out in the cope of practice and medical protocols. Deviations from protocol, medical errors or lapses in medical judgment are addressed in relative real time. As a result, the methodical review by the physicians ensures that there is limited medical drift in care and strict adherence to the standards of care.

In the development of the practice of medicine at LifeFlight, protocols have been developed in coordination with the LifeFlight Clinical Practice Committee (CPC). This group of physicians and providers work in conjunction with the medical directors to insure appropriate clinical practice. These clinicians made up of emergency medicine physicians, critical care providers and other relevant medical specialists are called upon to examine and provide feedback around the scope of practice and protocol development. This team meets quarterly to review current clinical guidelines as well as current practices within the system. Individual specialists can provide valuable feedback around the clinical care of the LifeFlight teams

13.7 SCOPE OF PRACTICE AND PROTOCOLS:

As evident from the previous excerpts above, the care provided by the staff at LifeFlight of Maine is more than staff following "cookbook" medicine. Other programs have developed systems of care designed on similar protocols without the education, training, QI and physician oversight that LifeFlight has provided to its staff. It is imperative to identify that on order to have a fully defined and functioning advanced scope of practice, development of protocols must be accompanied by all the components outlined in the sections above. By outlying care in the comprehensive set of protocols set out in the upcoming sections along with all the necessary requirements in clinician training, education and practice, the medical leadership of this organization can ensure that quality care is provided in the out of hospital environment. Additionally, the QAPI process allows for thorough review of care provided and lessons learned from completed transports can be utilized to improve care in future transports. Like many high functioning critical care transport services, the systems of care at LifeFlight of Maine are developed and maintained in such a fashion that to deliver on the promise of "high quality care," it must be done in such a way that training, education, and medical oversight remain the cornerstone of quality in critical care transport.

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13.8 DRUG INFUSION MIXING GUIDE

Drug	Bag Mixing	Syringe Mixing	Concentration	NOTES
Amiodarone	Add 450mg to 250mL	Add 90mg to 50mL	1.8 mg/mL	Inline filter suggested
Diltiazem	Add 125mg to 100mL		1 mg/mL	Add 25mL of Diltiazem to 100mL
DoBUTAmine	Add 500mg to 250mL	Add 100mg to 50mL	2000 mcg/mL	
DOPAmine	Add 400mg to 250mL	Add 80mg to 50mL	1600 mcg/mL	
EPInephrine	Add 4mg to 250mL	Add 0.8mg to 42mL	16 mcg/mL	
Esmolol	Add 2.5mg to 250mL		10 mcg/mL	
Fentanyl	Add 1000mcg to 80mL	Add 500mcg to 40mL	10 mcg/mL	Remove 20mL from 100mL bag
Fosphenytoin	Add 1.5g to 100mL		15 mg/mL	Infuse over 15 minutes and rate not to exceed 150 mg/min
Heparin	Add 5000units to 100mL	Add 2500units to 50mL	50 units/mL	
Insulin	Add 100units to 100mL		1 unit/mL	Prime tubing and then expel another 25mL through tubing
Ketamine	Add 250mg to 250mL	Add 50mg to 50mL	1 mg/mL	
Levetiracetum	Add 1.5g to 100mL		15 mg/mL	Infuse over 15 minutes
Lidocaine	Add 1g to 250mL		4 mg/mL	
Nicardipine	Add 25mg to 250mL		0.1 mg/mL	
Nitroglycerin	Add 50mg to 250mL	Add 10mg to 50mL	200 mcg/mL	Mixed in D5W and Non-PVC, Non-DEHP)
Norepinephrine	Add 8mg to 250mL	Add 1.6mg to 48.4mL	32 mcg/mL	
Octreotide	Add 500mcg to 100mL		5 mcg/mL	
Oxytocin	Add 30 units to 500mL		0.06 units/mL	500ml/hr for post-partum hemorrhage
PHENYLephrine	Add 20mg to 100mL		200 mcg/mL	
Prostaglandin		Add 500mcg to 24mL	20 mcg/mL	
VASOpressin	Add 40 units to 100mL	Add 20units to 50mL	0.4 units/mL	
Calcium Gluconate	Add 1g to 100mL		10 mg/mL	Infuse over 10 minutes